"Soil Health: A Key to Food Security"

20th International Congress of Soil Science

20-22 February 2024, Rawalpindi, Pakistan

Abstracts

Editors

Hafiz Naeem Asghar, Zia-ul-Hassan Shah, Arif Ali Siyal,
Saifullah, Munazza Yousra, Zain Mushtaq, Muhammad Iqbal,
Muzammil Anjum, Waqas Mahmood

PIR MEHR ALI SHAH ARID AGRICULTURE UNIVERSITY 1994 RAWALPINDI

SOIL SCIENCE SOCIETY OF PAKISTAN -SSSP-

Soil Science Society of Pakistan

www.sss-pakistan.org

CONTENTS

			Page
A	**Abstracts for Oral Presentation**	Section # 1-8	1
B	**Abstract for Poster Presentation**	Section # 9-15	258

A: ABSTRACTS FOR ORAL PRESENTATION

1. INVITED TALKS 2

1.1 SOIL HEALTH FOR FOOD SECURITY: WHERE DO WE STAND TO FEED THE ESCALATING POPULATION IN THE FACE OF CLIMATE CHANGE? 3

SHABBIR AHMAD SHAHID*[1] MAJDA KHALIL SULEIMAN[1] 3

1.2 PLANT PHENOTYPING: ANALYSIS OF PLANT PHYSIOLOGICAL STATUS 4

MAURO CENTRITTO*[1] 4

1.3 IN-SITU FARM WASTE MANAGEMENT FOR SOIL HEALTH: IS IT SOIL BIOLOGY, AND/OR SOIL MICROBIOLOGY ONLY? 5

MUHAMMAD TAHIR RASHID[1*] 5

1.4 ANAEROBIC BIOGEOCHEMICAL PROCESSES TO MITIGATE GREENHOUSE GAS EMISSIONS AND RECLAIM OIL SANDS MINING WASTES 6

TARIQ SIDDIQUE*[1] 6

1.5 HYDROTHERMAL TREATMENT OF FOOD WASTE DIGESTATE SOLID 7

MI YAN*[1], FENG CHEN[1], YAYONG YANG[1] 7

1.6 ENVIRONMENTAL DEGRADATION AND LIVELIHOOD SECURITY IN SOMALIA" A CASE STUDY OF AFGOYE DISTRICT 9

HASSAN WARSAME NOR*[1] 9

1.7 EVALUATING PROBABILITY OF EROSION AND FORECASTING SOIL EROSION RATES IN SOMALIA 10

ABDUNNASIR ABDULLAHI MOHAMED*[1], HASSAN WARSAME NO[1] 10

1.8 MICROPLASTICS CONTAMINATION IN MANGROVE SEDIMENT: A CASE STUDY OF POLLUTION UPTAKE BY SELECTED ANIMALS 11

FAUZIAH S.H.*, PRIYA M., FURUMAI H., KAHOKO N., YEOH WEI WANG, CHIANG HAN TECK 11

1.9 WASHED RICE WATER AS A FERTILIZER RESOURCE FOR SUSTAINABLE AGRICULTURE: EXPERIMENTAL FINDINGS AND FUTURE PROSPECTS 12

CHRISTOPHER TEH BOON SUNG[1*] AND ABBA NABAYI[2] 12

1.10 MICROPLASTICS UPTAKE BY FRESHWATER FISH FROM WATER AND SEDIMENTS OF MALAYSIA RIVERS 13

SITI SUHAILA HARITH[1*], FAUZIAH SHAHUL HAMID[2], ZAINUN ABDULLAH[1], NURUL FAQIHAH MOHD ZIDIN[1], NURUN NAJWA FATINI MOHD ZULKEFLI[1] 13

1.11 ANALYSIS OF BIOCHAR IN THE NEMORAL CLIMATIC ZONE: APPLICATIONS OF MINERAL NITROGEN FERTILIZERS FOR IMPROVING SOIL SUSTAINABILITY AND CROP PRODUCTION 14

MUHAMMAD AYAZ [1,2*], UROOJ JAMIL [3], EDITA BALTRĖNAITĖ-GEDIENĖ [4] 14

1.12 SEED FILM CULTIVATION TECHNOLOGY FOR CONSERVING WATER AND FERTILIZER IN HARSH AGRICULTURAL ENVIRONMENT OF UNITED ARAB EMIRATES 15

KHALIL UR RAHMAN[1], MOHAMED KHALIFA BIN THALETH[1], KAIYRKUL SHALPYKOV[2], AND SUNGJIN CHOE[3] 15

1.13 INFLUENCE OF MONSOON ON MICROPLASTIC POLLUTION IN MANGROVE SEDIMENTS: A MALAYSIAN CASE STUDY 16

PRIYA MOHAN [1], FAUZIAH SHAHUL HAMID [1,2*], ZEEDA FATIMAH MOHAMAD [2,3], AND AGAMUTHU PARIATAMBY[4] 16

1.14 IMPORTANCE OF COLD FALLOW SEASON MANAGEMENT TO ENHANCE SOIL ORGANIC CARBON STOCK IN TEMPERATE PADDY SOIL 17

MUHAMMAD ISRAR KHAN[1,2], RUBAB SARFRAZ[2], GIL WON KIM[1,2], PIL JOO KIM[1,2] 17

1.15 POTENTIAL AND CHALLENGES IN ACHIEVING EDIBLE OIL SELF-SUFFICIENCY THROUGH OIL PALM CULTIVATION IN COASTAL AREAS OF SINDH PAKISTAN 19

ALLAH WADHAYO GANDAHI*[1] 19

1.16 CLEANER PRODUCTION LEADING TO MINIMIZATION OF POLLUTION 20

M. IRSHAD RAMAY*[1] 20

1.17 HARNESSING PGPR: A CONTEMPORARY APPROACH TO MANAGING CHILLI GROWTH AND NUTRIENTS IN SEMI-ARID CLIMATE OF SINDH 21

QURBAN ALI PANHWAR[*], AMANAT ALI, AND NIZAMUDDIN DEPAR 21

1.18 NANOTECHNOLOGY BASED APPROACHES TO TACKLE EMERGING POLLUTANTS FOR FOOD SAFETY AND SECURITY 22

MUHAMMAD ARSHAD*[1] 22

2 SOIL FERTILITY AND PLANT NUTRITION SECTION 23

2.1 ENHANCING SOIL HEALTH THROUGH REGENERATIVE AGRICULTURE: PRINCIPLES AND PRACTICES OF RA FOR SUSTAINABLE SOIL HEALTH 24

ABID SUBHANI*[1], SHAHID ZIA[1,2], FARZANA SHAHID[1,2], FARAH FAROOQ[1,2], AREEBA SHOUKAT[1,2], ATTA UL MUSTAFA[1,2] 24

2.2 ADDRESSING CHALLENGES IN MICROBIAL BIOFERTILIZERS FOR SUSTAINABLE AGRICULTURE TO ENHANCE SOIL HEALTH AND FOOD SECURITY 25

GHULAM RASOOL[1*] 25

2.3 IMPACT OF POTASH AND MICRONUTRIENTS ON SUGARCANE CROP PRODUCTION AND ECONOMIC RETURN 26

MUHAMMAD ZAMEER KHAN[1*], MUHAMMAD MANZOOR[1], SAGHEER AHMAD[1], SAIR SARWAR[1], AHMER BIN ZAMIR[2], MUHAMMAD ASAD HAMEED[1] 26

2.4 CONCURRENT IMPROVEMENT IN MAIZE YIELD AND NITROGEN USE EFFICIENCY THROUGH ROOT ZONE TARGETED FERTILIZATION 27

MUHAMMAD IRFAN[1,2,3*], DIANJUN LU[1,2], XIAOQIN CHEN[1,2], HUOYAN WANG[1,2] 27

2.5 EFFECT OF VALUE ADDED COMPOST ON MAIZE UNDER SALT EFFECTED SOIL (*ZEA MAYS L.*) 28

ASBAH FATIMA*[1] 28

2.6 EFFICIENCY OF FE-SOLUBALIZING BIO-INOCULANTS FOR ENHANCING MAIZE GROWTH AT EARLY GROWTH STAGES 29

TEHSEEN*[1], SAMIA[1] 29

2.7 ANTI-TRANSPIRANTS: A POTENTIAL STRATEGY TO MITIGATE THE EFFECTS OF DROUGHT ON SPINACH 30

KOMAL PANHWAR[1]*, GHULAM MURTAZA JAMRO[1], INAYATULLAH RAJPAR[1], ABDUL HAMEED MEMON[2], DURSHANA KHAN KHANZADA[1,3], ZAHOOR AHMED PALIJO[4], SALEEM MASEEH BHATTI[1] 30

2.8 CULTIVATING RESILIENCE: HARNESSING COVER CROPS FOR ROBUST SOIL SUSTAINABILITY 31

HINA NAWAZ[1]*, MUHAMMAD TAHIR AKRAM[1], MEHWISH LIAQUAT[1] 31

2.9 GROWTH AND QUALITY INDEX OF TOMATO AS INFLUENCED BY POULTRY MANURE AND COMPOST UNDER DIFFERENT TEXTURED SOILS 32

LAIBA TAHIR[1*], MUHAMMAD IQBAL[1], TOOBA MUMTAZ[1], MUSSAWAR ABBAS[1], HIFZA JABBAR[1] 32

2.10 EFFECT OF SULPHUR APPLICATION ON GROWTH, YIELD, AND NUTRIENT UPTAKE OF COTTON 33

RIAZ HUSSAIN SOOMRO[1] 33

2.11 EFFECT OF BONE MEAL COMPOST ON GROWTH AND NUTRIENT CONTENT OF BANANA CROP 34

MUHAMMAD SIDDIQUE LASHARI[1]*, BAKHT-UN-NISA MANGAN[1], ABDUL LATEEF JAT[1], INAYATULLAH RAJPER[1], PIRKASH SUTHAR SALEEM[1], MASEEH BHATTI[1], MUHAMMMAD SALEEM SARKI[1] 34

2.12 EFFECT OF FARMERS' MANAGEMENT PRACTICES ON AGGREGATE STABILITY, CARBON STORAGE AND SOIL HEALTH IN BANANA GROWING AREAS OF SINDH 35

AZAM SOLANGI*[1], WAQAR AHMAD[1], SALEEM SARKI[1], ALLAH WADHAYO GANDAHI[1] 35

2.13 GROWTH, NODULATION AND YIELD OF PEA (*PISUM SATIVUM* L.) IN RESPONSE TO PHOSPHORUS AND MOLYBDENUM APPLICATIONS UNDER GREENHOUSE CONDITIONS 36

MUHAMMAD SARFRAZ[1], ABDUL KHALIQ[1] 36

2.14 RESPONSE OF BIOCHEMICALLY MODIFIED BIOCHAR TO IMPROVE CHICKPEA PRODUCTION ON SANDY SOILS 37

HAFIZ SHAHZAD AHMAD[1], TANVEER UL HAQ[1*], AHMAD MAHMOOD[1], MUHAMMAD IMRAN[1] AND MUHAMMAD ASIF SHEHZAD[2] 37

2.15 ORGANIC SOIL AMENDMENTS PROVIDING ORGANIC SOURCES OF NITROGEN, PHOSPHORUS, AND POTASSIUM TO SOIL AND PLANTS 38

ABID KAMAL[1*], ISHAQ AHMAD MIAN[1] AND MUHAMMAD TARIQ[1] 38

2.16 ROADMAP TOWARDS SUSTAINABLE NITROGEN MANAGEMENT IN PAKISTAN 39

TARIQ AZIZ[1], MUHAMMAD IRFAN SOHAIL[1], MUHAMMAD AAMER MAQSOOD[2], ABDUL WAKEEL[2], SANA ULLAH[2], AZHAR ABBAS[3], MASOOD I. AWAN[1] AND MUHAMMAD NASIM[4] 39

2.17 EVALUATING THE EFFECT OF DUAL SUPPLEMENTATION OF BORON AND SILICON ON SHEDDING OF FRUITING STRUCTURES AND QUALITY COTTON PRODUCTION UNDER CHANGING ENVIRONMENT 40

ABDULLAH KEERIO*[1,2] GHULAM MURTAZA JAMRO[1], ZIA-UL-HASSAN SHAH1, PIR AHMED NAQI SHAH3, JAVAID AHMED SHAH4 40

2.18 NITROGEN MINERALIZATION IN SOIL IN RESPONSE TO DIFFERENT ORGANIC AMENDMENTS: AN INCUBATION TRIAL AND POT EXPERIMENT 41

MEMOONA IJAZ[1*], SARVET JEHAN[1], AMNA NISAR[1], WASEEM UR RAHMAN[3], SARA KHAN[3], TANVEER IQBAL[1], MEHWISH LIAQUAT[2] 41

2.19 MAIZE CROP RESILIENCE AND NUTRITIONAL ENHANCEMENT THROUGH ZN-CHITOSAN NANOPARTICLES AND ZINC SOLUBILIZING BACTERIA 42

MUHAMMAD AFTAB AKRAM[1]*, TAYYABA SAMREEN[1], GHULAM FAREED[1] 42

2.20 EVALUATING THE EFFECT OF ZINC SOLUBILIZING BACTERIA AND APPLE PEEL FOR SUSTAINABLE PRODUCTION OF WHEAT 43

TAYYABA SAMREEN[1]*, FARAZ ANJUM[1], SIDRA TAHIR[1], MUHAMMAD AFTAB AKRAM[1], MUHAMMAD ZULQERNAIN NAZIR[1], MUHAMMAD AHMAD[1] 43

2.21 EFFICACY OF PGPR IN COMBINATION WITH COMPOST IMPROVING PRODUCTIVITY OF CUCUMBER (*CUCUMUS SATIVUS L.*) CROP 44

USMA IRSHAD*, MAQSHOOF AHMAD*, ABUBAKAR DAR, AZHAR HUSSAIN, SHUMAILA SHAHID 44

2.22 PEDOMETRIC MAPPING AND SATELLITE REMOTE SENSING BASED PREDICTION OF NITROGEN CONTENT IN KINNOW ORCHARDS OF DISTRICT SARGODHA 45

HUMAIR AHMED[1*], M.Z KHAN[1], ISHTIAQ HYDER[1], RAZA ULLAH KHAN[1], ASIM HAYAT[1], MARIA NIAZ[2] 45

***2.23* PERFORMANCE OF PREFERRED WHEAT VARIETIES FOR YIELD AND ZINC BIOAVAILABILITY AS A FUNCTION OF SOIL ZINC APPLICATIONS IN SINDH 46**

MUHAMMAD ASIF SIDDIQUI[*1, 2], SALEEM MASEEH BHATTI[1], INAYATULLAH RAJPAR[1], NIZAMUDDIN DEPAR[3] 46

2.24 INTEGRATED NUTRIENT MANAGEMENT FOR IMPROVING AGRO-BOTANICAL GROWTH AND STIGMA YIELD OF SAFFRON (*CROCUS SATIVUS* L.) 47

MUHAMMAD SARFRAZ[1], ABDUL KHALIQ[2] 47

2.25 OPTIMIZING SOIL MOISTURE REDUCTION FOR ROOT AND SHOOT GROWTH OF MAIZE VARIETIES 48

MANZOOR AHMAD[1] ASAD SHAH[2] AND ROSHNA AHMAD[1] 48

2.26 ACIDIC PHOSPHATE FERTILIZERS SUSTAIN HIGHER NUTRIENT AVAILABILITY FOR BETTER CROP YIELD ON ALKALINE CALCAREOUS SOILS 49

MUHAMMAD AKHTAR[*1], MUHAMMAD YAQUB[1], MUHAMMAD SALEEM[1], MUHAMMAD RIZWAN KHAN[1], AROOBA ASHRAF[1], AYESHA SIDDIQUE[1] 49

2.27 IODINE SOLUBILITY IN SOIL AND ITS UPTAKE BY MAIZE AS INFLUENCED BY IODINE SOURCES, SOIL LIMING AND HUMIC ACID APPLICATION 50

ASIF NAEEM*[1], MUHAMMAD ASLAM[1] 50

2.28 EVALUATING WHEAT YIELD AND NITROGEN-UPTAKE IN RELATION TO VARYING LEVELS OF SOIL AND FOLIAR APPLIED UREA 51

MAZHAR ALI KHASKHELI[1], KHALID HUSSAIN TALPUR[*1], ZIAUL HASSAN SHAH[1], NIAZ AHMED WAHOCHO[2], AND RIJA FATIMA[1] 51

2.29 EFFECT OF DIFFERENT NITROGENOUS AND PHOSPHATIC FERTILIZER SOURCES ON WHEAT YIELD AND MICRONUTRIENTS ACCUMULATION 52

RIJA FATIMA[*1], KHALID HUSSAIN TALPUR[1], MUHAMMAD SALEEM SARKI[1], AMBRIN RAJPUT[2], AND MAZHAR ALI KHASKHELI[1] 52

2.30 EFFECT OF B-FORTIFIED DAP FERTILIZER ON GROWTH AND YIELD PERFORMANCE OF MAJOR CROPS 53

AFTAB NASEEM[1], M. ABBAS AZIZ*[1], SHAFIQ UR REHMAN[1], IMRAN KHALIQ[1], NOMAN ALI TAHIR[1] 53

2.31 PEDOMETRIC MAPPING AND SATELLITE REMOTE SENSING BASED PREDICTION OF POTASSIUM CONTENT IN APPLE PRODUCING REGION OF DISTRICT SWAT 54

Maria Niaz[1*], M. Tariq Siddique[1], Khalid Saifullah[1], Ishfaq Ahmad Hafiz[1], Humair Ahmed[2], Muhammad Iqbal[3] 54

2.32 RESPONSE OF MAIZE VARIETY *DADU-1* TO VARIABLE RATES AND INTERACTION OF PHOSPHORUS AND POTASSIUM 55

Zeeshan Mashori[*1], Farhan Nizamani[1], Saima Kalsoom Babar[1], Hassan Ali Shujrah[1] 55

2.33 EVALUATION OF SUNFLOWER GENOTYPES FOR K-USE EFFICIENCY AT EARLY GROWTH STAGE 56

Hajra Khan[1], Zia-ul-hassan[2*], Javed Ahmed Shah[3] and Ghulam Murtaza Jamro[2] 56

2.34 EFFECT OF PHOSPHORUS FROM DIFFERENT SOURCES ON THE COMPOSTING PROCESS, PHOSPHORUS FRACTIONATION, AND CROP YIELD IN CALCAREOUS SOILS 57

Dost Muhammad[1], Muhammad Waheed[2], Maria Mussarat[1] and Zaryab Khan[1] 57

2.35 LOWER NH_3 EMISSION FROM BORON COATED UREA IMPROVES PRODUCTIVITY OF WHEAT GROWN ON ALKALINE SOILS 58

Sajid Mahmood*[1], Basit Haider[1], Muhammad Akhtar[1] 58

2.36 IMPACT OF TRYPTOPHAN APPLICATION ON GROWTH AND YIELD OF *LYCOPERSICUM ESCULENTUM* L. 59

Noor ul Aİn[1]*, Hafİz Tanvİr Ahmad[2], Muhammad Salİk Alİ Khan[1], Ghulam Rasul[1], Farİha Amİn[1] and Imran Latİf[1] 59

2.37 ENHANCING GARLIC GROWTH AND YIELD VIA PGPR-ENRICHED VERMICOMPOST 60

Muhammad Rizwan Khan[*1], Tauseef Tabassam[2], Dost Muhammad[1] , Farmanullah Khan[1,3], Muhammad Sharif[1] 60

2.38 MODIFIED NITROGEN RECOMMENDATIONS OF FINE RICE FOR PUNJAB: INSIGHTS OF AGRONOMIC AND ECONOMIC EFFICIENCY 61

Muhammad Nadeem Iqbal*[1], Samina Hamid[1], Zia Chishti[1], Abdul Ghaffar[1], Muhammad Akram Qazi[1], Hafiz Riaz Ahmad[1], Sajid Ali, Nadeem Raza[1], Abdul Waheed[1] 61

2.39 POTENTIAL OF BIOCHAR AND MINERAL NUTRIENTS ON PLANT RESISTANCE TO STRESSES AND DISEASE MANAGEMENT 62

Abdul Basit*[1,3], Mueen Akram[1], Kashif Ali Khan[1], Faizan Bashir[1], Huzaifa Luqman[1], Saira Irum[4], Sammar Abbas[1] 62

2.40 ROCK PHOSPHATE SOLUBILITY CAN BE IMPROVED BY VERMICOMPOSTING AS CONFIRMED BY NUTRIENT UPTAKE AND ONION GROWTH 63

Fazli Wahid [1*], Amjad Ali [1,2*], Rafiullah[1], Muhammad Adnan[1,] Hidayat Ullah[1], Muhammad Azim Khan[3], Ishaq Ahmad Mian[3], , Muhammad Javed[4] 63

2.41 SUNFLOWER RESPONSE TO POTASSIUM APPLICATION IN ARTIFICIALLY DEVELOPED CALCAREOUSNESS 64

Abdul Aleem Memon[1*], Inayatullah Rajpar[2], Ghulam Murtaza Jamro[2], Javaid Ahmed Shah[3], Hafeezullah Babar[1], Muhammad Suleman Memon[1], and Ambrin Rajput[1] 64

2.42 MODIFYING EFFECT OF MINERAL NITROGEN, PHOSPHORUS, AND CELLULOSE ON BIOCHAR INDUCED CHANGES IN SOIL HEALTH INDICATORS 65

Shemawar[1], Tanvir Shahzad[*1] 65

2.43 IMPACT OF ZINC SOAKING ON THE GERMINATION OF WHEAT SEEDS 66

Saibrina Sethar[1,2], Dr. Hafeezullah Babar[1], Dr. Mahendar Kumar Sootahar[1,2], Muhammad Aslam Panhwar[1,2], Khalid Hussain Khokhar[1,2] and Abdul Qudoos Abbasi[1,2] 66

2.44 GLUCOSE ADDITION PATTERNS INFLUENCE SOIL MICROBIAL BIOMASS CARBON, CARBON DIOXIDE ACCUMULATION AND PROPERTIES OF BLACK SOIL IN CHINA 67

Muhammad Suleman Memon[1], Hafeez. B[1], Ambrin Rajput[1] , Abdul Aleem Memon[1], Aijaz Ali Odhano[1], Mehrunissa Memon[2],Nizamuddin Depar[3] and Minggang Xu[4]. 67

2.45 FERTILIZATION AND SALICYLIC ACID APPLICATION FOR GROWTH ENHANCEMENT AND RUST DISEASE MANAGEMENT OF WHEAT 68

Ambrin Rajput[1*], Hafeezullah. Babar[1], Muhammad Suleman Memon, Ajaz Ali Odhano, Qurban Ali Panhwar, Shazia Pathan, Hassan Bux Rashidi and Abdul Aleem Memon 68

2.46 EFFECT OF DIFFERENT PHOSPHATIC FERTILIZERS ON GROWTH AND YIELD OF LATE-SOWN WHEAT VARIETIES 69

Khalid Hussain Khokhar[1], Mahar-un-nisa Memon[2], Hafeezullah Babar[1], Ambreen Baby Rajput[1] Mahendar Kumar Sootahar[1], Saibrina Sethar[1], Muhammad Aslam Panhwar[1] 69

2.47 EDAPHO-VEGETATION RELATIONSHIPS IN THARPARKAR, PAKISTAN 70

Irfan Ahmed Sahito[1*], Muzafar Hussain Sirohi[1], and Nizamuddin Depar[2] 70

2.48 WHEAT (*TRITICUM AESTIVUM* L.) GROWTH IN RESPONSE TO ACTIVATED CARBON-TO-NITROGEN RATIOS UNDER CALCAREOUS SOIL CONDITIONS 71

Sajid Masood[1]*, Muhammad Abid Ali Khan[1], Mubashir Hussain[2*], Niaz Ahmed[1], Muhamad Ashraf[3], Khalid Saifullah Khan[4] 71

2.49 EFFECT OF LONG-TERM APPLICATIONS OF ORGANIC AND INORGANIC FERTILIZERS ON ORGANIC MATTER, AMINO SUGARS AND AMINO ACIDS IN A SANDY LOAMY SOIL 72

Zarina Bibi[1*] and Qudratullah Khan[2] 72

2.50 DECOMPOSITION DYNAMICS OF SURFACE APPLIED INDIVIDUAL AND MIXED *TRIFOLIUM* AND *POPULUS* LEAF RESIDUES 73

Majid Mahmood Tahir*, Juveria Mushtaq, and Abdul Khaliq 73

2.51 ORGANO-MINERAL FERTILIZATION REGIMES TRIGGER GROWTH AND STIGMA YIELD OF TEMPERATE SAFFRON (*CROCUS SATIVUS* L.) 74

Muhammad Sarfraz[1]*, Abdul Khaliq[1], Majid Mahmood Tahir[1] and Sair Sarwar[2] 74

2.52 SOIL INCORPORATION OF CHILLA (*CASEARIA TOMENTOSA*) PLANT RESIDUES INHIBIT NITRIFICATION AND IMPROVE NITROGEN USE EFFICIENCY OF MAIZE (*ZEA MAYS* L.) 75

Khalid Mehmood[1*], Siddique Aslam[1], Majid Mahmood Tahir[2], Muhammad Shehzad[1] and Hira Abbasi[1] 75

2.53 EVALUATION OF DIFFERENT ORGANIC SOURCES OF NITROGEN FOR ENHANCING FERTILIZER USE EFFICIENCY IN WHEAT (*TRITICUM AESTIVUM* L.) 76

Shazia Pathan[1], Rabia Asma Memon[1], Saeed Akhtar[1] and Nizamuddin Depar[2] 76

2.54 IRON BIOFORTIFICATION THROUGH INTEGRATED AGRONOMIC APPROACHES FOR CEREAL CROP 77

Ifra Saleem*[1], Qudsia Nazir[1], Nisa Mukhtar[1], Ana Aslam[1], Allah Nawaz[1], Muhammad Arfan ul Haq[1], Muhammad Arif[1], Muhammad Nasim[1] 77

2.55 GROWTH AND YIELD PERFORMANCE OF WHEAT CROP AFFECTED BY DIFFERENT CUTTING METHODS 78

Mukhtiar Khatoon Solangi*[1], Hafeezullah Babar[1], Suleman Memon[1], Ambrin Rajput[1], Aijaz Ali Odhano[1] 78

2.56 BORON-COATED UREA AS SLOW-RELEASE NITROGENOUS FERTILIZER FOR IMPROVING YIELD AND QUALITY PARAMETERS OF CANOLA CROP 79

Qudsia Nazir*, Ifra Saleem, Sajid Mahmood, Muhammad Rafay, Ana Aslam, Amina Kalsom, Arfan ul Haq, Muhammad Aftab, Muhammad Nasim and Muhammad Arif 79

2.57 IMPACT OF POTASSIUM FERTILIZER ON POTASSIUM UPTAKE AND USE EFFICIENCY IN ONIONS (*ALLIUM CEPA* L.) 80

Syeda Fatima Qamer[1], Farooque Ali Bughio[1] and Nizamuddin Depar[2*] 80

2.58 EFFECTS OF NANO-BIOCHAR-AMENDED BIOGAS SLURRY ON SOIL CHARACTERISTICS, SORGHUM YIELD, AND AMMONIA EMISSIONS IN RAINFED AGRICULTURE 81

Muhammad Ramzan*[1], Ghulam Abbas Shah[1], Ahsan Yasin[1] 81

2.59 STATUS AND SOIL PROPERTIES WITH BIOCHAR, COMPOST AND CO-COMPOSTED BIOCHAR DERIVED FROM FRUIT VEGETABLE MARKET WASTE 82

Ghulam Mujtaba[1*], Mukhtar Ahmad[2], Ghulam Qadir[2], Qaiser Hussain[1], Rifat Hayat[1*] 82

2.60 NANOBIOCHAR-COATED DAP FERTILIZER ENHANCES NUTRIENT DYNAMICS IN THE SOIL AND MAIZE CROP PRODUCTIVITY 83

Ghulam Abbas Shah[1*], Khubra Shoukat[1], Muhammad Ramzan[1], Ahsan Yasin[1] and Muhammad Zain[1] 83

2.61 MORPHO-PHYSIOLOGICAL CHARACTERISTICS OF HISTORICAL BREAD WHEAT PANEL OF PAKISTAN AT DIFFERENT LEVELS OF SALINITY AT SEEDLING STAGE 84

Zarlish Fayyaz[1]*, Kainat Naeem[1], Mehreen Kanwal[1], Rizwana Kousar[1], Sadia Latif[1]* 84

2.62 CROP RESIDUES MANAGEMENT UNDER RICE-WHEAT CROPPING SYSTEM FOR IMPROVING SOIL PROPERTIES AND CROP YIELD 85

Muhammad Arfan ul Haq*[1], Muhammad Nasim[1], Ifra Saleem[1], Ana Aslam[1], Allah Nawaz[1], Qudsia Nazir[1], Amina Kalsom[1], Farah Rasheed[1], Raheela Naz[1] 85

2.63 PREPARATION AND EVALUATION OF ORGANIC WASTE COMPOST FOR MAIZE PRODUCTION 86

Muhammad Noman Rafiq[1], Arshad Nawaz Chaudhry [1]*, Tajwar Alam [2], Rimsha Sadaf [1], Musaver Abbas [1], Sabiha Kanwal [1] 86

2.64 SCREENING OF BENGAL AND ASSAM AUS PANEL (BAAP) OF RICE IN PAKISTAN: CHARACTERIZATION BASED ON PHENOTYPIC DATA 87

Hassan Sajjad[1], Dr. Muhammad Aamer Maqsood[1], Dr. Tariq Aziz[1], Dr. Abdul Wakeel[1], Dr. Muhammad Sana Ullah[1], Dr. Aysha Kiran[2], Dr. Abdul Qadeer[1], Dr. Hamaad Raza Ahmad[1] and Zunaira Bano[2]. 87

2.65 EFFECT OF COMPOST AND BIOCHAR IN PHOSPHORUS MANAGEMENT FOR WHEAT 88

Muqarrab Ali[1*], Abdul Latif[2], Muhammad Saleem Ullah[2], Rehan Jamil[2], Amar Matloob[1], Ahmad Mahmood[1], Muhammad Imran[3], Omer Farooq[4], Imran Khan[5], Khurram Shahzad[6] and Abid Hussain[3] 88

2.66 MUSTARD ROOT ARCHITECTURE AND YIELD IN RESPONSE TO PHOSOHORUS APPLICATION AND AAC-DEAMINASE RHIZOBACTERIAL SEED INOCULATION 89

Hajra Khan[1], Nazakat Abbas Lighari [2], Zia-ul-hassan Shah[2], Inayatullah Rajpar[2], Naheed Akhter Talpur[2] 89

2.67 AGRONOMIC EVALUATION OF BIOLOGICAL ACTIVE SUBSTANCES FOR ENHANCING THE EFFECTS POTASSIUM ENRICHED COMPOST ON MAIZE PRODUCTION 90

Pir Ahmed Naqi Shah1, Muhammad Nawaz Kandhro1, Zia ul Hassan Shah2, Ghulam Murtaza Jamro2, Awais Ahmed Naqi Shah1, Zulifqar Ali Abbasi3, Muhammad Mahmood ur Rahman Jamro3 90

2.68 FOSTERING MANGO (*MANGIFERA INDICA*) YIELD AND QUALITY: ASSESSING MICRONUTRIENT (ZN, B, & CU) APPLICATION TECHNIQUES 91

Niaz Ahmed[1]*, Zee Shan Ali[1], Muhammad Abid Ali Khan[1], Sajid Masood[1], Muhammad Arif Ali[2], Muhammad Tariq Malik[3], Javed Iqbal[4] 91

2.69 MAIZE GROWTH AND PHOSPHORUS UPTAKE MODULATION BY ORGANIC AMENDMENTS IN THE FACE OF SALINITY VARIABILITY 92

Tayyaba Naz[1,2*], Muhammad Qasim[1,2], Muhammad Umair[1,2], Iqra Ghafoor[1,2], Maham Naeem[1,2], Muhammad Anwar-ul-Haq[1, 2], Muhammad Mazhar Iqbal[3], Muhammad Saqib[1,2] 92

2.70 ALLELOPATHIC IMPACT OF SELECTED FERTILE SOILS LOVING WEEDS ON GROWTH AND YIELD PARAMETERS OF WHEAT CROP GROWN IN DISTRICT BHIMBER, AZAD KASHMIR 93

Tanveer Hussain*[1], Muhammad Ishtiaq[1], Muhammad Ajaib[1], Madiha Kabir[1], Rawish Sikander[1] 93

2.71 CADMIUM ACCUMULATION IN FODDER MAIZE IS PARTIALLY MITIGATED THROUGH GREEN MANURING AND SOIL ZINC APPLICATION 94

Muhammad Intissam Rana[1], Raza Abbas*[1], Shahid Hussain[1], Ammara Basit[1] 94

2.72 PARTIAL SUBSTITUTION OF EXOGENOUSLY APPLIED PHOSPHATIC FERTILIZERS BY PHOSPHATE SOLUBILIZING BACTERIA IN MAIZE UNDER CALCAREOUS SOIL 95

Muhammad Adnan*[1,2], Hajira[1], Yousaf Jamal[1] 95

2.73 ALLEVIATION OF FOOD SECURITY UNDER CHANGING CLIMATE BY IMPROVING THE EFFICIENCY OF MAIZE CROP LEADS TO GREEN GOVERNANCE 96

Sadia Afzal*[1], Sajid Hussain[1,2], Muhammad Zeshan Mansha[3], Dilshad Hussain[1], Muhammad Ramzan[1], Nabeel Arslan[1], Naseem Abbas[1] and Muhammad Sameed[1] 96

2.74 PHYSIOLOGICAL EFFECTS OF DIFFERENT GROWTH PROMOTING HORMONES ON WHEAT CROP AND THEIR EFFECTS ON PRODUCTIVITY AND YIELD 97

Sajid Hussain[*1, 2], Muhammad Zeshan Mansha[3], Muzamil Jawad[1], Muhammad Usman[1], Muhammad Zubair[1], Kashif Raza[1], Muhammad Aatif[1], Danial Akhtar, Muhammad Afaq[1], Yousra Kalsoom[1] and Wajahat Ali[1] 97

2.75 NUTRIENT RETENTION AFTER CROP HARVEST IN A TYPIC HAPLUDULTS AMENDED WITH BIOCHAR TYPES UNDER NO-TILLAGE SYSTEM 98

Qamar Sarfaraz[*1,2], Leandro Souza da Silva[2], Mohsin Zafar[3], Gerson Laerson Drescher[4] 98

2.76 IMPACT OF CO-COMPOSTED BIOCHAR ON GROWTH AND PRODUCTIVITY OF MAIZE GROWN UNDER NICKEL AND CHROMIUM-CONTAMINATED SOIL 99

Asadullah[1] and Allah Ditta[1,2*] 99

3 SOIL AND ENVIRONMENTAL POLLUTION AND THEIR REMEDIATION SECTION 100

3.1 ORGANIC FERTILIZERS: A POTENTIAL SOURCE OF MICROPLASTICS ENTRY INTO FOOD CHAIN 101

Aamna Naeem[1], Aamir Alaud Din[1], Muhammad Ansar Farooq[1]* 101

3.2 ASSESSMENT AND CHARACTERIZATION OF METAL-ENRICHED DUST PARTICULATE MATTER ALONG JARANWALA ROADSIDE SOILS, FAISALABAD: SPATIAL DISTRIBUTION PATTERNS AND ENVIRONMENTAL IMPLICATIONS 102

Hamaad Raza Ahmad*[1], Muhammad Aamer Maqsood[1], Muhammad Zia ur Rehman[1], Muhammad Sabir[1], Nadeem Ashraf[1], Muhammad Safraz[2] 102

3.3 SOIL ZINC APPLICATION DECREASES ARSENIC AND INCREASES ZINC CONCENTRATION IN GRAINS OF ZINC-BIOFORTIFIED WHEAT CULTIVARS 103

Ammara Basit*[1], Shahid Hussain[1] 103

3.4 INTEGRATED NUTRIENT MANAGEMENT EFFECTS ON NUTRIENT AVAILABILITY, LABILE CARBON FRACTIONS, AND YIELD OF HYBRID MAIZE (*Zea mays* L.) 104

Sajjad Ali Shah[1], Ghulam Murtaza Jamro[1], Nazia Rais[2], Javaid Ahmed Shah[3], Mehrunisa Memon[1], Asif Ali Mastoi[1], Sohail Ahmed Qureshi[2] 104

3.5 INFLUENCE OF IONIC CERIUM AND CERIUM OXIDE NANOPARTICLES ON MAIZE (*Zea mays*) SEEDLINGS GROWN WITH AND WITHOUT CADMIUM 105

Muhammad Ashar Ayub*[2,5], Muhammad Zia-ur-Rehman[1], Hamaad Raza Ahmad[1], John-Paul Fox[2], Preston Clubb[3], Alan L. Wright[4], Muhammad Anwar ul Haq[1], Muhammad Nadeem[4,5], Cyren M. Rico[3] and Lorenzo Rossi[2] 105

3.6 ENVIRONMENTAL MONITORING OF SELF-SUSTAINING ARTIFICIAL MICRO ECOSYSTEM 106

Anum Fatimah[1]*, Samia Qadeer 106

3.7 ANTIBIOTIC RESISTANCE GENES AND GENETIC ELEMENTS IN LIVESTOCK MANURE: A THREAT TO SOIL HEALTH 107

Luqman Riaz*[1] 107

3.8 INTEGRATED STRATEGIES FOR EFFECTIVE CARBON SEQUESTRATION: A HOLISTIC APPROACH TO MITIGATE GLOBAL CLIMATE CHANGE 108

Hasham Fatima, Ahmad Mahmood*, Shahzadi Bibi, Mehak Gull, Laiba Tassawar 108

3.9 SUSTAINABLE WASTE MANAGEMENT THROUGH HOUSEHOLD-LEVEL COMPOSTING: A PATHWAY TO ENVIRONMENTAL HEALTH AND AGRICULTURAL PROSPERITY IN PAKISTAN 109

Shahzadi Bibi[1], Aliza Riaz[1], Hasham Fatima[1], Shakeel Ahmad[1], Ahmad Mahmood[1], Muhammad Arif[1], Tanveer-ul-Haq[1] 109

3.10 PRELIMINARY ASSESSMENT OF HEAVY METAL CONTAMINATION IN CROPS GROWN WITH WASTEWATER IN PUNJAB, PAKISTAN 110

Ana Aslam[1*], Muhammad Nasim[1], Farah Rasheed[1], Nisa Mukhtar[1], Qudsia Nazir[1], Muhammad Aftab[1], Allah Nawaz[1], Sarfraz Hussain[2] 110

3.11 IMPACT OF UNTREATED TEXTILE EFFLUENT ON GROWTH OF RICE (*Oryza sativa L.*) 111

Tajwar Alam[1*], Tanzeem-Ur-Rehman[2], Muhammad Ikram[3], Rimsha Sadaf [3], Muhammad Noman Rafiq[3] 111

3.12 BIOMARKERS ANALYSIS IN THE SOIL IMPREGNATED WITH OIL SEEPS OF POTWAR PLATEAU 112

Suleman Orakzai[1], Samina Siddiqui[1*] 112

3.13 SEDIMENTS BOUND PHOSPHORUS FRACTIONS AND ALGAL AVAILABILITY FROM CONNECTING SOURCES OF RIVER JHELUM PAKISTAN 113

Mohsin Zafar[*1], Gulfam Mohi-ud-Din[2], Qamar Sarfaraz[3] 113

3.14 AIR QUALITY IMPACT ASSESSMENT OF CO AND CH_4EMISSIONS FROM HATTAR INDUSTRIAL ESTATE USING SPATIO-STATISTICAL ANALYSIS 114

Sumbal Zaheer[1] 114

3.15 EFFECT OF APPLIED BOUNDARY CONDITIONS AND TREATMENT TIME ON THE ELECTRO-RECLAMATION OF SALT-AFFECTED SOILS 115

Kashif Kamran*[1], Abdul Ahad Hussain[1], Maryam Hina[2], Muhammad Imran[1] 115

3.16 EXOGENOUS APPLICATION OF CADMIUM AND ZINC DIFFERENTLY AFFECTS THE RICE MORPHOLOGICAL TRAITS AND PADDY YIELD UNDER SIMULATED WASTEWATER 116

Sadia Talpur[1], Farooque Bughio[1], Javaria Afzal[2], Nizamuddin Depar[2], Bushra Danish Talpur[3] 116

3.17 ALONE AND COMBINE APPLICATION OF CuNPs AND nHAP IMPROVE THE GRWOTH AND PHYSIOLOGY OF WHEAT PLANT UNDER CADMIUM STRESS 117

Saleha Mushtaq*[1], Muhammad Zia-ur-Rehman[1], Muhammad Usman[1], Mujahid Ali[1], Sana Rana[1], Asia[1], Muhammad Rizwan[2] 117

3.18 HEAVY METAL ACCUMULATION IN SPINACH UNDER DIFFERENT IRRIGATION WATERS AND SOIL ZINC APPLICATION 118

Waleed Ramzan*, Ammara Basit, Shahid Hussain 118

3.19 SORPTION OF CADMIUM, CHROMIUM, AND LEAD ON GREEN-WASTE AND POPULAR-TWIG BIOCHARS IN WASTEWATER AND WASTEWATER-IRRIGATED SOIL 119

Zeshan Aslam[1,2], Muhammad Aon[3]*, Shahid Hussain[3], Muhammad Amjad Bashir[4], Muhammad Farooq Qayyum[3], Waleed Ramzan[3] 119

3.20 Evaluating Cadmium (II) Removal Enhancement in Aqueous Solutions through Potassium Permanganate-Modified Eucalyptus Biochar: Adsorption Performance and Mechanistic Insights.... 120

Audil Rashid[1*], Anila Sikandar[2], Arslan Rafique[1] and Shamim Akhtar[3] 120

3.21 USING MICROBIAL INOCULANTS FOR ENHANCING DECOMPOSITION OF CITY WASTE AND BIOGAS PRODUCTION 121

Amna Nisar[1], *Tanveer Iqbal[1], Ghulam Jilani[1], Muhammad Umair[2] 121

3.22 IMPACT OF INSECTICIDE CHOICE ON THIOPHENATE METHYL METABOLISM AND ASSESSING CARBENDAZIM RESIDUES IN VEGETABLES 122

Rehman Gul*, Abdullah Niaz, Muhmmad Sadiqque Shakir, Mehrana Ehsan, Arslan Nazarat, Umber Ghafoor, Sarfraz Hussain. 122

3.23 COMPARATIVE EFFECTIVENESS OF MICRON SIZED ORGANIC AND INORGANIC AMENDMENTS TO IMMOBILIZE Cd AND ITS PHYTOAVAILABILITY TO MAIZE GROWN ON CONTAMINATED SOILS 123

Mujahid Ali*[1], Muhammad Zia-ur-Rehman[1], Muhammad Rizwan[2], Sana Rana[1], Muhammad Ashar Ayub[1,3], Muhammad Usman[1], Ali Rizwan[1], Muhammad Saqib[1] 123

3.24 CADMIUM AND ZINC INFLOWS THROUGH IRRIGATION WATER GOVERN THEIR BALANCES IN SOILS UNDER WHEAT-SORGHUM ROTATION 124

Ayta Umar[1], Muhammad Nadeem[2], Shahid Hussain[1*], Ammara Basit[1] 124

3.25 URBAN TREE RESPONSE TO HEAVY METAL ENRICHMENT FROM DUST DEPOSITION IN METROPOLITAN AREA OF LAHORE 125

Usama Ahmad Khan*[1], Hamaad Raza Ahmad[1], Muhammad Hassan Bashir[1] 125

3.26 REGRESSION MODELING AND PREDICTIVE ANALYSIS FOR DTPA INDUCED METAL SORPTION AND PHYTOACCUMULATION IN LETTUCE (LACTUCA SATIVA) 126

Faiza Naseem[1], Rabia Safeer[2], Zainab Zafar[3] and Hafiz Muhammad Touqeer[4] 126

3.27 MCPA SORPTION AND DESORPTION AS A FUNCTION OF BIOCHAR PROPERTIES AND PYROLYSIS TEMPERATURE 127

Abdullah Niaz[1,2], Kurt A. Spokas[3*], Bea Ga´miz[4], David Mulla[2], Khaliq R. Arshad[1], Sarfraz Hussain[1] 127

3.28 ANAEROBIC CO-DIGESTION OF COW MANURE WITH VEGETABLE RESIDUES USING BENTONITE AND BIOCHAR AS COMPOSITE ACCELERANT 128

AYAZ MEHMOOD[1*], MUHAMMAD HANZALAH AMJAD[1], YASIR ABBAS[2], SHAH RUKH[3], MOHSIN TARIQ[1], MAZHAR HUSSAIN[1], SINING YUN[2*] 128

3.29 **THE COMPETITIVE ADSORPTION BEHAVIOR OF METALS (CD, FE, NI, PB, AND ZN) ON BIOCHARS PREPARED USING DIFFERENT FEEDSTOCK** 129

MUHAMMAD AHMAR AMIN[1], MUHAMMAD FAROOQ QAYYUM[1*] 129

3.30 **COMBINED USE OF (*BACILLUS SAFENSIS)* AND COMPOST TO IMPROVE GROWTH AND PRODUCTIVITY OF SPINACH UNDER LEAD (PB) STRESS** 130

ASMA MUKHTAR[1]*, FARHEEN NAZLI[1], GHULAM HASSAN ABBASI[1], QASIM ALI[2], ASMA MAJEED[1] MUHAMMAD HAMZA[2],KIRAN JAVED[1] 130

3.31 **ASSESSING THE INTEGRATED EFFECT OF CADMIUM AND COPPER CONCENTRATION IN MAIZE** 131

MUHAMMAD ASAD FAROOQ*[1], CHANDA SALEEM[1], HAMAAD RAZA AHMAD[1], ZILYAD-UL-HASSAN[1], REHMAN ALI[1] 131

3.32 **IMPACT ASSESSMENT OF INDUSTRIAL EFFLUENTS ON FOOD QUALITY OF *BRASSICA OLERACEA* SPECIES** 132

ALISHA[*1], MUHAMMAD ANWAR-UL-HAQ[1], MUHAMMAD USAMA MUSTAFA[1], ANEELA RIAZ[1], MUHAMMAD USAMA JAVED[1], SYED MUHAMMAD MIZFAR GOHAR[1], REHMAN ALI[1] 132

3.33 **BIOSURFACTANT-ASSISTED BIOTREATMENT OF TANNERY EFFLUENTS CONTAMINATED WITH DYE AND CHROMIUM** 133

HIRA SALEEM*[1], AZEEM KHALID[1] 133

3.34 **CAN PHOSPHORUS AND FARMYARD MANURE CHANGE ARSENIC BEHAVIOR IN SOIL AND ITS TOXICITY TO PLANTS?** 134

MUHAMMAD ASHRAF[1*], MUHAMMAD AWAIS PAIRACH[1], SAJID MASOOD[2], SHER MUHAMMAD SHAHZAD[1], NAEEM AKHTAR[3] 134

3.35 **USE OF RICE STRAW AS BIO-SORBENT FOR REMOVAL OF CHROMIUM FROM CONTAMINATED WATER** 135

MUHAMMAD AHMED AKRAM[1]*, MUHAMMAD ATIF RIAZ[1], WAJID ISHAQUE[1], MUHAMMAD AKHTAR[1] 135

3.36 **RESPONSE OF *ACACIA AMPLICEPS* UNDER WATER AND CHROMIUM STRESSED SOILS** 136

MUHAMMAD NAUMAN SATTAR[1], MUHAMMAD SAAD BIN ZAFAR[*1], QANDIL SHAFIQ[1], M. SAQIB[1], NAIN TARA MUSHTAQ[1], NOMAN ZAHID[1], AMINA ABDUL RAHIM[1], LARAIB NOOR[1], AYESHA ABID[1], SAMRA SATTAR[1] 136

3.37 **ASSESSMENT OF HEAVY METAL CONTAMINATION IN LEAFY VEGETABLES: IMPLICATIONS FOR PUBLIC HEALTH AND REGULATORY MEASURES** 137

NASIR RAHIM1, AIMEN NOOR1, AQSA KANWAL1, MAJID MAHMOOD TAHIR1, ABID YAQUB1 137

3.38 **EFFECT OF VARIOUS SOWING METHODS AND ZINC APPLICATION ON GROWTH AND QUALITY TRAITS OF MAIZE** 138

AZIZ LAGHARI [1], MAHMOODA BURIRO[1], GHULAM MUSTAFA LAGHARI[1], KHALID HUSAIN TALPUR[1] 138

3.39 **IN-SITU STABILIZATION OF HEAVY METALS AND YIELD OF SPINACH THROUGH VARIOUS ORGANIC AMENDMENTS IRRIGATED WITH WASTEWATER** 139

MARIA MUSSARAT[1], MUHAMMAD ZOHAIB IKRAM[1], MUHAMMAD RASHID[2], DOST MUHAMMAD[1] 139

3.40 **APPLICATION OF RELEASE NITROGEN FERTILIZERS AND BIOCHAR FOR SUNFLOWER (*HELIANTHUS ANUS L.*) PRODUCTIVITY AND TO ALLEVIATE THE DROUGHT STRESS** 140

SHABIR HUSSAIN*, MEHRAB KHAN, MUHAMMAD NADEEM SHAH*, BUSHRA HUSSAIN 140

3.41 EFFECT OF PHYTOSYNTHESIZED IRON NANOPARTICLES ON GROWTH AND LEAD UPTAKE IN MAIZE (*ZEA MAYS* L.) PLANTS 141

HASEEBA MARYAM[1], MUHAMMAD RIZWAN[1]* 141

3.42 NANO-PARTICLES: A NOVEL TOOL FOR SUSTAINABLE CROP PRODUCTION AND PROTECTION 142

MUHAMMAD HAMZA KHALIL[1*], MUNAZZA RAFIQUE[2], MUHAMMAD NAVEED[1], AHMED HASSAN[1], MUHAMMAD FARHAN QADIR[3] HINA[1] 142

3.43 IRON APPLICATION IN CD-CONTAMINATED SOIL CAN ENHANCE THE PHYTOREMEDIATION POTENTIAL OF CASTOR BEAN 143

ZARISH MAQSOOD[1], MUHAMMAD SHAUKAT[2], SHER MUHAMMAD[2*], SOFIA KHALID[1], ELLEN D.V.L. MAAS[3], ... 143

4 SOIL MICROBIOLOGY & BIOCHEMISTRY SECTION 144

4.1 COMBINED APPLICATION OF PGPR AND BIO-STIMULANTS FOR GROWTH PROMOTION OF RICE (*ORYZA SATIVA L.*) 145

FATIHA KHAN[1], HAFIZ NAEEM ASGHAR*[1], ZAHIR AHMAD ZAHIR[1], TEHREEM FATIMA[1], ZARA ALI[1] 145

4.2 ISOLATING, SCREENING, AND INTEGRATED IMPACT OF CONSORTIUM OF RHIZOBIUM AND RHIZOBACTERIA ON YIELD OF MASH BEAN UNDER IN VITRO CONDITIONS 146

KASHIUF ASIF*[1], WAQAS MAHMOOD[1], HAFIZ NAEEM ASGHAR[1], ZAHIR AHMAD ZAHIR[1] 146

4.3 ACIDIFIED MANURE AND NITROGEN-ENRICHED BIOCHAR SHOWED SHORT-TERM AGRONOMIC BENEFITS ON COTTON-WHEAT CROPPING SYSTEMS UNDER ALKALINE ARID FIELD CONDITIONS 147

SULEMAN HAIDER SHAH[1], MUHAMMAD BAQIR HUSSAIN[1*], GHULAM HAIDER[2], TANVEER UL HAQ[1], ZAHIR AHMAD ZAHIR[3], AND CLAUDIA KAMMANN[4] 147

4.4 ISOLATION AND SCREENING OF RHIZOBIUM AND PGPR FOR IMPROVEMENT IN GROWTH AND NODULATION OF SOYBEAN. 148

NABIHA ASGHAR*[1], HAFIZ NAEEM ASGHAR[1], ZAHIR AHMAD ZAHIR[1] 148

4.5 EXPLORING THE POTENTIAL OF ENDOPHYTIC BACTERIA TO MANAGE THE DROUGHT STRESS IN CHICKPEA BY PROMOTING RHIZOBIA-CHICKPEA SYMBIOSES 149

MUHAMMAD USMAN JAMSHAID*[1], MUHAMMAD BAQIR HUSSAIN[1], ZAHIR AHMAD ZAHIR [2], MEHREEN GUL[3] AND MUHAMMAD KHUBAIB AYYAZ4 149

4.6 SIDEROPHORE-MEDIATED IRON UPTAKE: A KEY TO IMPROVED GROUNDNUT (*ARACHIS HYPOGAEA* L.) PRODUCTIVITY AND NUTRITIONAL QUALITY 151

SAIR SARWAR[1]*, ABDUL KHALIQ[2], MUNAZZA YOUSRA[1], TARIQ SULTAN[1], TAUSEEF TABASSAM[1], MUHMMAD ZAMEER KHAN[1], MUHAMMAD MANZOOR[1] 151

4.7 EXPLORING ENTEROCOCCUS DURANS S2C: PRODUCTION OF ANTIFUNGAL GELATINASE AND ITS POTENTIAL ROLE IN BIOLOGICAL CONTROL 152

ZAFAR HAYAT[1], IRUM MUKHTAR[1], FALUK SHAIR[1], KIFAYAT ULLAH[1], AHMED HAFEEZ[1], FAUZIA YUSUF HAFEEZ[1] AND ANWAR ULLAH[1] 152

4.8 ANTAGONISTIC POTENTIAL OF DIFFERENT RHIZOBACTERIA ISOLATED FROM SORGHUM AGAINST DIFFERENT FUNGAL PATHOGENS 153

TAUSEEF TABASSAM[1*], MARYUEM HUMAYUN[1], TARIQ SULTAN[1], SAIR SARWAR[1], MUNAZZA YOUSRA[1], SONIA SAMREEN[1] 153

4.9 SYNERGIZING THE EFFECT OF PHOSPHATE SOLUBILIZING BACTERIA, COMPOST AND BIOCHAR WITH DI-AMMONIUM PHOSPHATE AND NITRO-PHOS 154

MUHAMMAD YASIR[1], MUHAMMAD BAQIR HUSSAIN[1*], WAZIR AHMAD[1], SHAHID IQBAL[2], MUHAMMAD USMAN JAMSHAID[1], AND SAJID HUSSAIN[3] 154

4.10 BIODEGRADATION OF AZO DYE THROUGH MICROALGAE AND SIMULTAEOUS BIOLIPID PRODUCTION **155**

AQSA RIAZ[*1], SHAHID MAHMOOD[1], AZEEM KHALID[1], MUZAMMIL ANJUM[1] 155

4.11 EFFICACY OF BIO-ACTIVATED IRON COATED UREA FOR IRON BIOFORTIFICATION OF MAIZE UNDER POT TRIAL **156**

SAMMIA GHAZANFAR[1], AZHAR HUSSAIN[1], MAQSHOOF AHMAD [1], ABUBAKAR DAR[1] 156

4.12 ISOLATION AND CHARACTERIZATION OF BACTERIA FROM LENTIL TO IMPROVE ITS YIELD **157**

SABIHA KANWAL [1], ARSHAD NAWAZ CHAUDHRY [1]*, RIMSHA SADAF [1], TAJWAR ALAM [2], MUHAMMAD NOMAN RAFIQ[1], MUHAMMAD IKRAM[1] 157

4.13 COMPARATIVE EFFECTS OF BIO-PRIMING AND OSMO-PRIMING TO MODULATE DROUGHT STRESS IN WHEAT (*TRITICUM AESTIVUM L.*) **158**

SANAULLAH YASIN[1]*, SONIA IHSAN[1], GHULAM ABBAS NAREJO[2], MUHAMMAD ASIF SHEHZAD[3], NOSHEEN MIRZA[1], ABID MAHMOOD[4] AND MUHAMMAD QASIM[5] 158

4.14 MODIFIED SMECTITE AS ADSORBENT OF AFLATOXIN B1 .... **159**

AHMAD KHAN[1,2*], MOHAMMAD SALEEM AKHTAR[1], KHALID SAIFULLAH KHAN[1], SABA AKBAR[1,2], YOUJUN DENG[2] 159

4.15 HEAT INDUCED STRUCTURAL CHANGES IN PALYGORSKITE, SEPIOLITE AND SMECTITE FOR AFLATOXIN B1 ADSORPTION **160**

SABA AKBAR[1,2*], MOHAMMAD SALEEM AKHTAR[1], AHMAD KHAN[1,2], YOUJUN DENG[2] 160

4.16 UTILIZING *STREPTOMYCES SP.* AS AN ECO-FRIENDLY CATALYST FOR SLUDGE BIOCONVERSION: AN INNOVATIVE APPROACH IN WASTE BIO-REFINERY **161**

SANA AKBAR[1], AZEEM KHALID[2], MUZAMMIL ANJUM[1]* 161

4.17 SYNERGISTIC EFFICACY OF ASCORBIC ACID AND RHIZOBACTERIA: A FLOURISHING ALLIANCE FOR ENHANCING SPINACH GROWTH IN SALINE SOILS **162**

ARBAB SHEHZADI[1], MUHAMMAD ZAFAR-UL-HYE[1*], SAJID MASOOD[1], MUHAMMAD MUEEN AKRAM[1], ZAINAB TAHIR SHAH[1], SHIZA MANZOOR AND SHERAZ KHADIM[1] 162

4.18 ADVANCING MICROALGAE BASED BIO-REFINERY AND BIOPROCESS EVALUATION **163**

SUMERA ARSHAD[1], TAJWAR ALAM[2]*, BEENISH AFSHEEN[1], SUMMAIA ARSHAD[3] 163

4.19 DEVELOPMENT OF LOW-COST MICROBIAL INOCULANTS FOR SUSTAINABLE AGRICULTURE WITH INCREASED SHELF LIFE **164**

HUMERA ASLAM AWAN [1,2,3*], MUHAMMAD IRFAN UL HAQ [2] AND KAUSER ABDULLA MALIK[3] 164

4.20 CHARACTERIZATION AND COATING OF ZN SOLUBILIZING ISOLATES ON UREA TO IMPROVE THE EFFICIENCY OF ZINC **165**

MUHAMMAD FASIH ULLAH[1]*, AZHAR HUSSAIN[1], MAQSHOOF AHMAD[1], ASAD BASHIR[1] 165

4.21 BROAD SPECTRUM PLANT GROWTH PROMOTION POTENTIAL EXHIBITED BY *ENTEROBACTER* SP. AF-31 NATIVE TO CHAMMANKOT, DISTRICT DHIRKIOT, AJK **166**

AFSHAN MAJEED*[1, 2], M. KALEEM ABBASI[1, 3], SOHAIL HAMEED[2], FATHIA MUBEEN[2], ASMA IMRAN[2], MAJID MAHMOOD TAHIR[1] 166

4.22* EFFECT OF PLANT GROWTH PROMOTING RHIZOBACTERIA (PGPR) AND BIOSTIMULANT (L-TRYPTOPHAN) ON THE GROWTH AND YIELD OF ONION *(ALLIUM CEPA) **168**

Iqra Akram[1]*, Fatima Aamir[1], Husna Ijaz[1] and Rehman Ali[2] 168

4.23 ISOLATION AND CHARACTERIZATION OF ZINC SOLUBILIZING BACTERIA FROM ONION FOR DEVELOPMENT OF NEXT GENERATION BIOFERTILIZER 169

Durshana Khan Khanzada[1,2*] Ghulam Murtaza Jamro[1], Inayatullah Rajpar[1], Sair Sarwar[2] 169

4.24 ALLEVIATE DROUGHT EFFECTS IN FIELD CROPS OF POTHWAR BY INOCULATION OF *RHIZOBIUM* AND PGPRS; IN FUTURE-PROSPECTS 170

Azhar Mahmood Aulakh[A], Mohammad Yunus[A], Saefraz Ahmad[A], Obaid ur Rehman[A], Ghulam Qadir[B], Tariq Sultan[C], Motsim Billah[D] 170

4.25 ENHANCING AEROBIC BIOREACTOR FOR OPTIMAL WASTE TO BIOLIPID CONVERSION WITH OLEAGINOUS BACTERIA 171

Rida Abbasi[1], Shahid Mahmood[2], Azeem Khalid[*] 171

4.26 ENHANCING MAIZE PRODUCTIVITY IN SALINE CONDITIONS THROUGH THE USE OF HALOTOLERANT PGPR IN CONJUNCTION WITH COMPOST 172

Hafiz Tanvir Ahmad[1,6*], Muhammad Iqbal[2], Usman Aziz[3], Azhar Hussain[4], Muhammad Abubakar Dar[5], Tanveer ul Haq[6], Noor ul Ain[7] and Fariha Amin[8] 172

4.27 IDENTIFICATION OF ANTIFUNGAL ACTIVITY AND GC-MS DETECTION OF *AMARANTHUS VIRIDS* AGAINST PHYTOPATHOGENIC FUNGI 173

Iram Naz Sherazi*[1], Muhammmd Akbar[1], Komal Shoukat[2], Noshia Arshad[1], Sair Sarwar[3], Zarrin Fatima Rizvi[2], Tariq Sultan[3], Muhammad Iftikhar[3] 173

4.28 SIMULTANEOUS DEGRADATION OF CITRUS AND OLIVE WASTE AND LIPID ACCUMULATION BY OLEAGINOUS BACTERIA 174

Javeeria Iqbal*[1], Azeem Khalid[2] 174

4.29 IMPROVING PHYTOREMEDIATION POTENTIAL OF WATER HYACINTH USING CHROMATE RESISTANT BACTERIA 175

Rabia Afzal[1]*, Muhammad Fasih Ullah[1], Wajeeha Attiq[1], Qasim Ali[1], Muhammad Ameen[1], Maqshoof Ahmad[1] 175

4.30 BIOREMEDIATION OF CONTAMINATED SOIL THROUGH CHROMIUM RESISTANT BACTERIA 176

Natasha Malik[*1], Maqshoof Ahmed[1], Zaffar Malik[1], Azhar Hussain[1], Iftikhar Ahmed[1], Zartasha Malik[1], Muhammad Usama[2] 176

4.31 ROLE OF BACTERIAL CELL WALL IN THE REDUCTION OF HEXAVALENT CHROMIUM IN AQUEOUS MEDIUM 177

Muhammad Waseem[1]*, Saima Muzammil[2], Alia Anayat[3], Muhammad Rizwan[1] 177

4.32 IMPROVING PHOSPHOROUS UPTAKE IN WHEAT (*TRITICUM AESTIVUM* L.) BY THE APPLICATION OF PHOSPHATE SOLUBILIZING BACTERIA AND BANANA PEEL UNDER CLIMATE CHANGE CONDITIONS 178

Tayyaba Samreen*[1], Sidra Tahir[1], Faraz Anjum[1], Samia Arshad[1], Muhammad Zulqernain Nazir[1], Muhammad Ahmad[1] 178

4.33 VERMICOMPOST; INEVITABLE CARRIER FOR NEXT GENERATION BIOFERTILIZER BIOTECHNOLOGY 179

Aftab Tabasum*[1], Mian Inayat Muhammad Muzamil[1], Muhammad Akmal[1], Mukhtar Ahmed[2], Rifat Hayat[1], Misbah-Ud-Din Ahmad[1] 179

4.34 Exploration of Symbiotic Association and Identification of Soil Fungal Species from Roots of Wheat in District Bhimber, Azad Kashmir 181

Tanveer Hussain*[1], Saleha Batool Munir[1], Aroosa Azeem[1] 181

5 SOIL AND ENVIRONMENTAL PHYSICS AND SOIL CONSERVATION SECTION 182

5.1 ASSESSING THE INFLUENCE OF PLANT RESIDUES ON RUNOFF AND SOIL LOSSES IN WHEAT-COMMON BEAN CROPPING SYSTEMS IN THE MOUNTAINOUS REGION OF RAWALAKOT, AZAD JAMMU AND KASHMIR 183

Aqila Shaheen*[1], Sania Latif[1] and Nadia Afsar[1] 183

5.2 A SOIL HEALTH INITIATIVE FOR AGRICULTURAL AND ENVIRONMENTAL SUSTAINABILITY IN PAKISTAN 184

Muhammad Iqbal*[1], Atif Javed[1] 184

5.3 EFFECTS OF DIFFERENT LAND USE PRACTICES ON SOIL FERTILITY AND PHYSICOCHEMICAL PROPERTIES IN SEMI-ARID DRYLAND REGION 185

Kashif Ali Kubar*[1], Abdul Wahab[1], Shahmir Ali Kalhoro[1], Punhoon Khan Korai[1], Muneer Ahmed, Qamar Sarfaraz[1], Ghulam Murtaza Jamro[2], Imran Ameer[1], Mukhtiar Ahmed[1] 185

5.4 POTENTIAL OF MODIFIED REDUCED TILLAGE WITH COVER/GREEN MANURE CROP FOR CLIMATE CHANGE MITIGATION IN SMALLHOLDER RAINFED FARMING SYSTEM 186

Shahzada Sohail Ijaz*[1], Nabeeha Javed[1], Qaiser Hussain[1], Muhammad Ansar[2] 186

5.5 IMPACT OF IN-SITU MOISTURE CONSERVATION TECHNIQUES ON WATER CONSERVATION AND YIELD IN A POMEGRANATE ORCHARD 187

Riffat Bibi*[1], Safia Naureen Malik[1], Waqas Naseem[1] and Obaid-ur- Rehman[1] 187

5.6 COMPARATIVE ROLE OF MELATONIN IN MITIGATING ABIOTIC AND BIOTIC STRESSES IN GROUNDNUT UNDER CLIMATE CHANGE SCENARIO 188

Ghulam Muhammad*[1], Waqas Naseem[1], Azhar Mehmood Aulakh[1], Sultan Ahmad Rizvi[1] and Obad ur Rehman[1] 188

5.7 IMPACT OF ORGANIC AND INORGANIC MULCHES ON SOIL PROPERTIES AND GROWTH PARAMETERS OF GARLIC 189

Safia Naureen Malik*[1,] Waqas Naseem[1], Majid Rahim[1] and Obaid-ur- Rehman[1] 189

5.8 CARBON MANAGEMENT FOR IMPROVING SOIL HEALTH AND CROP PRODUCTION 190

Sara*[1], Dost Muhammad[1] and Maria Mussarat[1] 190

5.9 EFFECT OF COWPEA (*VIGNA UNGUICULATE*) AS MULCH ON WHEAT UNDER RAINFED CONDITIONS 191

Sarfaz Ahmed*[1], Riffat Bibi[1], Safia Naureen Malik[1] and Obaid- ur- Rehman[1] 191

5.10 TECHNOLOGICAL APPROACH: IMPLEMENTING ROOT ZONE TRENCHES FOR THE MANAGEMENT OF DIEBACK DISEASE IN MANGO TREES 192

Fatima Bibi*[1], Abdul Ghaffar Grewal[1], Khurram Shahzad[2], Sidra Kiran[3], Javed Iqbal[3], Beenish Butt[4] 192

5.11 ASSESSMENT OF SOIL EROSION USING RUSLE MODELING UNDER CONVENTIONAL AND CONSERVATION AGRICULTURE 193

Mah-Noor Azad*[1], Shahzada Sohail Ijaz[1], Khalid Saifullah Khan[1], Muhammad Ansar[2] 193

5.12 EXPLORING IMPACT OF HYDROGEL APPLICATION ON GROWTH AND YIELD OF WHEAT UNDER RAINFED SCENARIO 194

Majid Rahim[1*], Adnan Umair[2], Sarfraz Ahmed[1], Muhammad Yunas[1] and Obaid-ur-Rehman[1] 194

5.13 ENHANCING PEACH PRODUCTION IN RAINFED AREAS OF PUNJAB THROUGH MULCHING TECHNIQUES 195

Muhammad Yunas*[1], Riffat Bibi[1], Waqas Naseem[1], Safia Naureen Malik[1], Sarfraz Ahmed[1], Obaid-ur-Rehman[1] 195

5.14 IMPACT OF FARMYARD MANURE ON SOIL PHYSICAL PROPERTIES AND MAIZE GROWTH 196

Mussawar Abbas*[1], Muhammad Iqbal[1], Laiba Tahir[1], Tooba Mumtaz[1], Hifza Jabbar[1] 196

5.15 ENHANCING SOIL MOISTURE AND CROP YIELD IN RAINFED AREAS THROUGH SUPER ABSORBENT POLYMERS 197

Waqas Naseem*[1], Muhammad Yunas[1], Sultan Ahmad Rizvi[1], Ghulam Muhammad[1] and Obaid-ur-Rehman[1] 197

5.16 TILLAGE PRACTICES CONTRIBUTE TO THE WATER CONSERVATION BENEFITS OF RAINWATER HARVESTING IN SEMI-ARID CONDITIONS 198

Sultan Ahmad Rizvi*[1], Waqas Naseem[1], Danish Majeed[1], Obaid ur Rehman[1] 198

5.17 NITRATE ACCUMULATION AND HUMAN HEALTH RISK ASSESSMENT IN SPINACH IRRIGATED WITH RAW DOMESTIC WASTEWATER BY APPLYING DIFFERENT N-SOURCES 199

Sadia Bibi[1*], Sana Faeooq[1], Saifullah[1], Muhammed Sabir[1], Sidrah Ashfaq[2], Hammad Raza Ahmed[1] 199

5.18 EFFECT OF COMPOST AND ORGANIC MULCHING ON WATER USE EFFICIENCY, SOC AND YIELD OF OKRA IN ARID AND SEMI-ARID REGIONS 200

Sadia Bibi[1], Hadia Muhammad[1], Saifullah*[1], Muhammad Sabir[1] 200

5.19 Improving water use efficiency in wheat through reduce irrigation and subsurface application of Farm yard manure 201

Muhammad Sulaiman[1], Muhamad Imran[1]*, Ahmad Mahmood[1], Muhammad Baqir Hussain[1] and Sarfaraz Hashim[2] 201

6 SALINITY SECTION 202

6.1 AMELIORATION OF SALINITY STRESS IN MAIZE PLANTS USING ACIDIFIED BIOCHAR: A POTENTIAL STRATEGY FOR ENHANCING CROP RESILIENCE AND PRODUCTIVITY 203

Tahira Akram[1], Muhammad Zia-ur-Rehman[1, *], Hamaad Raza Ahmad[1], Muhammad Usman[1], Uzair Anjum[1], Ali Rizwan[1], Muhammad Saqib[1], Rubaz Ahmad[1] 203

6.2 IDENTIFICATION OF SALT TOLERANT WHEAT GENOTYPES THROUGH AGRONOMICAL AND PHYSIO-BIOCHEMICAL TRAITS 204

Sajida Bibi*[1], Abdul Rasul Awan[1], Muhammad Akhtar[1] 204

6.3 ISOLATION AND CHARACTERISATION OF HALOTOLERANT BACTERIA FOR THE GROWTH OF TOMATO (*SOLANUM LYCOPERSICUM*) 205

Ahsan Raza Khan[A], Ali Raza Gurmani[A], Ayaz Mehmood[A], Rasheed Ahmed[A], Raheem Shahzad[B], Mazhar Rafique[A] and Jinlin Zhang[C] 205

6.4 ASSESSING THE IMPACT OF CONVENTIONAL AND MODIFIED ORGANIC AMENDMENTS IN RECLAIMING SALT-AFFECTED SOILS 206

Saifullah[1*], Nimra Sehar[1], Muhammad Sabir[1], Sadia Bibi[1], and Muhammad Naveed[1] 206

6.5 CO-APPLICATION OF PLANT GROWTH PROMOTING RHIZOBACTERIA AND FARMYARD MANURE FOR IMPROVING GROWTH AND YIELD OF ONION UNDER SALINE CONDITIONS 207

Mohammad Awais*[1], Wajeeha Attiq[1], QuratulAin Tayyab[1], Qasim Ali[1], Maqshoof Ahmad[1] 207

6.6 EFFECT OF ZINC AMINO ACID CHELATES ON GROWTH OF WHEAT IN SALT AFFECTED SOILS 208

Hafiz Abdullah Shah[1], Ayesha Mustafa*[1], Laiba Shabbir[1], Sabahat Kainat[1], Abdullah Maqsood[1] 208

6.7 ENHANCING WHEAT GROWTH UNDER SALINITY STRESS: THE IMPACT OF BIOCHAR APPLICATION ON SOIL CHARACTERISTICS AND CROP YIELD 209

Shahzad Ahmad*[1] 209

6.8 COMPARATIVE EVALUATION OF SORGHUM (*SORGHUM BICOLOR L.)* GENOTYPES AGAINST NACL STRESS 210

Rehman Ali[1*], Muhammad Anwar-ul-Haq[1], Muhammad Saqib[1], Muhammad Sajid Aqeel Ahmad[2], Usama Mustfa[1], Aneela Riaz[1] and Alisha[1] 210

6.9 EVALUATING NUTRITIONAL QUALITY OF SORGHUM EXPOSED TO SALINITY AND DROUGHT STRESS. 211

Fatima Aamir[1]*, Iqra Akram[1], Husna Ijaz[1] and Rehman Ali[2] 211

6.10 EFFECT OF CALCIUM CHLORIDE SEED PRIMING ON WHEAT SEEDLINGS DEVELOPMENT AND EMERGENCE UNDER SALT STRESS 212

Asif Muhammad*[1], Muhammad Dilshad[1], Haji Muhammad[2], Siraj Ahmed[3] 212

6.11 DIFFERENTIAL RESPONSE OF RICE VARIETIES TO SALINITY STRESS 213

Muhammad Haider Jamal, Tanveer Ul Haq, Muhammad Arif, Mehwish Sanaullah, Sajeela Sehar and Muhammad Farhan 213

6.12 INTERACTIVE EFFECT OF CAFFEIC ACID AND SALINITY ON MORPHO- PHYSIOLOGICAL, IONIC AND BIOCHEMICAL ATTRIBUTES OF WHEAT (*TRITICUM AESTIVUM* L.) 214

Hassan Mehmood[1*], Ghulam Hassan Abbasi[1], Zaffar Malik[1], Muhammad Ali[2], Muhammad Nadeem[2], Muhammad Ashar Ayub[2], Muhammad Waqar Akhtar[1], Muhammad Irfan[2], Fatima Nisar[1], Muhammad Sohaib[1] 214

6.13 CHILIES RESPONSE TO SALINITY IN HYDROPONIC CULTURE 216

Jameela Naz Jamro[1*], Inayatuallah Rajper[2], Nabi Bux Jamro[1], Ambrin Rajput[3], Ghulam Murtaza Jamro[2], Kaleemullah Shaikh[1] and Hassan Bux Rashidi[3] 216

6.14 IMPACT OF SALINIZED WATER ON TWO MALAYSIAN OIL PALM VARIETIES AT THE SEEDLING PHASE 217

Marvi Memon[1], Allah Wadhayo Gandahi*[1], Nasir Shahzad Memon[2], Saleem Mohammad Sarki[1] and Hafeezullah Babar[3] 217

6.15 NUTRIENT MANAGEMENT OF SALT TOLERANT FORAGE GRASSES FOR ENHANCING FORAGE PRODUCTION AND NUTRITIONAL QUALITY IN SALT AFFECTED SOILS 218

Muhammad Rizwan*[1], Ayesha Mustafa[1], Abdul Rasul Awan[1] 218

6.16 YIELD FORMATION IN MAIZE AS AFFECTED BY ABIOTIC STRESSES 219

Muhammad Saqib*[1], Muhammad Saad Bin Zafar[1], Tayyaba Naz[1], Qandil Shafiq[1], Nauman Sattar[1], Numan Zahid[1], Anosha Arshad[1], Aqsa Zafar[1] 219

6.17 EVALUATING PHYSIOLOGICAL AND BIOCHEMICAL RESPONSES OF WHEAT (*TRITICUM ASTIVUM L.)* AGAINST WATER STRESS BY USING ORGANIC AMENDMENTS 220

Muhammad Usama Mustafa[1*], Muhammad Anwar-ul-Haq[1], Alisha[1], Syed Muhammad Mizfar Gohar[1], Aneela Riaz[1], Rehman Ali[1] 220

7 SOIL CHEMISTRY 221

7.1 PRESSMUD AND FARMYARD MANURE IMPROVE WHEAT PRODUCTIVITY IRRIGATED WITH TEXTILE WASTEWATER THROUGH INCREASING NUTRIENT UPTAKE AND DYE DEGRADATION 222

Muhammad Imran[1], Muhammad Aslam[1], Abdul Rasul Awan[1] and Muhammad Akhtar[1] 222

7.2 ESTIMATION OF LEACHING LOSSES OF PHOSPHORUS IN TEXTURALLY DIFFERENT SALINE-SODIC SOILS 223

Sadia Sultana[*1, 2], Ayesha Amin[1], Muhammad Sabir[1], Saifullah[1], Ghulam Murtaza[1], Sadia Bibi[1] 223

7.3 SPATIAL VARIATION OF SALT DISTRIBUTION ACROSS DEPTHS IN DIVERSE SOIL SERIES NEAR TANDOJAM 224

Nasir khan Katiyar[1], Nazia Rais[1], Inzamam-ul- Haque Khanzada[1] ,Sohail Qureshi[1] and Ghulam Mustafa Banbhan[2] 224

7.4 RECLAMATION OF DENSE SALINE-SODIC SOILS BY BREAKING SUBSOIL WITH AUGER IN A RICE-WHEAT ROTATION USING GYPSUM, SAND AND RICE HUSK 225

Muhammad Abdullah[1*] Misbah Abbas [1,] Ghulam Murtaza 225

7.5 PHOSPHORUS LEACHING IN SALINE-SODIC SOILS FERTILIZED WITH PHOSPHATIC FERTILIZER AT DIFFERENT LEVELS 226

Sheeza Amin[1], M. Sabir*[1], Saifullah[1], Hamaad Raza Ahmad[1], Sadia Bibi[1] and Ejaz Ahmad Waraich[2] 226

7.6 EFFECT OF MICRON SIZED AMENDMENTS FOR ENHANCING CD IMMOBILIZATION AND REDUCING ITS UPTAKE IN DIFFERENT TISSUES OF MAIZE CROP GROWN ON CONTAMINATED SOILS 227

Mujahid Ali*[1], Muhammad Zia ur Rehman[1], Sana Rana[1], Muhammad Usman[1], Zahra Rana[2] Muhammad Ashar Ayub[3] 227

7.7 IMPACT OF VARIOUS AMELIORANTS ON GEOCHEMICAL CHROMIUM DISTRIBUTION AND CO_2-CARBON EFFLUX UNDER PADDY SOIL CONDITIONS 228

Muhammad Ashir Hameed[1*], Muhammad Mahroz Hussain[1,2,4,5], Irshad Bibi[1*], Nabeel Khan Niazi[1], Muhammad Shahid[2], Muhammad Ashraf[1] 228

7.8 SEDIMENT COLOUR AND GEOCHEMICAL CHARACTERIZATION OF UNDERGROUND SEDIMENTS FOR ASSESSING ARSENIC-CONTAMINATION POTENTIAL OF GROUNDWATER WELLS 229

Muhammad Mahroz Hussain[1,2,5*], Irshad Bibi[1], Nabeel Khan Niazi[1] Muhammad Shahid[2], and Jorg Rinklebe[5] 229

7.9 COMPARISON OF VARIOUS KINETIC MODELS FOR POTASSIUM RELEASE MODELLING OF ALKALINE SOILS OF DERA GHAZI KHAN, PUNJAB, PAKISTAN 230

Muhammad Imran1*, Ghousia liaquat1, Tahira Jameel1, Muhammad Ashar Ayub1, Ghulam Hassan Abbasi1, Muhammad Nadeem1, Waseem Hassan2,3, Muhammad Ali1, Muhammad Irfan1 230

7.10 COMPARATIVE RESPONSE OF COATED AND COMMERCIAL UREA ON LETTUCE PRODUCTION AND NITROGEN CONTENT 231

Mahnoor Baloch[1], Saima Kalsoom Babar[1*], Naseebullah Achakzai1, Zeeshan Mashori[1], Hassan Ali Shujrah[1], ... 231

7.11 SYNTHESIS AND CHARACTERIZATION OF METAL ORGANIC FRAMEWORKS FOR REMOVAL OF PARTICULATE MATTER 233

Anum Shafique*[1] 233

7.12 ORGANIC AMENDMENT ASSISTED LEACHING AND RECLAMATION OF SALT-AFFECTED SOILS. 234

Saifullah[1*], Zareen Batool[1], Sadia Bibi[1] Muhammed Sabir[1], Sidrah Ashfaq[2] 234

7.13 MODELING IMPACT OF N ON MUSTARD CROP USING DSSAT 235

NADIR ALI*[1], MUKHTARAHMED[1], GHULAM QADIR[1], DR. GHULAM SHABBIR [2], DR MUHAMMAD ASIM[3], MANSOOR ALI[1], ALVINA FARAZ[1] 235

7.14 OPTIMIZING DI-AMMONIUM PHOSPHATE (DAP) COATINGS IN ALKALINE SOIL FOR ENHANCED SOIL FERTILITY AND PLANT GROWTH: A COMPREHENSIVE EVALUATION 236

MUHAMMAD TARIQ[1], UMAIR RIAZ[1*], MUHAMMAD ARIF[1], ABID HUSSAIN[1], AHMAD WAQAS[2], TANVEER-UL-HAQ[1], HASEEB UR REHMAN[1] 236

8 OTHERS 237

8.1 PHENOTYPIC EVALUATION OF TOMATO F2 POPULATION IN ARID CLIMATE OF LAYYAH PAKISTAN 238

IFRAH JAVED[1], SAWAIRA ASHRAF[2], HUMERA ASHRAF[*3], SUSAN MUHAMMAD[4], MUHAMMAD ZAHID ASHRAF[4], HAMMAD AHMED[5] 238

8.2 NUTRIENT MANAGEMENT STRATEGIES FOR SUSTAINABLE COTTON PRODUCTION: A FIELD RESEARCH INITIATIVE IN LAYYAH DISTRICT, PAKISTAN 239

AHSAN AMIN[1], FAIZ UL HASSAN[2]*, UMM E HABIBA[3], MUHAMMAD ISLAM [4], UMAR SOHAIL[2], HAFIZ MUHAMMAD ALI RAZA[2], MUHAMMAD UMAIR[5], MUHAMMAD FAIZAN BASHIR[2], MUHAMMAD NOOR CHAN[6], MUHAMMAD USMAN[7], MUHAMMAD ATIF[8] 239

8.3 MODELING IMPACT OF CLIMATE CHANGE ON WATER USE EFFICIENCY, CARBON FOOTPRINT, PRODUCTIVITY AND NUTRITIONAL QUALITY OF WHEAT-GROUNDNUT CROPPING SYSTEM 240

ALVINA FARAZ*[1], MUKHTARAHMED[1], GHULAM QADIR[1], KHASIF SARFRAZ ABBASI[2], RIFAT HAYAT[3], NADIR ALI[1] AND AFTAB TABASUM[3] 240

8.4 BIODEGRADATION OF AN EMERGING MICROPOLLUTANT, DICLOFENAC FROM WASTEWATER 241

IRRUM SHAHZADI*[1], SAJIDA PERVEEN[1], SYEDA FATIMA ZAINAB[1], HIRA ABID[1], SOBIA JABEEN[1], FARZANA KAUSAR[1] 241

8.5 PHENOTYPIC EVALUATION OF 26 TOMATO F1 DEVELOPED FROM EXOTIC GERMPLASMS FOR ITS ADAPTATION IN ARID CLIMATE OF LAYYAH 242

SUSAN MUHAMMAD[1*], SAWAIRA ASHRAF[2], HUMERA ASHRAF[3], IFRAH JAVED[4], MUHAMMAD ZAHID ASHRAF[4] 242

8.6 INVESTIGATING THE CAUSES AND CONSEQUENCES OF OVER-EXPLOITATION OF NATURAL RESOURCES IN SWAT VALLEY OF KHYBER PAKHTUNKHWA, PAKISTAN 243

SANA ULLAH*[1] AND SHER MUHAMMAD[1] 243

8.7 EVALUATING DIFFERENT WHEAT (*TRITICUM AESTIVUM* L.) VERITIES UNDER DROUGHT STRESS 244

SAWAIRA ASHRAF*[1], IFRAH JAVED[2], HUMERA ASHRAF[3], MUHAMMAD ZAHID ASHRAF[4], SUSAN MUHAMMAD[4], SAMINA MAJEED[5] 244

8.8 ASSESSMENT OF QUALITY OF IRRIGATION WATER AND SOILS OF TEHSIL GANDAKHA DISTRICT JAFFARABAD BALOCHISTAN 245

I. K. M. HASSANI[1], S. M. BHATTI*[1], G. M. JAMRO[1], N. DEPAR[2], Z. R. BUGHIO[3], M. K. SOOTHAR[1] 245

8.9 BIOSTIMULANT THE KEY TO AGRO ENVIRONMENTAL SAFETY: A COMPREHENSIVE REVIEW ... 246

FAIZ UL HASSAN[1]*, MUHAMMAD AMJAD BASHIR[2], MUHAMMAD HUZAIFA LUQMAN KHAN[1], HAFIZ MUHAMMAD ALI RAZA[1], MUHAMMAD FAIZAN BASHIR[1], MUHAMMAD ISLAM[3], AHSAN AMIN[4], SAMMAR ABBAS[1], ABDUL BASIT[1] 246

8.10 BIOSTIMULANT APPLICATIONS FOR IMPROVING CROP WATER USE EFFICIENCY AND AGRO-ENVIRONMENT SUSTAINABILITY: A COMPREHENSIVE REVIEW 247

FAIZ UL HASSAN[1]* MUHAMMAD AMJAD BASHIR[2], HAFIZ MUHAMMAD ALI RAZA[1, 2], IRTAZ ALI[3], ABDUL BASIT[1], MUHAMMAD FAIZAN BASHIR[1], SAMMAR ABBAS[1], MUHAMMAD ISLAM[3] 247

8.11 COMPENSATORY RESPONSE OF MAIZE SEEDLINGS TO SHORT-TERM OZONE EXPOSURE: A COMPARATIVE ANALYSIS OF 2H, 4H, AND 6H PRE-GERMINATION SEEDLINGS OF ONE TIME EXPOSURE TO O_3 248

SABEEN AFZAAL*[1], ZAKIA KHANUM[1], FARIA ASAD[1], SAMIA QADIR[1] 248

8.12 EFFECT OF ELCTRON BEAM IRRIDATION ON THE PHYSIOCHEMICAL PROPERTIES, BIOACTIVE ELEMENTS AND MICROBIOLOGICAL CHARACTERISTICS OF RADIX OPHIOPOGONIS 249

MAHENDAR KUMAR SOOTAHAR[1,2,3], MUKESH KUMAR SOOTHAR[2,4], PUNAM SOOTHAR[5], SAIBRINA SETHAR[1,2], MUHAMMAD ASLAM PANHWER[1,2], KHALID KHOKHER[1,2] AND HAFEEZULLAH BABER[1,2] 249

8.13 ADVANCEMENTS IN SUSTAINABLE SOIL MANAGEMENT PRACTICES: A COMPREHENSIVE REVIEW FOR ENSURING GLOBAL FOOD SECURITY 250

MUHAMMAD ISLAM*[1], KASHIF ALI KHAN[2], SOBAN TASAWWAR[2] ARSHAD NAWAZ CHOUDHRY[3], IRTAZ ALI[3], MUHAMMAD AZEEM[4,] MUHAMMAD SOHAN AKBAR[2], MUHAMMAD TARIQ[4], MISBAH-UD-DIN AHMED[3], MUHAMMAD YOUNUS[4], UMAR SOHAIL[4] 250

8.14 EFFECT OF CHROMIUM STRESS ON GROWTH PARAMETERS OF TWO TOMATO CULITVARS 251

MUHAMMAD ASLAM PANHWAR[1], MAHENDAR KUMAR SOOTAHAR[1], SAIBRINA SETHAR[1], ABDUL QUDOOS[1], KHALID HUSSAIN KHOKHAR[1], HAFEEZULLAH BABAR[1] 251

8.15 ASSESSMENT OF VARIATION IN AGRO-CLIMATIC ZONE FOR SUSTAINABLE AGRICULTURE IN THE NORTHERN AREAS OF PAKISTAN 252

RIAZ KHAN*[1], ALI RAZ GURMANI[1], RASHEED AHMAD[1], GHANI AKBAR[2] 252

8.16 RECENT FLOODS: IMPACTS ON AGRICULTURE IN A CHANGING CLIMATE SCENARIO AND ADAPTATION 253

SAMMIA KHURSHID*, AZEEM KHALID, MUZAMMIL ANJUM, RAB NAWAZ, SHAFI ULLAH, HIRA SALEEM, KHURRAM SHAHZAD 253

8.17 DETECTION OF MICRO-FUNGI FROM DIFFERENT TYPES OF SOIL ORIGINATED WATER SAMPLES OF DISTRICT BHIMBER AZAD KASHMIR, PAKISTAN 254

TANVEER HUSSAIN*[1], MUHAMMAD ISHTIAQ[1], MUHAMMAD AJAIB[1], HUMMA FAROOQ[1] 254

8.18 RESPONSES OF FUNGAL STRESSES AND CLIMATIC IMPACT ON GROWTH AND YIELD OF CICER ARIETINUM IN DISTRICT BHIMBER, AZAD KASHMIR 255

TANVEER HUSSAIN*[1], MUHAMMAD ISHTIAQ[1], MUHAMMAD AJAIB[1], RAWISH SIKANDER[1], TARIQ SAIFF ULLAH[2] 255

8.19 PROSPECTS FOR MAKING BIOORGANIC FERTILIZER FOR SUSTAINABLE AGRICULTURE IN PAKISTAN AMIDST CLIMATE CHANGE 256

NOSHIN ILYAS*[1] 256

B: ABSTRACTS FOR ORAL PRESENTATION

9 SOIL MICROBIOLOGY 258

9.1 INTERACTION OF PLANT GROWTH PROMOTING REGULATORS AND NUTRIENT FORMULATION ON GROWTH AND YIELD OF CHILIES 259

MUHAMMAD UMAR[1], WAQAS MAHMOOD*[1], KASHIUF ASIF[1], UZMA AMBREEN[1], HAFIZ NAEEM ASGHAR[1], ZAHIR AHMAD ZAHIR[1] 259

9.2 SYNERGISTIC EFFECT OF SILICON AND RHIZOBACTERIA FOR IMPROVING GROWTH, SALINITY TOLERANCE AND ANTIOXIDANT STATUS OF ONION 260

WAJEEHA ATTIQ[1]*, MOHAMMAD AWAIS[1]*, QURATULAIN TAYYAB[1], RABIA AFZAL[1], QASIM ALI[1], MAQSHOOF AHMAD[1] 260

9.3 EFFECT OF CO-INOCULATION WITH *RHIZOBIUM* AND PLANT GROWTH PROMOTING RHIZOBACTERIA ALONG WITH BIOGAS SLURRY ON GROWTH AND YIELD OF MUNG BEAN (*VIGNA RADIATA* L.) 261

SABA MALIK[1*], MUHAMMAD JAVED AKHTAR[1] 261

9.4 EXPLORATION OF SOIL MYCODIVERSITY AND ORGANIC COMPOUNDS FROM DIFFERENT SOIL SAMPLES COLLECTED FROM DISTRICT BHIMBER AZAD KASHMIR PAKISTAN 262

TANVEER HUSSAIN*[1], AROOSA AZEEM[1], SABA BASHARAT[1] 262

9.5 ROLE OF MICROBIAL DECOMPOSERS ON COMPOSTING OF SOME INVASIVE WEEDS 263

TAUSEEF TABASSAM[1*], TAUSEEQ HAIDER[2], ALI RAZA GURMANI[2], TARIQ SULTAN1, MAZHAR RAFIQUE[2], SAIR SARWA[1] 263

9.6 INTERACTIVE EFFECT OF BIOCHAR, ORGANIC AMENDMENT AND MICROPLASTICS ON CARBON MINERALIZATION AND ENZYME ACTIVITIES IN SOIL 264

ALISHBA ASLAM[1*], MUHAMMAD FAROOQ QAYYUM[1] 264

9.7 ROLE OF BACTERIAL INOCULATION ON GROWTH OF BRINJAL PLANT IN LEAD CONTAMINATED SOIL 265

UZMA AMBREEN*[1], AMINA ZIA[2], HAFIZ NAEEM ASGHAR[1], ZAHIR AHMAD ZAHIR[1], FAHAD RASOOL[3] 265

9.8 INTERACTIVE ROLE OF DROUGHT TOLERANT RHIZOBACTERIA AND PRESSMUD FOR IMPROVING GROWTH AND YIELD OF TOMATO UNDER SKIPPED IRRIGATION 266

MUHAMMAD SULEMAN AMJAD[1], FATIMA SIDDIQA[1], HAFIZ NAEEM ASGHAR[1], ZAHIR AHMAD ZAHIR[1] 266

9.9 INTERACTION OF SULFUR WITH BIOFERTILIZER/BIOHERBICIDE TO IMPROVE THE YIELD OF WHEAT (*TRITICUM AESTIVUM* L.) 267

ZAHOOR MUJDDED CHOUDARY[1], ESHA MUJTABA[1], ZAHIR AHMAD ZAHIR[1], MUHAMMAD ADNAN SHAHID[2], HAFIZ NAEEM ASGHAR[1] 267

9.10 EXPLORING THE POTENTIAL OF FAST-FOOD WASTE AS CO-SUBSTRATE IN ANAEROBIC DIGESTION FOR METHANE PRODUCTION 268

IMAN FATIMA[*], MUZAMMIL ANJUM 268

9.11 HARNESSING THE POTENTIAL OF FUNGI TO DEGRADE INDUSTRIAL WASTEWATER SLUDGE INTO MICROBIAL BIODIESEL 269

BUSHRA NOOR*[1], MUZAMMIL ANJUM[1], WAQAR UN NISA[2], AZEEM KHALID[1], SAMIA QADEER[3] 269

9.12 EFFECT OF PLANT GROWTH PROMOTING RHIZOBACTERIA (PGPR) FOR ENHANCING PLANT GROWTH AND YIELD OF CHILI (*CAPSICUM ANNUUM* L.) CROP 270

SOHAIL[*1], MUHAMMAD SALEEM SARKI[1], QURBAN ALI PANHWAR[2] AND AMANAT ALI[2], ALLAH WADHAYO GANDAHI[1] 270

9.13 EFFECT OF EXOGENOUS APPLICATION OF SALICYLIC ACID ON THE GROWTH OF *BRASSICA OLERACEA L.* UNDER LEAD STRESS 271

ANEELA KOUSAR[1]*, FARHEEN NAZLI[1], GHULAM HASSAN ABBASI[1], QASIM ALI[2], MUHAMAD HAMZA[2] 271

9.14 ENHANCING PHOSPHORUS USE EFFICIENCY OF WHEAT BY APPLYING POLYMER COATED PHOSPHATIC FERTILIZERS 272

Zain Mushtaq[1*], Maria Hashmi[2], Salwa Saeed[1] 272

9.15 EVALUATING THE EFFECT OF PHOSPHORUS SOLUBILIZING BACTERIA AND ORGANIC AMENDMENTS ON QUINOA TO REDUCE THE DISPROPORTIONATE USE OF CHEMICAL FERTILIZERS INDUCING ENVIRONMENTAL POLLUTION 273

Tayyaba Samreen[1]*, Samia Arshad[1], Sidra Tahir[1], Faraz Anjum[1], Muhammad Zulqernain Nazir[1], Muhammad Ahmad[1] 273

9.16 VARIOUS LEAVE COMPOST ROLE IN ENHANCING SOIL PHYSIOCHEMICAL PROPERTIES, SOIL CONSERVATION AND CROP PRODUCTIVITY 274

Mueen Akram*[1], Muhammad Murtaza[2], Abdul Basit[2,3], Aisha Alam[2], Ahtasham Khan[1], Shamsa Bibi[1], Kashifa Shabeer[2], Muhammad Hammad[4], Muhammad Khalid[4] 274

9.17 PLANT GROWTH-PROMOTING BACTERIA AS SUSTAINABLE ALLIES IN ALLEVIATING DROUGHT STRESS FOR MUNG BEANS 275

Hafsa Maqsood[1], Rimsha Sharif[1], Najma Majeed[1], Tehreem Fatima[1], Muhammad Noman Sheeraz[1], Muhammad Arif[1], Muhammad Ahmad Mahmood[1], Muhammad Baqir Hussain[1] 275

9.18 RESPONSE OF GARLIC CULTIVARS TO APPLIED BIOCHAR AND PLANT GROWTH PROMOTING RHIZOBACTERIA (PGPR) UNDER SALINE-SODIC CONDITIONS 276

Muhammad Arslan Asir[1], Muhammad Usman Jamshaid*[1], Tanveer Ul Haq[1], Khuram Mubeen[3], Ahmad Mahmood[2], Hafiz Shahzad Ahmad[1], Javed Iqbal[1], Ahsan Qureshi[1] 276

9.19 MAXIMIZING MAIZE (*ZEA MAYS*) GROWTH AND SOIL HEALTH: HARNESSING THE POWER OF AUXIN (IAA) 277

Muhammad Hamza Khalil[1*], Muhammad Naveed[1], Munazza Rafique[2], Ahmed Hassan[1] Muhammad Farhan Qadir[3], Muhammad Sabir[1], Ameer Hamza[1] 277

9.20 ABUNDANCE AND DIVERSITY OF EARTHWORM (ANNELIDA) IN SUBDIVISION RAWALAKOT AZAD JAMMU KASHMIR 278

Nasir Rahim, Samia Shabbir, Majid Mahmood Tahir, Afshan Majeed and Aqsa Kanqal 278

9.21 ENVIRONMENTAL SUSTAINABILITY THROUGH ADVANCED PHOTOCATALYSIS: BLACK TiO_2 SYNTHESIS FOR EFFICIENT TREATMENT OF POULTRY FEED MANUFACTURING WASTEWATER 279

Amna khursid Nawaz*[1], Sajida Parveen[1], Muzammil Anjum[1] 279

10 SOIL FERTILITY 280

10.1 STRATEGIC MAPPING OF SOYBEAN CULTIVATION ZONES IN SUBTROPICAL DESERT CLIMATES THROUGH GEOSPATIAL TECHNIQUES 281

Noman Ahmad[1], Hamaad Raza Ahmad[1*], Muhammad Ashar Ayub[2], Ayesha Siddique[1], Tariq Aziz[3] 281

10.2 POTENTIAL OF SILICON IN ENHANCING YIELD AND GRAIN QUALITY OF RICE UNDER WATER STRESS 282

Amina Kalsom*[1], Abdul kareem[2], Ana Aslam[1], Ifra saleem[1], Qudsia Nazir[1], Nisa Mukhtar[1], Raheela Naz[1], M. Arfan-ul-Haq[1], Muhammad Arif[1] and Muhammad Nasim[1] 282

10.3 IMPACT OF BAND PLACEMENT OF PHOSPHATE FERTILIZER ON PHOSPHORUS ACQUISITION AND YIELD OF WHEAT IN CALCAREOUS SOIL 283

Ana Aslam[1*], Ifra Saleem[1], Amina Kalsom[1], Raheela Naz[1], Muhammad Arfan ul Haq[1], Muhammad Arif[1], Muhammad Nasim[1] and Sarfraz Hussain[2] 283

10.4 APPRAISAL OF PECAN NUT COMPOSITION USING VARIOUS PHYSICO-CHEMICAL AND NUTRITIONAL FUNCTIONS 284

Muhammad Qasim[1,2,3*], Naseem Akhtar[2], Tayyaba Naz[1,3], Maryam Safdar[2], Maham Naeem[1,3], Muhammad Umair[1,3], Muhammad Mazhar Iqbal[4], Iqra Ghafoor[1,3] and Muhammad Anwar-ul-Haq[1,3] 284

10.5 EXTRACTION AND CHARACTERIZATION OF HUMIC AND FLUVIC ACIDS FROM ORGANIC SOURCES: AN INNOVATIVE WASTE MANAGEMENT STRATEGY 285

Siraj Ahmed Baloch[1,2*], Ghuam Murtaza Jamro[1], Inayatullah Rajpar[1], Javed Ahmed Shah[3] 285

10.6 EVALUATING NUTRIENTS USE EFFICIENCY, GROWTH, AND YIELD OF WHEAT THROUGH THE APPLICATION OF COMMERCIAL VALUE-ADDED FERTILIZER 286

Mansoor Ali Shah[1*], Ghulam Murtaza Jamro[1], Khalid Hussain Talpur[1], Syed Shahid Hussain Shah[2], Muhammad Umair Mubark[2], Inayatullah Rajpar[1], Pir Ahmed Naqi Shah[3], Aftab Ali Chohan[1] 286

10.7 SELECTION OF POTENTIAL RICE (O*RYZA SATIVA* L.) GENOTYPES FOR ZINC-BIO-FORTIFICATION USING DIFFERENT AGRONOMIC STRATEGIES 287

Ghulam Murtaza Kaleri[1], Rabia Asma Memon[1], Saeed Akhtar Abro[1] and *Nizamuddin Depar[2] 287

10.8 EVALUATING THE EFFECT OF SILICON AND BIOCHAR ON THE GROWTH, PHYSIOLOGICAL AND BIOCHEMICAL ATTRIBUTES AND Cd ACCUMULATION IN BRASSICA UNDER WATER DEFICIT STRESS 288

Iqra Ghafoor[1,2*], Tayyaba Naz[1,2], Muhammad Mazhar Iqbal[3], Shah Nawaz[4], Muhammad Anwar-ul-Haq[1,2], Tayyaba Akhtar[1], Naqshe Zuhra[1], Muhammad Umair[1,2], Muhammad Qasim[1,2], Maham Naeem[1,2] 288

10.9 RESIDUAL EFFECT OF GREEN MANURING AND SOIL ZINC APPLICATION ON GRAIN ACCUMULATION OF CADMIUM AND ZINC IN WHEAT GROWN ON CADMIUM-CONTAMINATED SOIL 289

Raza Abbas*[1], Muhammad Intissam Rana[1], Shahid Hussain[1], Ammara Basit[1] 289

10.10 NITRATE UPTAKE IN MUSTARD, SPINACH, AND CARROT IRRIGATED WITH WASTEWATER 290

Tayyaba Akhtar*[1], M. Aamer Maqsood,[1], Naqshe Zuhra,[1]Tariq Aziz,[2] M. Zia-ur-Rehman,[1]Hamaad Raza Ahmad[1], Iqra Ghafoor,[1] Muhammad Rizwan Yasin,[1] Ayesha Chaudhary[1] 290

10.11 MAIZE YIELD AND FOOD SECURITY ENHANCEMENT BY DAIRY MANURE-AMENDMENTS 291

Naqshe Zuhra*[1], Muhammad Aamer Maqsood[1], Tariq Aziz[2], Muhamamd Rizwan Yasin[1], M. Zia ur Rehman[1], Hamaad Raza Ahmad[1], Abdul Qadeer[1], Tayyaba Akhtar[1], Dua Waheed[1], Riyan Ashraf[1] 291

10.12 UPTAKE, PARTITIONING, AND REMOBILIZATION OF CADMIUM AND ZINC IN STANDARD AND Zn-BIOFORTIFIED WHEAT CULTIVARS GROWN IN Cd-CONTAMINATED SOIL 292

Ayta Umar[1], Shahid Hussain*[1] 292

10.13 EVALUATING THE ROLE OF NUTRIENTS IN GRAIN BIOFORTIFICATION OF WHEAT TO MITIGATE THE NUTRITIONAL DEFICIENCY AND FOOD SECURITY UNDER CHANGING CLIMATE 293

Muhammad Ramzan[1], Sajid Hussain[*1, 2], Muhammad Zeshan Mansha[3], Sadia Afzal[1], Dilshad Hussain[1], Nabeel Arslan[1], Naseem Abbas[1] and Muhammad Sameed[1] 293

10.14 SELF-SUFFICIENCY OF OIL PRODUCTION THROUGH CANOLA PRODUCTIVITY WITH AUGMENTED SUPPLY OF INORGANIC FERTILIZER UNDER SEMI-ARID CONDITIONS 294

Kashif Raza[1], Sajid Hussain[*1,2], Muhammad Zeshan Mansha[3], Muhammad Usman[1], Muhammad Zubair[1], Muzamil Jawad[1], Muhammad Aatif[1], Muhammad Afaq[1], Yousra Kalsoom[1] and Danial Akhtar[1] 294

10.15 CONVERTING DESTROYED DEPLETED SOILS TO SUSTAINABLE HEALTHY SOILS THROUGH MANAGEMENT PRACTICES: HISTORY, FACTS & SOLUTIONS 295

Muhammad Atta ul Mustafa Awan[*1], Abid Subhani[2], Shahid Zia[2], Areeba Shoukat[2] and Farah Farooq[2] 295

10.16 BALANCED USE OF MICRO AND MACRONUTRIENTS IMPROVES CROP YIELD AND SUCROSE CONTENTS OF SUGARCANE 296

ABDUL MAJEED[1]*, MUHAMMAD ZAFAR[1], IMRAN RASHID[1], MUHAMMAD AKHLAQ MUDASSIR[1], MUHAMMAD SHAFIQUE[1], HAFIZ BASHIR AHMAD[1], MAHMOOD-UL-HASSAN[1], MUHAMMAD SHAHZAD AFZAL[1], ABDUL KHALIQ[1], NAEEM FIAZ[1], MUBASHRA YASIN[1], SALMA NIAZ[1], AND SYED SAQLAIN HUSSAIN SHAH[1] 296

10.17 IMPACT OF PLANT GROWTH PROMOTING RHIZOBACTERIA ON MICROBIAL ACTIVITIES IN RHIZOSPHERE AND BULK SOILS 297

ANAM NAZ[1*], HUSNAIN JAWAD[2], NAWAL CHAUDARY[1], MUHAMMAD RIZWAN[1], AHMAD MUJTABA[1], MUHAMMAD SANA ULLAH[1]* 297

10.18 IMPACT OF FARMYARD MANURE ON SOIL PHYSICAL PROPERTIES AND MAIZE GROWTH 298

OSAMA TANVEER[1*], MUHAMMAD IQBAL[1], LAIBA TAHIR[1] 298

10.19 NUTRIENT INDEXING OF MANGO ORCHARDS OF RAHIM YAR KHAN DISTRICT OF THE PUNJAB PROVINCE 299

NIAZ AHMED[1]*, MUHAMMAD ABID ALI KHAN[1], MUHAMMAD KASHIF[1], MUHAMMAD MUBASHIR[2], JAVED IQBAL[3], MUHAMMAD TARIQ MALIK[4] 299

10.20 GROWTH AND YIELD RESPONSE OF COTTON CROP TO FOLIAR APPLICATION OF NITROGEN AND SALICYLIC ACID 300

SHAHABUDIN[1], MOHAMMAD SALEEM SARKI[1], AMBRIN RAJPUT[1], ANILA MASTOI[1] 300

10.21 USE OF PGPR TO ENHANCE WHEAT PRODUCTIVITY AT DIFFERENT SOWING DATES UNDER CLIMATE-INDUCED HEAT STRESS 301

NAWAL CHAUDARY*[1], HUSNAIN JAWAD[2], ANAM NAZ[1], MUHAMMAD RIZWAN[1], ABDUL QADEER[1], MUHAMMAD SANA ULLAH[1] 301

10.22 NUTRIENT STATUS OF CITRUS AND GUAVA FRUITS GROWN IN ALKALINE CALCAREOUS SOILS OF PUNJAB 302

NISA MUKHTAR[1]*, IFRA SALEEM[1], QUDSIA NAZIR[1], AMINA KALSOM[1], ANA ASLAM[1], MUHAMMAD AFTAB[1], M. ARFAN UL HAQ[1], RAHEELA NAZ[1], FARAH RASHEED[1], MUHAMMAD ARIF[1], MUHAMMAD NASIM[1], SARFRAZ HUSSAIN[1] 302

10.23 OPTIMIZING BORON-TOLERANT BACTERIA AND PRESS MUD SYNERGIES FOR SUSTAINABLE CANOLA SEED PRODUCTION AND INCREASED CROP YIELDS 303

GHULAM FAREED[*1], TAYYABA SAMREEN[1], MUHAMMAD AFTAB AKRAM[1] 303

10.24 VERTICAL FARMING-SMART URBAN AGRICULTURE FOR ENHANCING RESILIENCE AND SUSTAINABILITY IN FOOD SECURITY 304

TAYYABA TANVEER[1]*, MEHWISH LIAQUAT[1]*, SHAFIQ UR REHMAN[2], MUHAMMAD TAHIR AKRAM[1], SARVET JEHAN[3], ALEENA KHALID[1], NAVEED UR REHMAN[1] 304

10.25 SUSTAINABLE PRACTICES: NURTURING SOIL HEALTH FOR ENHANCED FOOD SECURITY IN HORTICULTURE 305

ALEENA KHALID[1]*, MEHWISH LIAQUAT[1]*, SHAFIQ UR REHMAN[2], MUHAMMAD TAHIR AKRAM[1], TAYYABA TANVEER[1], SARVET JEHAN[3], MISBAH-UD-DIN AHMED[3], NAVEED UR REHMAN[1] 305

10.26 PROMOTING SUSTAINABLE AGRICULTURE THROUGH BIOFERTILIZER IMPLEMENTATION 306

MEHWISH LIAQUAT[1*], MUHAMMAD TAHIR AKRAM[1], ZAIN MUSHTAQ[2], SHAFIQ UR REHMAN[3], TANVEER HUSSAIN[1], SARVET JEHAN[4], SAKEENA TUL-AIN HAIDER[5] 306

10.27 AGRONOMIC FORTIFICATION OF WHEAT WITH ZINC NANO-PARTICLES TO IMPROVE GROWTH, YIELD AND PHYSIOLOGICAL CHARACTERISTICS UNDER ALKALINE CALCAREOUS CONDITIONS 307

FAISAL HAYAT[1] AND MUHAMMAD ASHRAF[1, 2*] 307

10.28 ENHANCING PHOSPHORUS USE EFFICIENCY AND PROFITABILITY FROM WHEAT THROUGH HUMIC ACID APPLICATION IN COMBINATION WITH ROCK PHOSPHATE AND SINGLE SUPER PHOSPHATE 308

IJAZ AMIN[1] AND DOST MUHAMMAD[1] 308

10.29 NURTURING SOIL HEALTH THROUGH SUSTAINABLE AGRICULTURE 309

FARHAT ULLAH[1], MUHAMMAD NOMAN[1], ABDULLAH SHAFI[1], HAMZA[1], RAHILA AKHTAR[1], UM-E-AIMAN[1], AHMAD MAHMOOD* 309

10.30 SOIL SOLUTION-P AND ITS CONCENTRATION IN PLANTS FROM SELECTED WHEAT FIELDS FOR YIELD AND TRAITS 310

TEHLEEM[1], MARIA MUSSARAT[1] AND DOST MUHAMMAD[1] 310

11 SOIL SALINITY 311

11.1 INTERACTION BETWEEN NACL AND CDCL2 DIFFERENTLY INFLUENCES NA AND CD UPTAKE BY WHEAT 312

SAJID MASOOD[1]*, M. ZAFAR UL HYE[1], AND QAISER HUSSAIN[2] 312

11.2 INVESTIGATING THE SYNERGISTIC APPLICATION OF ACIDIFIED CO-COMPOSTED BIOCHAR AND BACILLUS ENDOPHYTE FOR ENHANCING THE GROWTH AND YIELD OF SOYBEAN GROWN IN SALINE SODIC SOIL 313

MUHAMMAD UMAIR[1,2*], TAYYABA NAZ[1,2], MUHAMMAD NAVEED[1], FAIZ UL HASSAN[3], MUHAMMAD MAZHAR IQBAL[4], MUHAMMAD QASIM[1,2], FAZAL MAQSOOD[1,2], IQRA GHAFOOR[1,2], MAHAM NAEEM[1,2] 313

11.3 RESPONSE OF THREE EGGPLANT CULTIVARS TO COMBINED SALINITY AND SODICITY STRESS 314

MEHWISH SANAULLAH[1*], TANVEER UL HAQ[1], MUHAMMAD ARIF[1], M. HAIDER JAMAL[1], SAJEELA SEHAR[1], AYESHA ALI[1], MINAHIL ATHER[1], AND NAJMA MAJEED[1] 314

11.4 EFFECT OF HIGH RSC WATER ON PHYSICAL PROPERTIES OF SOIL UNDER RICE-MUSTARD ROTATION 315

MUHAMMAD FAISAL NAWAZ[1]*, KHALIL AHMED[1], MUHAMMAD QAISAR NAWAZ[1], MUHAMMAD ASHFAQ ANJUM[1], GHULAM QADIR[1], MUHAMMAD[1] AND MUHAMMAD RIZWAN[1] 315

11.5 EXAMINING THE EFFICACY OF SILICON IN MITIGATING SALINITY STRESS ON SOYBEAN PLANTS 316

BEENISH SHAKEEL[1*], MUHAMMAD ANWAR-UL-HAQ[1], MUHAMMAD SAQIB[1], REHMAN ALI[1] 316

11.6 EVALUATING PHYSIOLOGICAL AND BIOCHEMICAL RESPONSES OF COTTON (*GOSSYPIUM HIRSUTUM* L.) TO ORGANIC AMENDMENTS UNDER SALINITY STRESS 317

SYED MUHAMMAD MIZFAR GOHAR[1*], MUHAMMAD ANWAR-UL-HAQ[1], ALISHA[1], MUHAMMAD USAMA MUSTAFA [1], ANEELA RIAZ[1] , AMBER NAWAZ[1] , REHMAN ALI[1] 317

11.7 INVESTIGATING THE RESPONSE OF SOYBEAN (GLYCINE MAX) GENOTYPES AGAINST SALINITY STRESS 318

FAZAL MAQSOOD[1*], MUHAMMAD ANWAR-UL-HAQ[1], REHMAN ALI[1] AND MUHAMMAD UMAIR[1] 318

11.8 EVALUATION OF MILLET (*PENNISETUM GLAUCUM L.)* GENOTYPES AGAINST NACL STRESS 319

HAFIZ HUSSAIN ALI[1*], MUHAMMAD ANWAR-UL-HAQ[1], TAYYABA NAZ[1], AND USAMA MUSTFA[1] 319

11.9 PROSPECTS OF SALINE AGRICULTURE IN FOOD SECURITY UNDER CHANGING CLIMATE 320

Bhaveesh Chander[1], Fozia Naz Memon[2], Ravi Prakash[3], Muhammad Daniyal Ali Khan[3], Utam Chand[4]and Attiya Muneer[4] 320

11.10 EFFECT OF ORGANIC AMENDMENTS ON MAIZE (*ZEA MAYS* L.) GROWTH IRRIGATED WITH BRACKISH WATER 321

Saifullah[1*], Hamza Azam[1], Sadia Bibi[1], Sidrah Ashfaq and Muhammed Sabir[1] 321

11.11 IMPROVING YIELD PERFORMANCE OF WHEAT/MAIZE CROPPING SYSTEM UNDER HEAT, WATER AND SALT STRESSES 322

Muhammad Saad Bin Zafar[*1], Muhammad Saqib[1], Nauman Sattar[1], Noman Zahid[1], Qandil Shafiq[1], Nain Tara Mushtaq[1], Laraib Noor[1], Amina Abdul Rahim[1], Nain Tara Mushtaq[1], Samra Sattar[1], Ayesha Abid[1] and Zilyad Ul Hassan[1] 322

11.12 SULPHUR FERTILIZATION AND *ACIDITHIOBACILLUS THIOOXIDANS* IMPROVED SUNFLOWER GROWTH AND ACHENE YIELD UNDER SALINE AND SALINE SODIC CONDITIONS 323

Muhammad Ibrar[1]*, Ali Raza Gurmani[1], Ayaz Mehmood[1], Muhammad Jawwad[1], Mazhar Rafique[1], Rasheed Ahmed[1] Ghulam Jilani[2] and Zahoor Ahmed[1] 323

11.13 COMBINE APPLICATION OF BIOCHAR WITH GYPSUM, LIME, AND FARM MANURE TO ENHANCE THE RICE PLANT GROWTH BY IMPROVING CHEMICAL PROPERTIES OF SOIL 324

Talha Saleem[1], Muhammad Zia-ur-Rehman[1], Muhammad Anwar-ul-Haq[1], Muhammad Aamer Maqsood[1], Muhammad Usman[1], Abdullah Maqsood[1], Rubaz Ahmad[1], Ghulam Mohiuddin[1] 324

12 SOIL CHEMISTRY 325

12.1 STOICHIOMETRIC CHARACTERISTICS OF C, N, P AND S IN BENCHMARK SOIL SERIES UNDER DIFFERENT CROPPING SYSTEMS OF PUNJAB, PAKISTAN 326

Munazza Yousra*[1], Qaiser Hussain[2], Khalid Saifullah Khan[2], M. Mahmood-ul-Hassan[1], Sair Sarwar[1], Muhammad Zameer khan[1], Ahsan Ali Anwar[3], Sana Naeem[1] 326

12.2 EXPLORING THE EFFECT OF NANOPARTICULATE IRON OXIDE MINERALS ON CHROMIUM IMMOBILIZATION UNDER VARYING ENVIRONMENTAL CONDITIONS 327

Hamna Bashir[1], Nabeel Khan Niazi[1], Zulfiqar Ahamd Saqib[1], Khalid Hussain[2], Muhammad Mahroz Hussain[1,3,4] 327

12.3 ENVIRONMENTAL ASSESSMENT OF GROUNDWATER CONTAMINATION WITH TOXIC METALS AND MICROPLASTICS DUE TO LEACHATES AROUND WASTE DISPOSAL SITE IN FAISALABAD 328

Ghulam Murtaza[1], Hafsah Iqbal Meo[1], Muhammad Abdullah[1*], Misbah Abbas[1], Tajammal Hussain[1C] 328

12.4 Examining the Impact of Industrial Sewage Sludge and Municipal Compost Application on Soil Health in the Rice-Wheat Cropping System of Punjab, Pakistan 329

Umair Riaz[1]*, Ghulam Murtaza[2], Saifullah[2], Humera Aziz[3], Abid Hussain[1], Tanveer-ul-Haq[1] 329

12.5 WHEAT YIELD AS INFLUENCED BY VARIOUS APPLICATION METHODS AND DOSES OF PHOSPHORUS FERTILIZER UNDER ARID CONDITIONS 330

Hafiz Imran Iqbal[1]*, Matiullah Khan[1], Rizwan Ahmad[1], Shoaib Ahmad[1], Muhammad Mohsin Raza[1], Muhammad Arshad[2], Muhammad Ibrar Ahmad[3] 330

12.6 ZINC AVAILABILITY TO WHEAT AS EVALUATED BY DIFFERENT FRACTIONS OF ZINC IN SALINE-SODIC SOIL 331

Sadia Sultana[*1, 2], Ayesha Amin[1], Muhammad Sabir[1], Saifullah[1], Ghulam Murtaza[1], Sadia Bibi[1] 331

12.7 ROLE OF ALTERNATE WETTING AND DRYING ON ARSENIC BIOACCUMULATION BY RICE AND ASSOCIATED HEALTH RISK 332

Muhammad Mahroz Hussain[1,2,4]*, Hamna Bashir[1], Hamza Yousaf[1], Nabeel Khan Niazi[1], Irshad Bibi[1], Khalid Hussain[3] 332

12.8 INFLUENCE OF SULPHER (BENTONITE) ON THE GROWTH AND YIELD OF COTTON CROP 333

Naseer Ahmed Deho[1], Sohail Ahmed Qureshi[1], Fozia Naz Memon[1], Nazia Rais*[1], Nasir Ahemd Katyar[1], Masood Babar[1], Inzmam-ul-haq Khanzada[1] 333

12.9 PESTICIDE RESIDUES ANALYSIS OF MAIZE (*ZEA MAYS* L.) SAMPLES FROM SAHIWAL DISTRICT USING MASS SPECTROMETRY TECHNIQUES 334

Haseeb-Ur-Rehman[1*], Umair Riaz[1*], Abid Hussain[1], M. Asif Farooq[2], Abdullah Niaz[3], Rehman Gul[3], Muhammad Tariq[1], Qurrat-ul-Ain[1] 334

12.10 ADSORPTION POTENTIAL OF CASSIA FISTULA SEED ACTIVATED CARBON FOR THE TREATMENT OF LAUNDRY WASTEWATER 335

Hadia Tassadaq* 335

***12.11* MITIGATING DROUGHT STRESS THROUGH BIOCHAR AND GIBBERELLIC ACID IN RICE (*ORYZA SATIVA* L.) 336**

Imran Ullah[1], Muhammad Arif[1], Shakeel Ahmad[1], Kashif Razzaq[1], Ahmad Mahmood[1], Hafsa Maqsood[1], Dad Muhammad[1], Muhammad kamran[1], Gul Marjan[1] 336

12.12 NITROUS OXIDE EMISSION FROM SOIL UNDER MAIZE CROP AS INFLUNCED BY THE APPLICATION OF BIOCHAR AND NITRIFICATION INHIBITORS COATED UREA 337

Aamir Khan[1]*, Muhammad Akmal[1], Khalid Saifullah Khan[1], Ghulam Qadir[1] 337

13 SOIL PHYSICS 338

13.1 SOIL QUALITY INDICATORS AND GROWTH OF MUNGBEAN AS INFLUENCED BY APPLICATION OF COMPOST AND DAIRY MANURE 339

Muhammad Iqbal*[1], Areeba Fatima[1], Tooba Mumtaz[1], Liaba Tahir[1], Mussawar Abbas[1] 339

13.2 REGENERATIVE WATERSHED MANAGEMENT STRATEGIES: A RESILIENCE TO CLIMATE CHANGE FOR SUSTAINABLE AGRICULTURE IN RAINFED AREA OF PAKISTAN 340

Obaid-ur Rehman[1]*, Riffat Bibi[1], Safia Naureen Malik[1] and Majid Rahim 340

13.3 ASSESSMENT OF COMPARATIVE EROSION OF DIFFERENT SOIL ORGANIC CARBON FRACTIONS UNDER CONVENTIONAL AND CONSERVATION PRACTICES AND SUBSEQUENT CHANGES IN SOIL QUALITY, AND CROP YIELD 341

Mah-Noor Azad*[1], Shahzada Sohail Ijaz[1], Khalid Saifullah Khan[1], Muhammad Ansar[2], Nighat Musa[1] 341

13.4 EVALUATING THE IMPACT OF SOIL AMENDMENTS ON RAINWATER RUNOFF, SEDIMENT AND NUTRIENT LOSS UNDER DIFFERENT SLOPE GRADIENTS 342

Ayesha Malik[*1], Obaid-ur-Rehman[2], Rahina Kausar[1], M. Usman Mohsin[1] and Muhammad Rashid[3] 342

13.5 SIMULATION-BASED ASSESSMENT OF THE IMPACT OF CONSERVATION TILLAGE AND STRIP INTERCROPPING ON SOIL MICROBIAL BIOMASS CARBON 343

Sana ur Rehman*[1,2], Shahzada Sohail Ijaz[1], Muhammad Ali Raza[2], Imran Haider[2], Zafar Iqbal[2] 343

13.6 THE URGENCY OF SOIL CONSERVATION FOR SUSTAINABLE FUTURE 344

Inaba Hawraa*[1], Muhammad Tahir Akram[1], Muhammad Azam Khan[1], Mehwish Liaquat[1] 344

13.7 RICE QUALITY AND GROWTH INDEX UNDER DIFFERENT COMPOST LEVELS USING SEWAGE SLUDGE 345

Hifza Jabbar*[1], Muhammad Iqbal[1], Laiba Tahir[1], Tooba Mumtaz[1], Mussawar Abbas[1] 345

13.8 STRAW MANAGEMENT WITH POTASSIUM FERTILIZATION INFLUENCES ORGANIC C POOLS, AGGREGATE-ASSOCIATE C, AND WATER-STABLE AGGREGATES IN RICE-RAPE CROPPING SYSTEM 346

Kashif Ali Kubar*[1,2], Li Huang[1]*, Bin Xue[1], Xiaokun Li[1], Jianwei Lu[1], Qambar Baloch[2] 346

13.9 RICE CROP RESIDUE MANAGEMENT EFFECT ON SOIL HYDROLOGY AND WHEAT YIELD IN RICE-WHEAT CROPPING SYSTEM 347

Rukhsana Parveen Jamro*[1], Ijaz Ali[2], Ghulam Murtaza Jamro[1] 347

14 POLLUTION AND REMEDIATION 348

14.1 ARSENIC AND ZINC ACCUMULATIONS IN ZINC-BIOFORTIFIED WHEAT UNDER ARSENIC-CONTAMINATED IRRIGATION AND VARIOUS ZINC APPLICATION METHODS 349

Ammara Basit*[1], Shahid Hussain[1] 349

14.2 EFFECT OF Fe-Mg BIMETALLIC BIOCHAR ON REMEDIATION OF MULTI-METAL CONTAMINATED SOIL AND THE REDUCTION OF METAL TOXICITY IN SPINACH (*SPINACIA OLERACEA* L.) 350

Muhammad Kashif Irshad[1, 2], Jong Cheol Lee[2], Muhammad Aqeel[3], Wasim Javed[4], Ali Noman[5], Ali El-Naggar[6], Muhammad Ibrahim[1], Hun Ho Lee[2], Nabeel Khan Niazi[7], Sang Soo Lee[2] 350

14.3 SOIL HEAVY METALS CONCENTRATION AND HEALTH RISK ASSESSMENT IN PERI-URBAN AREAS OF GUJRANWALA, PAKISTAN 351

Matiullah Khan[1], Shoaib Ahmad[1], Rizwan Ahmad[1], Muhammad Mohsin Raza[1], Hafiz Imran Iqbal[1] 351

14.4 MICROPLASTICS IN SOIL: UNRAVELING IMPACTS ON SOIL HEALTH AND ENVIRONMENTAL QUALITY 352

Maha Saleem*[1], Neha Naqi[1], Hamna Iftikhar[1], Muhammad Adeel Akram[1], Ahmad Mahmood[1], Shakeel Ahmad[1] 352

14.5 DIFFERENTIAL INFLUENCE OF ZINC AND COPPER CONTAMINATED SIMULATED WASTEWATER ON GROWTH AND MINERAL QUALITY OF LETTUCE 353

Sanaullah[1], Dovile Motiejauskaite[1], Karolina Barcauskaite[1] 353

14.6 HARNESSING BIOCHAR FOR SUSTAINABLE AGRICULTURE: A NOVEL APPROACH TO MITIGATE SMOG FROM RICE STRAW 354

Sajeela Sehar[1], Muhammad Arif[1], Mehwish Sana Ullah[1], Ayesha Ali[1], Najma Majeed[1], Minahil Athar[1], Nauman Hanif[1], Ahmad Mahmood[1] 354

14.7 IMPACT OF MICROPLASTICS ON SOIL PHYSIOCHEMICAL AND BIOLOGICAL PROPERTIES 355

Muhammad Nauman Hanif[1*], Tanveer-ul-Haq[1], Najma Majeed[1], Ayesha Ali[1], Muhammad Naeem Akhtar[2], Minahil Ather[1], Sajeela Sehar[1] 355

14.8 COMPARISON OF DIFFERENT VARIETIES OF MAIZE FOR HYPER ACCUMULATION AND TOLERANCE OF LEAD (Pb) 356

Ifra Saleem*[1], Qudsia Nazir[1], Nisa Mukhtar[1], Muhammad Nasim[1], Muhammad Aftab[1], Amina Kalsom[1], Farah Rasheed[1], Raheela Naz, Sarfraz Hussain[1] 356

14.9 MONITORING LAND DEGRADATION HOTSPOTS FOR MITIGATING SMOG IN PUNJAB USING MODERN GEOSPATIAL TECHNIQUES 357

Muhammad Danish Majeed[1*], Sultan Ahmad Rizvi[1], Obaid-ur-Rehman[1], Muhammad Adnan Shahid[3,4], Waqas Naseem[1], Sikandar Ali[3,4], Muhammad Usman Mohsin[2], Muhammad Safdar[3,4], Hifza Mariam[5] 357

14.10 UPTAKE OF CADMIUM AND LEAD BY WHEAT (*TRITICUM AESTIVUM*) IN RESPONSE TO BIOCHAR IN DIFFERENT GROWING MEDIUM 358

Muhammad Moinudin[1], Muhammad Ahmar Amin[1], Muhammad Farooq Qayyum[1*] 358

14.11 COMPARATIVE EFFECTIVENESS OF ORGANIC AMENDMENTS FOR REDUCING LEAD (PB) UPTAKE AND IMPROVING GROWTH AND YIELD OF LETTUCE (*LACTUCA SATIVA*) 359

Maham Naeem[1,2*], Tayyaba Naz[1,2], Muhammad Saqib[1,2], Muhammad Anwar-ul-Haq[1,2], Muhammad Qasim[1,2], Muhammad Mazhar Iqbal[3], Iqra Ghafoor[1,2], Muhammad Umair[1,2] 359

14.12 MICROEMULSION PRODUCTION AND FATTY ACIDS CHARACTERIZATION USING (*SERRATIA LIQUEFACIENS*) OLEAGINOUS STRAIN AS BIOREFINERY 360

Hira Abid*[1], Sobia Jabeen[1], Wajiha Naz[1], Syeda Aliza Naqvi[1], Irrum Shahzadi[1] 360

14.13 METHYLENE BLUE DYE ADSORPTION FROM TEXTILE WASTEWATER USING MODIFIED TEA WASTE ACTIVATED CARBON 361

Nayyab Nadeem*[1], Aniqa Batool[1] 361

14.14 HEAVY METAL LOADS IN CANAL WATER AND WASTEWATER OF MULTAN CITY 362

Waleed Ramzan*, Ammara Basit, Shahid Hussain 362

14.15 EFFECT OF COMPOST AND VERMICOMPOST ON GROWTH AND YIELD OF CHILI (*CAPSICUM ANNUUM* L.) 363

Saqib Bashir[1], Ayesha Siraj[2], Allah Bakhsh Gulshan[2], Saadullah Khan[2], Safdar Bashir[1] 363

14.16 COMPARATIVE EFFECT OF ORGANIC AND INORGANIC AMENDMENTS ON GROWTH AND PB UPTAKE OF SPINACH (*SPINACIA OLERACEA*) GROWN IN PB CONTAMINATED SOIL 364

Aqsa Rashid[1,2*], Tayyaba Naz[1,2], Zulfiqar Ahmad Saqib[1,2], Aysha Kiran[4], Maha Rashid[5], Muhammad Mazhar Iqbal[3], Iqra Ghafoor[1,2] 364

14.17 SUSTAINABLE AGRICULTURE: NAVIGATING CLIMATE CHANGE THROUGH SOIL REFORMING STRATEGIES 365

Rabeel Fatima[1]*, Muhammad Tahir Akram[1], Mehwish Liaquat[1] 365

14.18 CARBON POOLS IN SURFACE AND SUBSURFACE SOIL LAYERS IN AN AGROECOSYSTEM IN RESPONSE TO POULTRY MANURE AND ITS BIOCHAR 366

Umm-e-Aiman fiaz[1] and Tanvir Shahzad[1] 366

14.19 MICROPLASTIC POLLUTION: AN EMERGING CHALLENGE TO SOIL HEALTH AND AGRICULTURE SUSTAINABILITY 367

Ahsan Qureshi[1], Shakeel Ahmad[1*], Muhammad Arslan Asir[1], Muhammad Sulaiman[1], Mohammad Wasim[1], Muhammad Yasir[1] 367

14.20 EVALUATION OF NITRATE CONTENTS AND ASSOCIATED ENVIRONMENTAL ISSUES IN ENERGY DRINKS AVAILABLE AND CONSUMED IN PAKISTAN 368

Sadia Bibi[1*], Sana Saud[1], Saifullah[1], Muhammed Sabir[1], Sidrah Ashfaq[2] 368

14.21 SALINITY AND WATER STRESS INTERACTION IN *ACACIA AMPLICEPS* 369

Qandil Shafiq[1], Muhammad Saqib*[1], Muhammad Saad Bin Zafar[1], Tayyaba Naz[1], Muhammad Nauman Sattar[1], Noman Zahid[1], Amina Abdul Rahim[1], Nain Tara Mushtaq[1], Samra Sattar[1], Aysha Abid[1], Laraib Noor[1] 369

14.22 ENHANCING CLIMATE-SMART AGRICULTURE AND GLOBAL FOOD SECURITY THROUGH EFFECTIVE SOILMANAGEMENT 370

Rahila Akhtar[1], Umme Aiman[1], Abdullah Shafi[1], Farhat Ullah Amar Matloob[1], Ahmad Mahmood*[1] 370

14.23 ASSESSING MICROPLASTIC CONTAMINATION AWARENESS AND KNOWLEDGE: A COMPARATIVE STUDY BETWEEN URBAN HEALTH PROFESSIONALS AND RURAL FARMERS IN PENANG, MALAYSIA 371

Vanitha Thurairasu*[1] 371

15 OTHERS 372

15.1 PROSPECTS OF HYDROGEL TO IMPROVE WHEAT YIELD IN RAINFED AGRICULTURE 373

Rahina Kausar[1*], Obaid-ur-Rehman[2], Ayesha Malik[1], M. Usman Mohsin[1] and Muhammad Rashid[3] 373

15.2 COMPARATIVE EVALUATION OF BIOGAS ENRICHMENT BY USING DIFFERENT TECHNIQUES 374

Muhammad Usman Mohsin[*1], Obaid-ur-Rehman[2], Rahina Kausar[1], Ayesha Malik[1] and Muhammad Danish Majeed[2] 374

15.3 ADVANCING SOIL HEALTH MANAGEMENT THROUGH GIS AND REMOTE SENSING: A SUSTAINABLE APPROACH 375

Najma Majeed[1], Muhammad Imran[1], Sajeela Sehar[1], Minahil Ather[1], Ayesha Ali[1], Mehwish Sana-ullah[1], Muhammad Sulaiman[1], Muhammad Nauman Hanif[1], Ahmad Mahmood*[1], Tanveer ul Haq[1] 375

15.4 SOIL HEALTH IN A CHANGING CLIMATE: CHALLENGES AND MITIGATION STRATEGIES FOR SUSTAINABLE AGRICULTURE 376

Ayesha Ali[1], Shakeel Ahmad[1*], Minahil Athar[1], Sajeela Sehar[1], Najma Majeed[1], Muhammad Nauman Hanif[1], Mehwish Sana Ullah[1], Ahsan Qureshi[1], Ahmad Mahmood[1] 376

15.5 SOIL-ROOTSTOCK INTERACTION- AN IMPORTANT PHENOMENON THAT DETERMINES THE ABOVE-GROUND TREE PERFORMANCE 377

Naeem Akhtar[*1], Ghulam Muhammad[1], Danish Majeed[1] and Obaid ur Rehman[1] 377

15.6 SUSTAINABLE MANAGEMENT OF AGRICULTURAL BYPRODUCTS: A STRATEGIC APPROACH TO BOLSTER FOOD SECURITY AND MITIGATE CLIMATE CHANGE 378

Minahil Athar[1], Usman Jamshaid[1], Ayesha Ali[1], Najma Majeed[1], Sajeela Sehar[1], Mehwish Sana Ullah[1], Muhammad Noman Hanif[1], Ahmad Mahmood[1] 378

15.7 BIODEGRADATION OF AN EMERGING MICROPOLLUTANT, DICLOFENAC FROM WASTEWATER 379

Farzana Kausar[1] and Irrum Shahzadi*[1] 379

15.8 SUBSTRATE MODIFICATION FOR OPTIMAL PRODUCTION OF BIODIESEL BY OLEAGINOUS *SERRATIA* SP. 380

Sobia Jabeen[*1], Wajiha Naz[1], Hira Abid[2], Syeda Fatima Zainab[3], Irrum Shahzadi[4] 380

15.9 ASSESSMENT OF HEAVY METALS IN COMMON POLLINATORS IN URBAN & PERI-URBAN AREAS 381

Syeda Aliza Naqvi*[1], Sobia Jabeen[1], Wajiha Naz[2], Hira Abid[3], Irrum Shahzadi[4] 381

15.10 BIOELECTRICITY GENERATION BY BACTERIAL DEGRADATION OF FRUIT PEEL WASTES IN DUAL CHAMBER MICROBIAL FUEL CELL 382

Wajiha Naz*[1], Sobia Jabeen[1], Hira abid[2], Syeda Aliza Naqvi[1] 382

15.11 EVALUATION OF OXYGEN EVOLUTION REACTION (OER) AND HYDROGEN EVOLUTION REACTION (HER) IN ELECTROCATALYTIC TREATMENT OF CONTAMINATED WASTEWATER 383

Sajida Perveen*, Irrum shahzadi[1], Syeda Fatima Zainab[2], Muzammil Anjum 383

15.12 OPTIMIZING PECAN-BASED ACTIVATED CARBON ADSORPTION THROUGH RESPONSE SURFACE METHODOLOGY FOR ENHANCED WASTEWATER TREATMENT AND ITS IMPACT ON PEA PLANT GROWTH 384

Konain Khurshid*[1], Muzammil Anjum[1], Rab Nawaz[2] 384

15.13 EFFICIENT REMOVAL OF DIBUTYL PHTHALATE FROM WATER USING SINGLE-LAYERED AND COMPOSITE ELECTROCATALYTIC ELECTRODES DEVELOPED FROM (CO, FE, MN) OXIDES AND HYDROGEN PRODUCTION 385

Shafi Ullah*[1], Rab Nawaz[2], Muzammil Anjum[1], Sammia Khurshid[1], Azeem Khalid[1], Shahid Mahmood[1], Rai Muhammad Amir[3] 385

15.14 UTILIZATION OF BENZOPHENONE CONTAMINATED WASTEWATER AS SUBSTRATE FOR MICROALAGE TO PRODUCE BIOLIPIDS 386

Fatima Zainab*[1], Sobia Jabeen[1], Wajiha Naz[1], Hira Abid[1], Syeda Aliza Naqvi[1], Irrum Shahzadi[1] 386

15.15 CONFERRING DROUGHT STRESS TOLERANCE IN MUNG BEAN THROUGH MICROBES: A SUSTAINABLE SOLUTION FOR CLIMATE CHANGE 387

Hafsa Maqsood[1], Rimsha Sharif[1], Najma Majeed[1], Tehreem Fatima[1], Muhammad Noman Sheeraz[1], Muhammad Arif[1], Muhammad Ahmad Mahmood[1] 387

15.16 PROSPECTS OF BIOCHAR USE IN AGRICULTURE FOR FOOD SECURITY AND ENVIRONMENTAL SUSTAINABILITY 388

Utam Chand[1], Tanveer Ul haq[1], Muhammad Talha Zubair[1], Syed Bayazeed[1], Mustafa Kamal[1], Attiya Muneer[1], Fizza Batool[1], Hafiz Shahzed Ahmad [1], Najma Majeed[1]and Ayesha Ali[1] 388

15.17 IMPACT OF SOIL EROSION ON AGRICULTURAL SUSTAINABILITY AND FOOD PRODUCTION 389

Attiya Muneer[1], Muhammad Arif[1], Syeda Rahab Zahra Bukhari[1], Fizza batool[1], Utam Chand[1], Minhal Naveed[1], Iqra zahoor[1], Aliha yaqub[1]and Amna rafique[1] 389

15.18 EVALUATING INCIDENCE OF ARSENIC CONTAMINATION IN GROUNDWATER USING GIS AND GEOSTATISTICAL NORMS IN MULTAN 390

Shah Rukh[1]*, Ahmad Khan[2], Ayaz Mehmood[3], Muhammad Imran[4], Humair Ahmed[5], Kouser Majeed Malik[6] 390

15.19 GREEN BUILDINGS AS A SOLUTION TO CHANGING CLIMATE; A PERSPECTIVE FOR PAKISTAN ... 391

Haseeba Bibi[1], Muqarrab Ali[1], Muhammad Imran[1], Ahmad Mahmood*[1], Amar Matloob[1] and Tanveer ul Haq[1] 391

15.20 ASSESSMENT OF SOIL CHARACTERISTICS IN THE VICINITY LANDS OF KHAUR OIL FIELD, ATTOCK, PUNJAB 392

Tehreem Nawaz[1]*, Aniqa Batool[1], Muzammil Anjum[1], Zia ur Rehman Mashwani[1] 392

15.21 COMPARATIVE EFFECTIVENESS OF BIOCHAR AND COMPOST IN AMELIORATING DROUGHT STRESS IN *FICUS CARICA* L. 393

Sehrish Saboor Khan[1], Mazhar Rafique[1], Ali Raza Gurmani[1], Bushra Gul[2], Zahoor Ahmad[1] 393

15.22 EFFECT OF FARMYARD MANURE ON SOIL MOISTURE CONTENT GROWTH AND CHEMICAL COMPOSITION OF CHILLI (*CAPSICUM ANNUUM* L.) 394

Maqsood Ahmed Soomro[1], Khalid Hussain Talpur[1], Ghulam Murtaza Jamro[1], Niaz Hussain Wahocho[2], Rabania Janat[1]* 394

15.23 LEAF AND PSEUDOSTEM RATIOS ON BANANA WASTE COMPOST EFFECT ON COMPOST QUALITY AND THEIR RESPONSE TO GROWTH AND CHEMICAL COMPOSITION OF MAIZE 395

ATTAULLAH ANSARI[1], GHULAM MURTAZA JAMRO[1], ZIA UL HASSAN SHAH[1], AHMED NAQI SHAH[2], DURSHANA KHAN KHANZADA[1], ZAHIDA JUNEJO[1*] 395

15.24 EFFECT OF NITRAPYRIN COATED UREA ON NITROGEN USE EFFICIENCY IN MAIZE 396

ATIYA RAJPUT[1], GHULAM MURTAZA JAMRO[1], JAVAID AHMED SHAH[2], DURSHANA KHAN KHANZADA[1], ATTAULLAH ANSARI[1] AND HINA PANHWAR[*1] 396

15.25 PLASTIC DEGRADATION POTENTIAL OF BACTERIAL STRAINS RETRIEVED FROM SOIL 397

MAHRUKH SAEED GILLANI[1*], SUNDAS INAYAT ALFRED[1], RIZWANA KOUSAR[1], ZAINAB SYED[1], SADIA LATIF[1*] 397

“Soil Health: A Key to Food Security”

20th INTERNATIONAL CONGRESS OF SOIL SCIENCE

20-22 February 2024, Rawalpindi, Pakistan

ORAL PRESENTATIONS

"Soil Health: A Key to Food Security"

20th INTERNATIONAL CONGRESS OF SOIL SCIENCE

20-22 February 2024, Rawalpindi, Pakistan

SOIL SCIENCE SOCIETY OF PAKISTAN -SSSP-

INVITED TALKS

SOIL HEALTH FOR FOOD SECURITY: WHERE DO WE STAND TO FEED THE ESCALATING POPULATION IN THE FACE OF CLIMATE CHANGE?

Shabbir Ahmad Shahid*[1] Majda Khalil Suleiman[1]

[1]Desert Agriculture and Ecosystems Program, Environment and Life Sciences Research Center, Kuwait Institute for Scientific Research PO Box 24885 Safat 13109 Kuwait

*Email: sshahid@kisr.edu.kw

ABSTRACT

The planet Earth was evolved nearly 4.54 billion years ago and the life on Earth could be mapped to 3,800 million years ago. In the Solar system, the Earth is the only planet to have an atmosphere containing free oxygen, oceans of liquid water on its surface, and, of course, life. Since the evolution of Earth and until the year 1971, the Earth used to provide surplus resources to live on sustainably. In the year 1971, human demand exceeded the capacity of Earth to provide resources. This shows that the Earth resources start shrinking rapidly and now the human needs 1.73 Earth planets to live on, and there is no virtual planet to import, and this suggests that the business as usual will lead us when we will require more than two Earth planets to meet our demand for food and eco-services for the current and escalating population estimated at 10.9 billion by 2100, which was 0.6 billion in 1700. This shows that the human demand on nature is unsustainable and increasing, confirming that by taking more from our ecosystems and natural processes than can be replenished, we are jeopardizing our and new generations future. For example, in 2023, we consumed 100% Earth resources by 2 August 2023, after this resources were overexploited to meet our demand, thus putting more pressure leading to marginalize the resources. This means that humanity is demanding more than the earth can provide. Currently, globally there is 1.1 global hectare eco-resources deficit per capita per year. In this context, the achievement of UN-FAO, SDG 2 (End hunger by 2030) is questionable. Globally, i) 33% per cent of soils are degraded, ii) soil erosion is causing 60% crop yield loss, iii) soil salinization is causing 27.3 billion $ annual loss due to decreased crop yields (20% irrigated lands are salinized), iv) IPCC scenario confirms crops yield to be declined over 75% by 2100, v) 1/3rd loss of food produced, vi) increase in urbanization and, vii) impact of climate change (rising temperature, low rainfall and subsequent decrease in aquifer recharge, increased drought etc), all are considered significant threats to food security. This is alarming situation, and the question is where do we stand currently to cope all the above impacts and what potential strategies we must adopt to mitigate the impacts to sustain our life with respect to improving soil health for food security and provision of ecosystem services in the broader context? On the positive side, the UN-FAO believes that sustainable soil management can lead to 58% increase in crop yield. Therefore, there is great challenge for us to adopt climate resilient soil management practices that enhance soil quality while producing the food, along with achieving land degradation neutrality. In this key note, innovative ideas with respect to improvement of soil health and crops intensification will be shared, as well as how the research in soil sector can be innovated in terms of long time suitability of soil health for crop production as well as biological innovations in changing the crops characters for another green revolution as a potential for crops intensification, and to set the future agenda for agriculture research to meet the food demand of escalating population.

Keywords: *Climate, innovation, human demand, escalating population, food security*

PLANT PHENOTYPING: ANALYSIS OF PLANT PHYSIOLOGICAL STATUS

Mauro Centritto*1

[1]Institute for Sustainable Plant Protection, National Research Council of Italy, Florence, Italy

*Email: mauro.centritto@cnr.it

ABSTRACT

Plant physiological status is the interaction of the plant genome and the prevailing growth conditions. Accurate characterization of plant physiology is therefore fundamental to effective plant phenotyping studies; particularly those focused on identifying traits associated with improved yield, lower input requirements, and climate resilience. Here, it is outlined the approaches used to assess plant physiology and how these techniques of direct empirical observations of processes such as photosynthesis, stomatal conductance, and the effectiveness of protective energy dissipation mechanisms are unsuited to high throughput phenotyping applications. Novel optical sensors, remote / proximal sensing (multi- and hyperspectral reflectance, infrared thermography, sun-induced fluorescence), LiDAR, and automated analyses of below-ground development offer the possibility to infer plant physiological status and growth. However, there are limitations to such 'indirect' approaches to gauging plant physiology. These methodologies appropriate to the rapid high temporal screening of a number of crop varieties over a wide spatial scale do still require 'calibration' or 'validation' with direct empirical measurement of plant physiological status. The use of deep-learning and artificial intelligence approaches may enable the effective synthesis of large multivariate datasets to more accurately quantify physiological characters rapidly in high numbers of replicate plants. Advances in automated data-collection and subsequent data-processing represent an opportunity for plant phenotyping efforts to fully integrate fundamental physiological data into vital efforts to ensure food and agro-economic sustainability.

Keywords: *Plant physiology, climate, LiDAR, AI*

IN-SITU FARM WASTE MANAGEMENT FOR SOIL HEALTH: IS IT SOIL BIOLOGY, AND/OR SOIL MICROBIOLOGY ONLY?

Muhammad Tahir Rashid[1*]

[1]EnviroLead, Calgary, Canada

*Email: tahir.rashid@envirolead.ca

ABSTRACT

Soil Health is the sustainable capacity of soil to function as a vital living system, recognizing that soil contains biological elements that are key to ecosystem functioning within land-use and an ecosystem boundary. There is a tendency to believe in an ideal microbial composition to be used for In-situ farm waste management because its effects are often observed quickly (petri dish and pot experiments). Soil health does not rotate only around biology as majority of soil microbiologists believe from a professional and/or financial perspective. There is always great benefit in the active collaboration of multiple disciplines to investigate Soil Health. We need to integrate soil chemical, physical and biological factors to investigate it. There is also a need to change research premises attitude to question what we and our colleagues are doing, or not doing, because of our disciplinary focus. An integrated strategy for In-Situ farm waste management for soil health will be presented including: I) Introduction to soil biological classification and where to focus, II) Myths and misconceptions in soil microbiology, III) Is it soil biology and/or soil microbiology depended only, and iv) an integrated strategy for in-situ farm waste management for soil health.

Keywords: *In-situ, farm waste management, integrated strategy*

ANAEROBIC BIOGEOCHEMICAL PROCESSES TO MITIGATE GREENHOUSE GAS EMISSIONS AND RECLAIM OIL SANDS MINING WASTES

Tariq Siddique*[1]

[1]Canada Faculty of Agricultural, Life and Environmental Sci–Renewable Resources Dept, University of Alberta

*Email: tariqs@ualberta.ca

ABSTRACT

Alberta's oil sands make up ~80% of Canada's total oil production and contribute ~10% to Canada's total greenhouse gas (GHG) emissions. The recovery of bitumen, for the production of synthetic crude oil, from surface mined oil sands generates huge volumes of fluid fine tailings (FFT) comprising water, sand, silt, clay, unrecovered bitumen, and residual diluent hydrocarbons. More than 1.2 billion m 3 of FFT have been deposited in ponds, covering an area of ~270 km 2 in Alberta, pending reclamation. Labile hydrocarbons in FFT produce methane (CH 4) in tailings ponds and end-pit lakes (EPL). Establishment of EPL is considered a suitable approach to reclaim FFT, however, CH 4 production has been implicated in preventing EPL progression into a viable aquatic system. This talk provides insights into anaerobic biogeochemical processes that help (1) understand emissions of GHG from tailings ponds and EPL, (2) investigate chemical flux in EPL affecting water quality, (3) consolidate FFT for effective reclamation, and (4) strategize redox processes to mitigate GHG emissions from tailings ponds and EPL.

Keywords: *Anaerobic, biogeochemical process, GHGs, sand mining*

HYDROTHERMAL TREATMENT OF FOOD WASTE DIGESTATE SOLID

Mi Yan*[1], Feng Chen[1], Yayong Yang[1]

[1]Institute of Energy and Power Engineering, College of Mechanical Engineering, Zhejiang University of Technology, Hangzhou, 310014, China

*Email: yanmi1985@zjut.edu.cn

ABSTRACT

Food waste digestate solid (FWDS) is the by-product of anaerobic digestion and it contains high moisture. Hydrothermal carbonization (HTC) and Supercritical water gasification (SCWG) have the ability to convert wet bio-waste to hydrochar and syngas, which are a potential technologies for handling FWDS. This study investigates the effect of reaction temperature and residence time on solid and liquid products from HTC and SCWG process of FWDS. The results showed that temperature had significant effect on hydrochar and syngas properties. The higher heating value of hydrochar was 15.46 MJ/kg and the yield was 49%, under reaction conditions of 260°C and 60 min. The Lower heating value of syngas was 11.2 MJ/Nm^3 under reaction conditions of 500°C and 40 min. The hydrochar generated at higher temperature had a more stable combustion, higher ignition temperature, higher burnout temperature. The syngas produced by the high-temperature reaction has a higher H_2 fraction and a higher gasification efficiency. Up to 67% (HTC) and 80% (SCWG) of nitrogen in solid feedstock emigrated from to liquid product, while phosphorus was mainly remained in the solid phase (>90%), which mainly existed in the form of apatite. FWDS were obtained from a food waste treatment plant in Hangzhou, China. HTC and SCWG experiments were conducted in a 500 mL Hastelloy batch reactor. Firstly, 120 g undried FWDS (with the moisture content of 83.35%) and 120 mL deionized water were mixed and placed in the reactor which was sealed afterwards. The reactor was then heated to the set temperature at a ramp rate of 10 °C/min and held at the target temperature for the predetermined period of time, then cooling the reactor to room temperature rapidly. The hydrochar samples was denoted as "x+y", in which x and y represent reaction temperature (220°C, 240°C, 260°C) and residence time (30 min, 45 min, 60 min) in HTC experiments, respectively. In SCWG experiments, x and y represent reaction temperature (400°C, 450°C, 500°C) and residence time (20 min, 40 min), respectively.

The results suggested that HTC temperature had significant effect on the yield of hydrochar, residence time had slight effect. The increase in HTC reaction temperature is beneficial for enhancing Ti and Tb. However, 260+45 produced the maximum Tb in the study at 601°C. The stability of compounds in the formation of hydrochar at 260+60 is related to lower Tb. The (dw/dt) mean of hydrochar decreased, indicating longer combustion periods. The combustibility index (S) of hydrochar was lower compared to FWDS, and with the increase of temperature from 220°C to 260°C, the S showed a decreasing trend. Previous studies on HTC of maize silage digestate has shown a trend of increasing temperature and decreasing S.

The liquid phase is rich in pollutants such as COD, TOC, NH_4^+-N, and TN. The increasing reaction temperature degraded COD and TOC, while other compounds in the liquid phase, such as phenolic compounds, nitrogen-containing heterocyclic compounds, organic acids, etc., are products of lignocellulose degradation. In HTC, nitrogen mainly migrates towards the liquid phase, up to 67%,

while phosphorus is mainly distributed in the solid phase. Syngas; H_2, CO, CO_2 and CH_4 are the main syngas products. Within the temperature increasing from 400℃ to 500℃, the total syngas yield rose from 2.4 mol/kg to 9.0 mol/kg at 20 minutes and from 3.5 mol/kg to 9.7 mol/kg at 40 minutes, respectively.

The proportion of carbon in the solid phase decreases from 55% to 38%, which decreases by 17%. The carbon content in the liquid presents the same trend, with a decrease of 12% from 26% to 14%. Nitrogen in the liquid from SCWG at 400℃ was 66%/69%, and it increased to 80% at 500℃. On the other hand, the proportion of N in the solid decreased from 18% at 400℃ to 14% at 500℃. Prolongation of residence time, the residual proteins and amino acids in FWDS will further decompose, resulting in the increase of N-containing compounds concentration in liquid phase. The results of N distribution were consistent with the results of the previous study of FWDS treated by SCWG. After SCWG, phosphorus is mainly distributed in the solid and liquid phases, and its main form is solid. The total solid phosphorus in the solid phase increased with the increase of temperature, and the phosphorus in the solid phase was mainly inorganic phosphorus, and with the increase of temperature and reaction time, organic phosphorus was gradually converted to inorganic phosphorus. The addition of food waste to FWDS could improve the heating value of hydrochar and syngas.

Hydrochar yield significantly decreased to 49.3% at 260+60, while residence time had a minor effect compared with temperature, and The HHV of hydrochar reach up to 15.46 MJ/kg. The hydrochar produced from higher temperature HTC had higher ignition temperature and stable combustion characteristics. However, the intensification of HTC can lead to a decrease in the combustion index S. The pollutants in liquid phase decreased significantly with HTC temperature increasing. The main organic matter in the liquid phase is containing nitrogen heterocycles and phenols, which is highly risk for environment pollution. In SCWG, higher temperature promoted the increase of syngas production and H_2 fraction, the migration of carbon from solid phase to liquid phase and gas phase, the migration of nitrogen to liquid phase, and the enrichment of phosphorus in solid phase.

Keywords: *Food waste, digestate, hydrothermal carbonization, hydrochar*

ENVIRONMENTAL DEGRADATION AND LIVELIHOOD SECURITY IN SOMALIA" A CASE STUDY OF AFGOYE DISTRICT

Hassan Warsame Nor[*1]

[1]Benadir University, Mogadishu, Somalia

*Email: hassanwnur58@gmail.com

ABSTRACT

This study examined the effects of environmental degradation (ED) on livelihood insecurity in Somalia with particular reference to Afgoye District. It focused the main causes and consequences on the livelihood insecurities on households (HHs). The study further appraised the responses of the government and other stakeholders towards curbing the effects of ED. A descriptive survey design was adopted to establish ED and its effect on livelihood security. Factual characteristics that compose the ED and livelihood security were qualitatively and quantitatively examined. The study sample was 398 derived from Afgoye population of 79,400. The study findings revealed, ED in Afgoye district is caused by various factors that has various consequences on livelihood security. These include, deforestation of OR (95%CI) of 3.12 (1.32-4.76, making 3.12 times more likely to cause ED. Similarly, it explored inappropriate farming practices OR (95%CI) of 2.22 (0.92-4.42) leads to ED statistically associated with livelihood insecurity with 2.22 times more to impact the livelihood security. Droughts of OR (95%CI) of 3.36 (1.32-4.76) is 3.36 times more likely to impair ED. Floods OR (95%CI) of 2.13 (1.25-4.35) are damaging significantly livelihood. The study found the livelihood insecurity of Afgoye will increase 98% at every increase in ED and vice versa. The study recommended effective ED policies and practices, enhancing the livelihood security of the HHs in Afgoye district.

Keywords: *Environmental degradation, livelihood, deforestation*

EVALUATING PROBABILITY OF EROSION AND FORECASTING SOIL EROSION RATES IN SOMALIA

Abdunnasir Abdullahi Mohamed*[1], Hassan Warsame No[1]

[1]Department of Soil Science and Plant Nutrition, Faculty of Agriculture, Benadir University, Mogadishu, Somalia

*Email: abdinaasir30@gmail.com

ABSTRACT

Soil erosion is a significant environmental issue in many parts of the world, affecting agricultural productivity as well as natural ecosystems. Soil erosion exacerbates food insecurity and land degradation concerns in Somalia, a country already dealing with a slew of socioeconomic issues. The goal of this study is to assess erosion risk and predict soil losses in Somalia, which will provide valuable insights for sustainable land management and resource planning. Using remote sensing data, geographic information system (GIS) techniques, and hydrological modeling, the study investigates erosion risk factors and their spatial distribution across the country. In order to pinpoint erosion-prone areas and hotspots, topographical information, soil properties, land use and land cover data, rainfall patterns, and vegetation indices are all used. In order to calibrate and validate the predictive models, which increases their accuracy and dependability, historical erosion data is also examined. The results of this study indicate that significant areas of Somalia are susceptible to erosion-caused soil losses. The most vulnerable areas are identified, allowing stakeholders to prioritize and allocate resources for soil conservation and erosion control efforts. Furthermore, the study emphasizes the role of human activity in exacerbating erosion risk, such as deforestation, poor agricultural practices, and overgrazing. The predictive models developed in this study provide useful resources for predicting soil losses under various scenarios, taking into account climate variability, land use changes, and mitigation strategies. Such forecasting abilities are critical for guiding policy decisions and implementing efficient erosion management techniques that can improve agricultural productivity, preserve ecosystems, and promote environmental sustainability across Somalia. In conclusion, a thorough understanding of the dynamics of erosion in the region is provided by the evaluation of erosion risk and the forecasting of soil losses in Somalia. In order to preserve and strengthen Somalia's natural resources and agricultural resilience, this research helps policymakers, land managers, and stakeholders develop focused, fact-based strategies for soil conservation and sustainable land use.

Keywords: *Erosion, soil loss models, SLEMSA, RUSLE, CORINE,*

MICROPLASTICS CONTAMINATION IN MANGROVE SEDIMENT: A CASE STUDY OF POLLUTION UPTAKE BY SELECTED ANIMALS

Fauziah S.H.*, Priya M., Furumai H., Kahoko N., Yeoh Wei Wang, Chiang Han Teck

[1]Institute of Biological Sciences, Faculty of Science, Universiti Malaya, Kuala Lumpur, Malaysia
[2]Chuo University, Tokyo, Japan

*Email: fauziahsh@um.edu.my

ABSTRACT

This paper elaborates on the extension of marine microplastics pollution by determining the abundance, physical characteristics, and relationship between tidal zones and microplastics uptake by selected animals in a mangrove ecosystem. For this purpose, a mangrove area located at Port Klang, a busy sea-port in West Malaysia was selected. The sediments from different tidal zone and selected animals namely hermit crabs (Geosesarma sp.) and mudskippers (Periophthalmodon schlosseri) were collected and analyzed. Microplastics extraction were conducted via density separation and filtration, followed with a visual classification into fiber, pellet, film, and fragment. Results showed that microplastics were significantly more abundant in sediment samples (1011.06 ± 117.36 particles/kg) than in seawater samples (18.23 ± 2.67 particles/L), which was more uniformly distributed in seawater samples across all tidelines. Between the two species, Geosesarma sp. accumulated higher microplastics in the tissue at 1.00 particles/g probably influenced by the feeding behavior of the crab. The results inferred that coastal microplastics pollution in Port Klang is more affected by marine deposition than terrestrial sources, which poses high risk of contamination due to bioaccumulation to the marine fauna. Thus, urgent mitigation measures are highly critical in order to significant reduce the Microplastics contamination at Port Klang.

Keywords: *Mangrove, microplastics, pollution, crabs, mudskippers*

WASHED RICE WATER AS A FERTILIZER RESOURCE FOR SUSTAINABLE AGRICULTURE: EXPERIMENTAL FINDINGS AND FUTURE PROSPECTS

Christopher Teh Boon Sung[1*] and Abba Nabayi[2]

[1] Faculty of Agriculture, Uni. Putra Malaysia
[2] Faculty of Agriculture, Federal Uni. Dutse, Nigeria

*Email: chris@upm.edu.my

ABSTRACT

This presentation summarizes the key findings from four experiments that evaluated the efficacy of Washed Rice Water (WRW) as a sustainable fertilizer. This study aimed to provide scientific validation for the use of WRW, which is traditionally discarded after rice washing, to enhance agricultural productivity while contributing to sustainable water management. The first experiment investigated the impact of the rice washing intensity, water-to-rice ratio (W:R), and fermentation period (FP) on the nutrient composition and microbial content of WRW. The results indicate that the concentrations of key nutrients, such as nitrogen, sulfur, and potassium, increased with higher W:R ratios and longer fermentation periods. Notably, the nitrogen content increased significantly with a W:R ratio of 3:1 and FP of 6 d. Beneficial nitrogen-fixing and phosphorus- and potassium-solubilizing bacteria were also detected, with optimal bacterial populations observed at a W:R ratio of 3:1 and FP of 3 d. In the second experiment, we focused on the effects of WRW fermentation on the nutrient levels and microbial dynamics. Fermentation for 3 days resulted in a 46.9–83.3% increase in nitrogen fixation and a 48.2–84.1% enhancement in phosphorus and potassium solubilization. Beneficial bacterial strains, such as Bacillus velezensis and Pantoea agglomerans, were identified, with notable increases in indole acetic acid production, which are crucial for plant growth. The third study assessed the continuous application of unfermented and 3-day fermented WRW to different soil types under rain shelter conditions. Application of fermented WRW led to a 5–61% increase in plant growth parameters, such as leaf weight and area, compared to the control treatments. Additionally, this treatment resulted in a significant increase in soil nutrient levels, particularly in clay soil, with increments of 19–152% for nutrients such as ammonium, phosphorus, and magnesium. The final experiment extended the application of WRW to open field conditions and compared its effectiveness with that of NPK fertilizer. The combination of half-rate NPK and 3-day fermented WRW (N0.5R3) showed superior results in plant growth and nutrient uptake. N0.5R3 increased plant biomass by over 40% compared to the conventional treatments, with enhanced nutrient absorption, especially for nitrogen, phosphorus, and potassium. These studies collectively demonstrated the viability of WRW as an alternative fertilizer. These findings highlight its potential in improving plant growth, nutrient uptake, and soil health, with specific benefits observed in terms of increased nutrient content, beneficial microbial activity, and enhanced water use efficiency. This research advocates the integration of WRW in sustainable agricultural practices, particularly as a measure to optimize water resource management and reduce environmental impact.

MICROPLASTICS UPTAKE BY FRESHWATER FISH FROM WATER AND SEDIMENTS OF MALAYSIA RIVERS

Siti Suhaila Harith[1*], Fauziah Shahul Hamid[2], Zainun Abdullah[1], Nurul Faqihah Mohd Zidin[1], Nurun Najwa Fatini Mohd Zulkefli[1]

[1]Faculty of Applied Sciences, Universiti Teknologi MARA Cawangan Pahang, 26400 Bandar Tun Abdul Razak Jengka, Pahang, Malaysia
[2]Institute of Biological Sciences, Faculty of Science, Universiti Malaya, 50603 Kuala Lumpur

*Email: ssuhaila@pahang.uitm.edu.my

ABSTRACT

The extensive utilisation of plastics has sparked significant apprehension regarding the contamination of microplastics (MPs), particularly in aquatic habitats. The objective of this study is to ascertain the constituting elements of MPs in samples of sediment and surface water, and how it accumulates in selected freshwater fish specimens collected from rivers in Malaysia. The samples consisted of 30 cultivated individuals of *Pangasianodon hypophthalmus* and *Oreochromis niloticus*, from Jelai River and Tembeling River, while from Kelantan River, wild *Anabas testudineus* were obtained. Sediments, surface water, and fish samples were subjected to digestion, density separation, and filtration to extract the MPs. The particles were examined, enumerated, and categorised according to their form and colour. Sediment samples have lower MPs concentrations, ranging from 2% to 7%, while water surface samples have the lowest concentrations, ranging from 1% to 2%. Most fish samples collected from all the rivers take in MPs, with concentrations ranging from 90% to 97%. *Pangasianodon hypophthalmus* contains a total of 956 microplastics (MPs), *Oreochromis niloticus* contains 684 MPs, and *Anabas testudineus* contains 454 MPs. Most of these MPs in all three fish species are in the form of fibres, ranging from 86% to 91%. While MPs in soil and water surface exist in fragmented form. Most MPs in the fish samples are black. Additionally, blue, red, and brown MPs were also detected. The analysis utilising Fourier transform infrared spectroscopy indicated that the polymer of the black MPs is polyethylene. This study indicates that rivers are contaminated with MPs, that MPs were present in all examined fishes, regardless of whether they are wild or farmed. Thus, this call for urgent need for appropriate mitigating measure to curb further contamination into the freshwater food chain.

Keyword: *Microplastics, River, Fish*

ANALYSIS OF BIOCHAR IN THE NEMORAL CLIMATIC ZONE: APPLICATIONS OF MINERAL NITROGEN FERTILIZERS FOR IMPROVING SOIL SUSTAINABILITY AND CROP PRODUCTION

Muhammad Ayaz [1,2*], Urooj Jamil [3], Edita Baltrėnaitė-Gedienė [4]

1Development of Bioeconomy Research Centre for Excellence, Vytautas Magnus University, Lithuani
2Institute of Agriculture, Lithuanian Research Centre for Agriculture and Forestry, Lithuania
3Department of Biotechnology, Comsat University, Pakistan
4Institute of Environmental Protection Vilniaus Gedimino technikos universitetas, Lithuania

*Email: muhammad.ayaz@vdu.lt

ABSTRACT

Agricultural waste poses a significant threat to climate change because it contributes significantly to greenhouse gas (GHG) emissions when not managed properly. Utilizing Biochar generated from swine-digestate-manure in temperate climates could provide a sustainable method to waste management and GHG emission reduction. The purpose of this study was to investigate the possibility of such biochar in lowering soil GHG emissions. Experiments included applying 25 t ha^{-1} of swine-digestate-manure-derived biochar (B1) to spring barley (Hordeum vulgare L.) in 2020 and pea crops in 2021, combined with nitrogen fertilizers at rates of 120 kg ha^{-1} (N1) and 160 kg ha^{-1} (N2) of synthetic nitrogen fertilizer (ammonium nitrate). Comparisons were done between control treatments (no intervention) and treatments that did not use biochar. Carbon dioxide (CO_2), nitrous oxide (N_2O), and methane (CH_4) emissions were measured directly utilizing static chamber technology. In comparison to untreated soils, both biochar alone and in conjunction with nitrogen fertilizers dramatically reduced GHG emissions. Cumulative emissions and global warming potential (GWP) were significantly reduced in biochar-treated soils. The study also looked into the effect of soil and environmental conditions on GHG emissions, and discovered a link between moisture, temperature, and GHG emissions. So, biochar generated from swine digestate manure appears to be a viable organic supplement for efficiently mitigating GHG emissions and tackling the issues faced by climate change in agricultural contexts.

Keywords: *Biochar; CO_2; N_2O; CH_4 emissions; cumulative emissions; global warming potential; soil moisture; soil temperature*

SEED FILM CULTIVATION TECHNOLOGY FOR CONSERVING WATER AND FERTILIZER IN HARSH AGRICULTURAL ENVIRONMENT OF UNITED ARAB EMIRATES

Khalil Ur Rahman[1], Mohamed Khalifa Bin Thaleth[1], Kaiyrkul Shalpykov[2], and Sungjin Choe[3]

[1]Al Nakhli Sector, The Private Office of Ruler of Dubai, UAE
[2]Instutue of Chemistry and Phytotechnologies of National Academy of Sciences of Kyrgyz Republic, 267 Chui Avenue, Bishkek, 720071
[3]G and S Corporation

*Email: khalil.rahman@alnakhli.ae

ABSTRACT

The United Arab Emirates (UAE), situated in south-east of the Arabian Peninsula and adjacent to Arabian Gulf, is committed to self-sufficiency in food (especially staple foods), feed and forages. Its climate is arid, with harsh and dry summers, and salinity is a major environmental stress, reducing crop productivity. In UAE, agriculture uses two-thirds of its water resources, which are not renewable. The forage grasses singly use 50% of the agriculture sector's water requirement and, thus, are responsible for much of the environmental damage and groundwater mining. High rates of agricultural water use are jeopardizing the UAE's strategic groundwater reserves. With increasing pressure on the limited water resources in the UAE, high water consuming irrigation systems need to be replaced by water-efficient application techniques. In this scenario, sustainable agricultural production is attempted using processes and systems which are non-polluting, conserve non-renewable energy and natural resources, are economically efficient, and do not compromise the needs of future generations. Overall goal of the reported R&D is to sustain crop productivity by introducing seed film cultivation technology which is a dry-soil direct seeding method employing a seed-attached biodegradable film, watered by drip tape irrigation under the film. The Seed film cultivation is implemented with the seed-attacher which attaches seeds to a biodegradable film to produce a seed film, and a mulcher which mulches the seed film on farmland and installs a drip tape irrigation hose at the same time. The Seed film cultivation not only helps to maintain temperature retention, uniform miniaturization, less plant competition and reduced weeding effect by film mulching but also enable high crop productivity while suppressing waste of water and fertilizer. The ultimate objective of this promising R&D is to implement the research-based technology for nutrient and water conservation for optimizing crop productivities under prevailing field conditions of UAE.

Keywords: *Seed film cultivation, Salinity, Water saving*

INFLUENCE OF MONSOON ON MICROPLASTIC POLLUTION IN MANGROVE SEDIMENTS: A MALAYSIAN CASE STUDY

Priya Mohan [1], Fauziah Shahul Hamid [1,2*], Zeeda Fatimah Mohamad [2,3], and Agamuthu Pariatamby[4]

[1]Institute of Biological Sciences, Faculty of Science, Universiti Malaya, 50603 Kuala Lumpur, Malaysia
[2]Center for Research in Waste Management, Faculty of Science, Universiti Malaya, 50603 Kuala Lumpur, Malaysia
[3]Department of Science & Technology Studies, Faculty of Science, Universiti Malaya, 50603 Kuala Lumpur, Malaysia
[4]Jeffrey Sachs Center on Sustainable Development, Sunway University, 47500 Selangor, Malaysia

*Email: fauziahsh@um.edu.my

ABSTRACT

The vulnerable mangrove ecosystem in Malaysia is increasingly threatened by widespread microplastic pollution. Regrettably, there has been a lack of comprehensive studies on the microplastic pollution in the Malaysian context. Therefore, the objective of this research is to examine the presence, distribution, and characteristics of microplastics in the sediment of Matang, Kuala Selangor, Sedeli Besar, and Cherating mangroves during the southwest and northeast monsoon seasons. Mangrove sediment was collected using an auger at a depth of 1-10cm. The microplastics in sediments were isolated through vacuum filtration and meticulously analyzed under a dissecting microscope to categorize them based on size, shape, and colour. Additionally, μFTIR was used to identify the polymer type of the microplastics. Microplastic concentration in sediment of Matang, Kuala Selangor, Sedeli Besar, and Cherating during the southwest and northeast seasons were 25.5 ± 4 particles/kg and 27.7 ± 1.65 particles/kg, 13.3 ± 1.41 particles/kg and 10 ± 1.17 particles/kg, 18.8 ± 0.23 particles/kg and 10 ± 0.71 particles/kg, and 6.67 ± 0.94 particles/kg and 18.89 ± 0.36 particles/kg, respectively. Microplastics with a size less than 0.1mm was detected in all sediment samples from the selected sites for both seasons. The most dominant microplastics are fragment-shapes, while the most dominant colour was blue. Results from this research showed a positive correlation (r=0.75) between microplastic concentrations in sediment during both the southwest and northeast monsoon seasons. Overall, microplastic abundance was higher during the northeast monsoon, with the east coast mangroves (Matang and Kuala Selangor) showed the highest levels of microplastic contamination. These findings contribute valuable data on the prevalence of microplastics in specific mangrove areas in Malaysia, serving as a pivotal reference point for understanding the distribution of microplastics within the ecosystem.

Keywords: *Mangrove, monsoon, microplastic, sediments*

IMPORTANCE OF COLD FALLOW SEASON MANAGEMENT TO ENHANCE SOIL ORGANIC CARBON STOCK IN TEMPERATE PADDY SOIL

Muhammad Israr Khan[1,2], Rubab Sarfraz[2], Gil Won Kim[1,2], Pil Joo Kim[1,2]

[1]Division of Applied Life Science (BK 21+ Program), Gyeongsang National University, Jinju, 660-701, South Korea
[2]Institute of Agriculture and Life Sciences, Gyeongsang National University, Jinju, 660-701, South Korea

ABSTRACT

In temperate rice paddy fields, mono-rice is cultivated under the flooding for less than the 120 days during the warm season, and thereafter, the soil is maintained under the dried upland conditions for more than 220 days during the cold fallow season. In this region, most of the rice straw is removed for livestock feeding and is not recycled into the soil under conventional management practices. Continuous removal of rice straw under conventional practices could rapidly deplete the soil organic carbon (SOC) stock which could severely compromise the soil sustainability and productivity. However, the seasonal variation of soil C balance has not been evaluated so far in temperate mono-rice paddy soil. To investigate the SOC stock changes in mono-rice paddy soils and to develop soil management strategies to enhance SOC stock, two seasonal C balances were investigated during the rice cropping season and the cold fallow season and were compared by the net ecosystem carbon budget (NECB) analysis under the conventional management (no fertilizer and straw removal for fallow season; chemical fertilization for rice cultivation) for three years. Furthermore, to increase the soil SOC stock, barley and hairy vetch cover crops were sowed at the seed recommendation rates (barley, 180 kg ha-1; hairy vetch, 90 kg ha-1) during the cold fallow season and its biomasses were incorporated into the soil before rice cultivation. At first, the influence of cover cropping and its biomass incorporation on total carbon input was evaluated. Secondly, the effect of its biomass application on mineralized C losses and SOC stock was investigated. Finally, the influence of cover cropping and its biomass application on improving soil quality was assessed by characterizing the soil microbial community structure. The conventional management practices significantly depleted the SOC because of low C input and higher C mineralization. The net primary production (NPP) of rice plants were the main C input source while the NPP of weeds and chemical fertilizer were negligible. The harvest removal and mineralized C loss covered around 67 and 33 % of the total C output, however, almost 94 % of the mineralized C loss occurred through CO2 emission during the cold fallow season. The changes in SOC stock were determined by the NECB formula, which is defined as the difference between the total carbon input and output, during the cold fallow and rice cropping season. The annual NECB showed negative value for NECB under conventional practices, mainly because of low C input and higher mineralized C loss during the cold fallow season. Cover cropping, and its biomass incorporation increased the soil C balance (NECB) over the conventional NPK, but it also has increased the mineralized C losses by 140-170 %, which were covered by 70-75 and 25-30 % of CO2 and CH4, respectively. Conclusively, the conventional management with only chemical fertilization and rice straw removal practices could deplete the SOC, because of low C input and high mineralized C loss during the cold fallow season. Cover cropping, and its biomass

incorporation was very effective soil management to increase the soil C stock by approximately 180 and 360 % for hairy vetch and barley, respectively in temperate mono-rice paddy soil. Furthermore, cover cropping, and its biomass incorporation also improved significantly the soil microbial activity, which is an early indicator of soil quality. Therefore, cover cropping and its biomass application during the cold fallow season could be very useful soil management for increasing the soil C stock in temperate mono-rice paddy soil.

Keywords: *SOC, Paddy soil, rice straw, NECB*

POTENTIAL AND CHALLENGES IN ACHIEVING EDIBLE OIL SELF-SUFFICIENCY THROUGH OIL PALM CULTIVATION IN COASTAL AREAS OF SINDH PAKISTAN

Allah Wadhayo Gandahi*[1]

[1]Department of Soil Science, Sindh Agriculture University Tandojam

*Email: awgandahi@sau.edu.pk

ABSTRACT

Although it is an agricultural nation, Pakistan relies on imports for more than 85% of its edible oil needs. About 2.681 million tons edible oil (including oil produced from imported oilseed) worth Rs 826.482 billion (US$ 3.562 billion) was imported during FY2023 (July-March). Local edible oil output in FY2023 (July-March) was about 0.496 million tons only. In Pakistan, palm oil is the second most important import after petroleum. Such massive imports are connected to the country's expanding per capita edible oil consumption and inability to produce the required quantity of the same domestically. The country's yearly import of edible oil is startling at $4 billion, putting a tremendous strain on the economy. Oil palm (*Elaeis guineensis* Jacq.) is a possible crop for bridging Pakistan's enormous gap between local demand and edible oil output. Sindh is naturally endowed with a potentially lucrative coastline stretch of 338 kilometers. Oil palm farming is projected to provide socioeconomic benefits such as self-sufficiency in edible oils, foreign exchange savings, support of industrialization, increased per-acre revenue for producers, and year-round usage of rural labor. Domestic production of palm oil will lower import costs while creating new revenue sources for farmers. Oil palm cultivation for edible oil production can assist reduce reliance on imported oils, therefore contributing to national food security and lowering the trade imbalance. However, achieving edible oil self-sufficiency in Pakistan has several Challenges including competing land-use, water shortage, technology Gaps, inadequate infrastructure, farmer finance availability, and the socioeconomic situation of smallholder farmers. Addressing these difficulties necessitates a comprehensive and integrated approach is critical to Pakistan achieving edible oil self-sufficiency.

Keywords: Coastal soils, Edible oil, Oil palm,

CLEANER PRODUCTION LEADING TO MINIMIZATION OF POLLUTION

M. Irshad Ramay*[1]

[1]National Cleaner Production Center Foundation, Rawalpindi

*Email: irshadramay@gmail.com

ABSTRACT

Cleaner Production (CP) is the ongoing application of an integrated preventative environmental approach to processes, goods and services to increase overall performance and decrease dangers to persons and the environment. End-of-pipe pollution management solutions can never be as economically viable as waste abatement projects, which reduce effluents by simply increasing efficiencies. When CP methods are applied to processes, raw materials and energy conservation, the elimination of hazardous raw materials, and the reduction of the amount and toxicity of all emissions and wastes before disposal are all involved. On the contrary, implementing CP technology into products requires minimizing environmental effects across the product's whole life cycle, from raw material extraction to final disposal. Conservation of natural resources, less waste, recovering valuable byproducts, enhanced environmental performance with less pollution, greater productivity, improved efficiency, lower energy consumption, and a general decrease in prices are all advantages of cleaner manufacturing. This expense, which occasionally accounts for a sizeable amount of the product's overall cost and is either passed on to customers or taken out of the industry's earnings, results in an indirect loss of funds. Simple techniques like basic housekeeping and transferring technology are all part of cleaner production. Other simple approaches include innovative product or process design. Due to the fact that it takes on the problems with sustainable growth on multiple levels, this is an integrated and comprehensive approach to environmental conservation.

NCPC is working as a non-profit organization with the ultimate aim to improve the environmental conditions which in turn contributes to the welfare of community. This initiative is the first of its kind in Pakistan with the aim of introducing Cleaner Production Technologies and Cleaner Products. Cleaner Production (CP) provides an integrated preventive environmental strategy to processes and products in order to reduce risks to human and the environment. Through the CP program, NCPC is bridging the gap between competitive industrial production and environmental concerns.

Keywords: *Cleaner production, human risk, environment, environmental performance, energy efficiency*

HARNESSING PGPR: A CONTEMPORARY APPROACH TO MANAGING CHILLI GROWTH AND NUTRIENTS IN SEMI-ARID CLIMATE OF SINDH

Qurban Ali Panhwar*, Amanat Ali, and Nizamuddin Depar

[1]Soil & Environmental Sciences Division, Nuclear Institute of Agriculture (NIA), Tandojam 70060, Sindh, Pakistan

*Email: pawhar107@yahoo.com

ABSTRACT

A study was conducted to assess PGPR strains from diverse chilli-growing regions in Sindh. A total of 40 soil and plant samples were randomly collected from Kunri, Umer Kot, Mirpurkhas, Badin, and Sanghar areas and screened for their potential to enhance chilli productivity. The bacterial population varied across locations, influencing chilli plants' growth positively. To evaluate the effectiveness of bacterial consortia combined with different levels of mineral fertilizer in enhancing chilli growth and production, experiments were conducted in both net-house and field conditions. Out of the 22 screened PGPR strains, 18 demonstrated the ability to fix atmospheric nitrogen, while 28 exhibited inorganic phosphate solubilizing activity. Moreover, 28 isolates were identified as producers of the plant hormone indole-3-acetic acid (IAA), with NIA-PGPR 9 being the highest IAA producer (42.61 mg L^{-1}). PGPR consortium-2 showed promise in improving chilli growth parameters (shoot length, root length, and plant dry mass) and yield (number of flowers and fruits, fruit fresh weight) when combined with 75% of the recommended level of mineral fertilizers in net-house conditions. The application of PGPR bio-inoculum, along with 75% of the recommended levels of nitrogen and phosphorus fertilizers, significantly (19.82%) improved chilli growth as compared to non-inoculated treatment. However, chilli shoot length (39 cm), number of branches (32), number of fruits (23), fruit weight (16.25 kg $plot^{-1}$), fruit girth (7.62 cm), and width (1.91 cm). Additionally, the highest SPAD values (59.85) and nutrient content, including nitrogen (2.52%), phosphorus (0.34%), and potassium (2.73%), were observed in the PGPR bio-inoculant with 75% of the recommended fertilizer application. In conclusion, the application of PGPR bio-inoculum has the potential to enhance chilli growth and yield, allowing for a 25% reduction in mineral fertilizer usage.

***Keywords*: Chilli growth, inoculation, nutrient uptake, crop sustainability, reduction in mineral fertilizer.

NANOTECHNOLOGY BASED APPROACHES TO TACKLE EMERGING POLLUTANTS FOR FOOD SAFETY AND SECURITY

Muhammad Arshad*[1]

[1]National University of Science and Technology, Islamabad

*Email: marshad@iese.nust.edu.pk

ABSTRACT

With recent developments in science and technology, nanotechnology has emerged as an all-around solution provider. Since the last decade, nanotechnology has progressed as an interdisciplinary science due to its broader applications in the agriculture and environmental sciences. Nanoparticles (NPs) possess a larger surface area as compared to bulk materials that offer very interesting functional properties for usage in the environment and agriculture. Worldwide, pharmaceutical products, especially antibiotics are being used in large quantities for humans, animals, agriculture, and aquaculture. These products are not metabolized fully within the body and are released into the environment with their active ingredients, referred to as emerging pollutants. Antibiotics released into the environment promote the spread of resistance in bacteria, pose significant risks to human health, and disturb ecosystems when enter in food chain. The antibiotics may kill beneficial bacteria in surface and subsurface water. The nanoparticles are being used to remove antibiotics of different classes: Fluoroquinolones, Beta-lactam, and Sulfonamide from wastewater namely, Ciprofloxacin, Ofloxacin, Levofloxacin, Amoxicillin, Ampicillin, and Sulfamethoxazole which are used most commonly. Different approaches to handle/ remove the emerging pollutants, growth responses, and fate into the environment will be presented/ discussed in detail.

Keywords: *Nanotechnology, emerging pollutants, food safety, pharmaceutical*

"Soil Health: A Key to Food Security"

20th INTERNATIONAL CONGRESS OF SOIL SCIENCE

20-22 February 2024, Rawalpindi, Pakistan

SOIL FERTILITY AND PLANT NUTRITION

ENHANCING SOIL HEALTH THROUGH REGENERATIVE AGRICULTURE: PRINCIPLES AND PRACTICES OF RA FOR SUSTAINABLE SOIL HEALTH

Abid Subhani*[1], Shahid Zia[1,2], Farzana Shahid[1,2], Farah Farooq[1,2], Areeba Shoukat[1,2], Atta ul Mustafa[1,2]

[1]Rural Business Development Center (RBDC Pvt Ltd.), G-9/4, Islamabad

[2]Lok Sanjh Foundation, Islamabad

Email: asubhani1962@gmail.com

ABSTRACT

The anthropogenic climate change has already slowed down agricultural productivity growth by 21% in last 60 years. Around 33% of the earth's soil is already degraded and over 90% could become degraded by 2050. The equivalent of one soccer pitch of soil is eroded every 5 seconds. Each year, an estimated 24 billion tons of fertile soil is lost due to erosion. That's 3.4 tons lost every year for every person on the planet. The global average soil erosion rate is 2.4 t $ha^{-1}yr^{-1}$. Almost all Pakistani soils are deficient in essential macro-nutrients (NPK) and particularly soil organic matter content. According to USDA Agricultural Research Service (ARS), soil is lost not because we farm, it's lost because of how we farm. Rural Business Development Center (RBDC), Islamabad is working on Regenerative Agriculture (RA) through practical application of RA practices in its two centers, one at Fatehjang and other at Toba Tek Singh, along with demonstrations of these practices in a village (Gugh, Dullah-Chakwal) declared as Village Learning Center where all activities are showcased and farmers trainings are being conducted there to replicate these principles/practices in their fields to spread these RA practices on a larger scale. These principles/practices includes: maintaining soil cover, minimizing soil disturbance (reduce/ no tillage), maintaining continual living plant roots, adding plant diversity, composting, agroforestry, integrating livestock etc. These practices are found very useful in enhancing the soil health and consequently the crop yields. These different practices helped to improve soil structure and fertility, organic matter content, soil microbial activity, nutrient cycling, and soil carbon cycle, and reduced soil erosion.

***Key Words**:* Regenerative Agriculture, Soil health, Sustainability, Fertility

ADDRESSING CHALLENGES IN MICROBIAL BIOFERTILIZERS FOR SUSTAINABLE AGRICULTURE TO ENHANCE SOIL HEALTH AND FOOD SECURITY

Ghulam Rasool[1*]

[1]GR Agro Services, Faisalabad

*Email: ghulamrasool@hotmail.com

ABSTRACT

The historical roots of commercial biofertilizers trace back to 1895 with the discovery of laboratory cultures of Rhizobium. In India, these biofertilizers have become integral to supplementing chemical fertilizers, showcasing an impressive growth rate of 12.5% from 2023 to 2028. Interestingly, Pakistan shares identical environmental conditions and agricultural traditions with India. However, it lags significantly behind in the mass-scale production and adoption of biofertilizers in agriculture. The aim is to explore the reasons behind this disparity and outline a forward-looking strategy to bridge the gap. Highlighting the potential synergy between biofertilizers and chemical fertilizers, the presentation underscores their pivotal role in enhancing soil health and ensuring affordable food production. In Pakistan, the primary challenge lies in the absence of a holistic approach, akin to having skilled drivers without workshops equipped with the necessary resources and capabilities. Bridging the mindset gap between biofertilizer users and production workshops is crucial for widespread adoption. The urgent need to comprehend the intricacies of biofertilizers is emphasized, coupled with an essential educational component to enlighten stakeholders about the indispensable trio of chemical fertilizers, organic fertilizers, and microorganisms for sustainable agriculture, soil health, and food security. The presentation delves into critical issues such as adulteration, akin to undermining the power of biofertilizers. Strategies to thwart adulteration and ensure the efficacy of these agricultural superheroes reaching fields are explored. Affordability and accessibility are paramount considerations, discussed through innovative strategies to make biofertilizers economically viable for farmers of all scales. The presentation concludes with a compelling message, inviting all stakeholders to join this transformative journey toward ensuring a healthier and sustainable food future for every individual in Pakistan. Together, we are crafting a superhero narrative for agriculture, turning farming into an inspiring and inclusive story.

Keywords: Biofertilizer, PGPR, Food Security, Sustainable agriculture

IMPACT OF POTASH AND MICRONUTRIENTS ON SUGARCANE CROP PRODUCTION AND ECONOMIC RETURN

Muhammad Zameer Khan[1*], Muhammad Manzoor[1], Sagheer Ahmad[1], Sair Sarwar[1], Ahmer Bin Zamir[2], Muhammad Asad Hameed[1]

[1]Soil and Plant Nutrient Program, Land Resources Research Institute, NARC, Islamabad
[2]PMAS-University of Arid Agriculture Rawalpindi.

*Email: zamirahmar@gmail.com

ABSTRACT

Balanced nutrient management is not only a way to sustain Sugarcane (*Saccharum officinarum* L.) production but also key to better profitability as well. A two-cropping years study was conducted to evaluate the impact of potash (K) and micronutrients (Zn+Fe+B) on sugarcane production economic return at two different locations (Rahimyar Khan and Sargodha). Treatments including T_1= N and P, @ 200, 100 kg ha^{-1} T_2= N and P as for T1 and K @150 kg ha^{-1} T_3= NPK and Micronutrients (Zn, Fe and B @ 0.1%, 0.1% and 0.06% foliar spray). The treatments were applied according to a randomized complete block design with a factor factorial arrangement. The Zn, Fe, and B foliar application was done at three different timings. Results indicated that on average over two locations and years indicated that applied K increased cane yield by 13.5% which was further improved by the micronutrient foliar application up to 17.3% higher than the FP. Similarly, K alone and in combination with micronutrients improved brix contents by 27.46% and 38.4%, polarity by 20.4% and 30.5%, and sugar recovery by 17.98% and 29.83% respectively over FP. The N and P contents of sugarcane leaves were 28.5 % higher while, K contents were 45.5% and 53.7% higher in the plots applied K alone and those where K was applied combined with micronutrients respectively. Consequently, the economics of cane yield revealed that soil-applied K alone and combined with micronutrient as foliar application produced a significantly higher return than the FP. The findings of the study appeal that K along with micronutrients foliar application have a pivotal role in the yield and quality of sugarcane as well as income generation of sugarcane growers.

Keywords: Balanced Fertilizers, Economic gain, Cane quality, Nutrient management

CONCURRENT IMPROVEMENT IN MAIZE YIELD AND NITROGEN USE EFFICIENCY THROUGH ROOT ZONE TARGETED FERTILIZATION

Muhammad Irfan[1,2,3]*, Dianjun Lu[1,2], Xiaoqin Chen[1,2], Huoyan Wang[1,2]

[1]State Key Laboratory of Soil and Sustainable Agriculture, Institute of Soil Science, Chinese Academy of Sciences, Nanjing, China
[2]University of Chinese Academy of Sciences, Beijing, China
[3]Soil and Environmental Sciences Division, Nuclear Institute of Agriculture (NIA), Tandojam, Pakistan

*Email: irfan1513_uaf@yahoo.com

ABSTRACT

Excessive N application coupled with low N-use efficiency (NUE) causes severe N losses, thus resulting in serious environmental consequences. One-time root-zone targeted fertilization (ORTF) is a promising approach to improve crop yields and NUE while simultaneously curtailing N input and associated losses. A field experiment was conducted in Northeast China to compare the impact of N application methods [band fertilization (BF, common practice in the region), and ORTF] on grain yield and NUE in maize crops. Four N rates i.e. 180, 225, 270, and 315 kg ha^{-1} were evaluated under each fertilization method along with a control treatment (without N). Overall, ORTF proved more efficient as compared to BF by producing 10% higher grain yield. The N rate of 225 kg ha^{-1} under ORTF showed maximum grain yield and cumulative N accumulation by aboveground plant parts. The ORTF remarkably increased N recovery efficiency (69.1%), agronomic efficiency (27.1 vs. 17.5 kg kg^{-1}), and partial factor productivity (64.6 vs. 55.1 kg kg^{-1}), while significantly reducing N losses (30.9 vs. 44.4%) compared with BF. In conclusion, one-time N fertilization based on targeted placement in the root zone could be an efficient nutrient management strategy for maize crops.

Keywords: Maize, Nitrogen, Nutrient management, Recovery efficiency, Root zone

EFFECT OF VALUE ADDED COMPOST ON MAIZE UNDER SALT EFFECTED SOIL (*Zea Mays L.*)

Asbah Fatima*[1]

[1]Department of Soil Science, Institute of Soil & Water Resources, The Islamia University Of Bahawalpur, Bahawalpur

*Email:fatimaasbah6@gmail.com

ABSTRACT

Soil salinization is the ecological worldwide problem including Pakistan. Larger area of Pakistan is affected by salinity because it is located in arid and semiarid region. The main reason for the formation of salt affected soil is that yearly evaporation exceeds the yearly precipitation due to capillary action causing salt to collect on the top layer of the soil. The recovery of these kinds of salt-exaggerated soils is being studied using a variety of management techniques. These include the use of organic amendments to ameliorate the salt effected soil. In present studies the pot experiment was conducted to evaluate the effect of value added compost on maize crop under salt effected soil. For pot experiment 1 kg soil were sieved for each pot and salinity was developed at the rate of 0, 40 and 80mM NaCl . Compost was applies at the rate of 0, 1.5 and 3. Experiment was completely randomized design with three replication. Plants were harvested at the vegetative growth (45 days) result show that the salinity negatively affects the plant growth physiological and biochemically. Application of compost significant increase the plant height, root length, fresh, dry weight and leaf area.The result suggest that the application of compost of 1.5 and 3% could be the better strategy to ameliorate the salt contaminated soil.

Keywords: Soil salinization, Semiarid, salt-exaggerated, Compost, Salt effected soil.

EFFICIENCY OF FE-SOLUBALIZING BIO-INOCULANTS FOR ENHANCING MAIZE GROWTH AT EARLY GROWTH STAGES

Tehseen*[1], Samia[1]

[1]Department of Soil Science, Institute of Soil & Water Resources, The Islamia University of Bahawalpur, Bahawalpur

*Email: tahseenqainth@gmail.com

ABSTRACT

Maize (Zea Mays L.) is a multipurpose staple crop which meets the requirement of animals and humans worldwide. Its total production is decreasing day by day due to various natural and anthropogenic factors. The micronutrient Iron(Fe) plays a very important role in metabolic processes such as photosynthesis, respiration and DNA synthesis therefore it is a very important micronutrient for all the living organisms. It also activates many metabolic pathways. It plays an important role in different physiological and biochemical pathways in plants and is required by the plants in wide range of biological functions. A root colonizing bacteria, PGPR is involved in improving the fertility and productivity of soils as well as improving the growth of grains. They play an important role in the development of plants since they protect roots from diseases, thereby improving their functionality. The main objective of this study is to determine the effect of Iron solubilizing bio inoculants on growth of maize in its early stages. We collected maize rhizospheric soil and isolated a total of 33 bacterial strains from it. After that we conducted a siderophores test and selected 10 bacteria that were giving positive response to the solubilization of iron. After the selection of these bacterial strains germinated seeds were inoculated with these bacterial strains and jar trail was conducted in growth room of soil microbiology lab. To evaluate the effect of Fe solubilizing bio inoculants on maize growth completely randomize design was used. After 30 days of sowing harvesting was done and growth parameters were recorded. It was analyzed that all the treatments (T1, T2, T3, T4, T5, T6, T7, T8, T9 and T10) showed significant amount of growth increase. Meanwhile, T10 (SG33) showed maximum growth. This treatment increases plant height (39%), root length (26%), shoot fresh weight (40%), root fresh weight (38%), shoot dry weight (9%), root dry weight (38%), chlorophyll (36%). It was concluded that application of iron solubilizing bacteria is an effective approach to enhance maize growth at early stage.

Keywords: Maize (Zea Mays L.), Iron (Fe), DNA synthesis, physiological, Biochemical, PGPR, Rizospheric soil, Siderophores, Growth Enhancement.

ANTI-TRANSPIRANTS: A POTENTIAL STRATEGY TO MITIGATE THE EFFECTS OF DROUGHT ON SPINACH

Komal Panhwar[1]*, Ghulam Murtaza Jamro[1], Inayatullah Rajpar[1], Abdul Hameed Memon[2], Durshana Khan Khanzada[1,3], Zahoor Ahmed Palijo[4], Saleem Maseeh Bhatti[1]

[1]Department of Soil Science, Sindh Agriculture University, Tandojam, Pakistan
[2]Shaheed Zulifqar Ali Bhutto Agriculture College Dokri, Larkana, Pakistan
[3]Directorate of Agriculture Extension, Tando Allah yar, Sindh, Pakistan
[4]Food and Agriculture Organization, Pakistan

*Email: gmjamro@gmail.com

ABSTRACT

Drought is considered a serious threat to sustainable crop production. Different chemical compounds which reduce transpiration are known as "antitranspirants". Because of the significance of antitranspirants, a pot experiment was conducted to evaluate the effect of antitranspirants on spinach under different field capacity moisture regimes. The study involved completely randomized design factorial included: Factor (A) Type of antitranspirants (ATs): ATC_1: Water, ATC_2: K_2SO_4, ATC_3: Castor oil and Factor (B): Field capacity moisture level (FCML): $FCML_1$: 50%, $FCML_2$: 75%, $FCML_3$: 100%. Five kilograms of soil from arable land of drought-affected areas of Badin was used in a pot experiment involving the local spinach variety "Sindhi Palak". The ATs were applied at 1% every 15 days of intervals until the harvesting of spinach. The results indicated that decreasing field capacity moisture levels reduced most of the growth parameters (plant height, fresh and dry weights of plant, number of leaves, stem girth, leaf area) and physiological parameters including relative growth rate and cell membrane stability index. Further, both ATs showed a greater effect of K_2SO_4 followed by castor oil as compared to water treatment. In the case of nutrients (N, P, and K) concentrations followed a similar trend as of growth parameters. However, N and K concentrations were found in an adequate range at 75% and 100 FCMLs in both ATs in plant tissue of spinach. It is concluded that the application of selected antitranspirants could help to mitigate drought effects on spinach plants.

Keywords: Field capacity, Moisture, Potassium sulphate, Castor oil, Nutrient uptake

CULTIVATING RESILIENCE: HARNESSING COVER CROPS FOR ROBUST SOIL SUSTAINABILITY

Hina Nawaz[1]*, Muhammad Tahir Akram[1], Mehwish Liaquat[1]

[1]Department of Horticulture, PMAS-Arid Agriculture University, Rawalpindi 46300, Pakistan

*Email: nawazhina23@gmail.com

ABSTRACT

Cover crops are non-cash crops primarily grown to protect and enrich the soil rather than for direct harvest. The extensive root system of these crops helps in improving the structure of the soil, increasing soil organic matter and boosting nutrient availability. All these factors provide favorable conditions for crops to grow, which will lead to higher yield and is a key step towards sustainable agriculture and enhancing soil quality. Certain cover crops such as legumes (peas, alfalfa, and clover) can fix atmospheric nitrogen to ammonium and reduce the need for chemical fertilizers. The decomposition of these crop cover crops enhances soil organic matter and improves soil structure and nutrient holding capacity. These crops are also helpful in suppressing weeds that minimize herbicides used and environmental pollution. Cover crops help the soil retain water by reducing soil evaporation. The incorporation of cover crops also reduces environmental impacts such as soil erosion and nutrient leaching. Therefore, careful selection of species and decomposition is necessary to get sustainable yield production.

Keywords: Cover crops; Legumes; Organic matter; Soil erosion; Soil structure

GROWTH AND QUALITY INDEX OF TOMATO AS INFLUENCED BY POULTRY MANURE AND COMPOST UNDER DIFFERENT TEXTURED SOILS

Laiba Tahir[1*], Muhammad Iqbal[1], Tooba Mumtaz[1], Mussawar Abbas[1], Hifza Jabbar[1]

[1]Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad

*Email: laibatahir555@gmail.com

ABSTRACT

The main issue facing Pakistan's expanding population is meeting its food needs through food production. Utilizing organic fertilizers, derived from animal dung or other farming wastes, is typically employed to boost crop plant quality and yield while also strengthening the soil's structure and stability. A pot trial was conducted to assess the impact of two organic amendments at four different levels, on soil properties for tomato growth. There was a total of twelve treatment combinations including two different soil textures. Organic amendments were applied @ control, 2.0%, 4.0%, and 6.0% (w/w). The results showed that the compost had a significant effect on plant height (91.4cm), root length, leaf area, and root fresh and dry weight. Whereas, higher shoot fresh (245g) and dry weight (33.40g) were observed where poultry manure was applied @2.0%. Similar results were observed where compost was applied @ 4.0%. The combination of loamy soil and compost exhibited the highest fruit dry matter percentage. Total N in soil was observed (0.14%) and soil available Phosphorus (11.6ppm). The findings of this experiment indicate that the organic amendments improved the availability of phosphorus to plants. Additionally, soil treated with compost showed a slight but considerable increase in organic P. Overall, loamy soil showed significant results as compared to sandy soils.

Keywords: Organic amendments, poultry manure, compost, Tomato

EFFECT OF SULPHUR APPLICATION ON GROWTH, YIELD, AND NUTRIENT UPTAKE OF COTTON

Riaz Hussain Soomro[1]

[1]Department of Soil Science, Faculty of Crop Production

*Email: soomroriaz933@gmail.com

ABSTRACT

The present study was conducted during Kharif season 2023 at Soil Fertility Institute Tandojam. The experimental material was comprised of Mehran cotton variety. The experimental design was a Randomized complete block design (RCBD) with three replications. The present study showed that the recommended NPK + 60 kg S ha^{-1} resulted statistically significant ($P<0.05$) increase in the plant height, number of bolls plant^{-1}, number of sympodial branches, seed cotton yield plant^{-1}, weight of bolls plant^{-1} and cotton lint yield. However, the recommended NPK resulted in minimum plant height, number of bolls plant^{-1}, number of sympodial branches, seed cotton yield plant^{-1}, the weight of bolls plant^{-1}, and cotton lint yield were statically significant ($P<0.05$). From the present study, it is concluded that cotton fertilized with recommended NPK + 60 kg S ha^{-1} resulted in maximum cotton lint yield, as compared to recommended NPK + 45 kg S ha^{-1} and recommended NPK + 25 kg S ha^{-1}.

Keywords: Cotton, NPK, Cotton lint

EFFECT OF BONE MEAL COMPOST ON GROWTH AND NUTRIENT CONTENT OF BANANA CROP

Muhammad Siddique Lashari[1]*, Bakht-un-Nisa Mangan[1], Abdul Lateef Jat[1], Inayatullah Rajper[1], Pirkash Suthar Saleem[1], Maseeh Bhatti[1], Muhammmad Saleem Sarki[1]

[1]Faculty of Crop Production, Department of Soil Science and Agronomy, Sindh Agriculture University Tandojam, 70060 Pakistan

*Email: mslashari@sau.edu.pk

ABSTRACT

The field experiment was conducted in 2022 to observe the effect of bone meal compost on the growth and nutrient content of banana crop. The experimental field was organized at the experimental site of Sindh Agricultural University Tandojam in a three-replicated randomized complete block design. Each block was further planted with 36 banana suckers of three months old. The treatments were designed as CK1: BMC=00 + recommended NPK (N=300, P=250 and K=500) kg ha^{-1}, CK2: BMC 7.0 t ha^{-1} and zero use of chemical fertilizer, CK3: BMC 7.0 t ha^{-1} + recommended NPK (N=300, P=250 and K=500) kg ha^{-1}. The findings of the results showed the beneficial effects of bone meal compost (BMC+IF) on banana health. Furthermore, the maximum increase in banana pseudo stem height 26.72%, the number of leaves was 15.74% leaf length 39.65%, leaf area index 36.37%, and stem girth 38.47% were observed in CK3. Moreover, the root length decreased by 8.77% in CK3. However, the maximum increase in leaf sap ions was observed with the application of bone meal compost and recommended inorganic fertilizer. The maximum increase in sap nitrogen was 38.29%, phosphorus 59.35%, potassium 22.51%, and calcium was increased up to 44.92% when the plant was treated with bone meal compost plus recommended inorganic fertilizer in compression to other treatments. Furthermore, improvements in soil macronutrients were observed with the amendment of bone meal compost and inorganic fertilizer. The maximum soil nitrogen content was 23.84%, phosphorus 31.75%, and potassium 15.46% at the depths of 0-20 cm with the application of (BMC+ IF). The overall results indicate the positive effects of bone meal compost and inorganic fertilizer for improving the growth and ion uptake in banana plants. Furthermore, the amendment also improves the nutrient content in soil at both depth levels.

Keywords: Bone meal compost, Banana crop, Nutrient content, Soil properties

EFFECT OF FARMERS' MANAGEMENT PRACTICES ON AGGREGATE STABILITY, CARBON STORAGE AND SOIL HEALTH IN BANANA GROWING AREAS OF SINDH

Azam Solangi*[1], Waqar Ahmad[1], Saleem Sarki[1], Allah Wadhayo Gandahi[1]

[1]Department of Soil Science, Sindh Agriculture University Tandojam

*Email azam.solangi@gmail.com

ABSTRACT

Soil health is an intricate interplay among all its naturally coexisting components. In the context of banana plants, they develop an adventitious root system, relying on the physico-chemical and biological properties of the soil for optimal functioning. The conditions of the soil significantly impact the weight of both banana roots and shoots. As an indicator of soil health, aggregate stability governs the movement and storage of air and water throughout the soil profile, potentially affecting soil carbon storage. To explore the relationship between aggregate stability, carbon storage, and soil health, we conducted a survey in two districts of banana-growing areas in Sindh, specifically Matiari and Tando Allah Yar (n = 12 sites, ~120 hectares). Soil samples were collected from a depth of 0-15 cm, processed, and analyzed for aggregate stability and carbon storage. Aggregate stability varied from poor to excellent, with an average considered good. In the surveyed area of 120 hectares, a total of 2687 tons of carbon was stored. In Matiari, carbon stock was estimated to range between 1.41 and 37.3 tons ha^{-1} (for small to large growers), while in Tando Allah Yar, the carbon stock ranged between 1.51 and 28.57 tons ha^{-1}. Our findings indicate that, regardless of farmers' classification (small, medium, and large), aggregate stability, carbon storage capacity, and soil health depend on soil management practices. One potential method for improving soil conditions is the addition of organic amendments tailored to the specific soil conditions. The incorporation of amendments with high and stable carbon content may potentially enhance the growth of banana plants. However, implementing this approach requires a comprehensive framework that integrates all soil components, fostering systematic and continuous improvement in soil management. This integration is crucial to ensure that banana production is sustainable and has a minimal impact on the surrounding environment.

Keywords: Soil health, soil stewardship, carbon storage, aggregate stability, banana, sustainable production.

GROWTH, NODULATION AND YIELD OF PEA (*Pisum sativum* L.) IN RESPONSE TO PHOSPHORUS AND MOLYBDENUM APPLICATIONS UNDER GREENHOUSE CONDITIONS

Muhammad Sarfraz[1], Abdul Khaliq[1]

[1]Department of Soil and Environmental Sciences, Faculty of Agriculture, University of Poonch Rawalakot

*Email: Sarfraz.ch121@gmail.com

ABSTRACT

Both phosphorus (P) and molybdenum (Mo) are considered important for nodulation, nitrogen fixation, and overall plant growth. The present study was carried out to evaluate the comparative and combined effectiveness of P and Mo on the growth, nodulation, and yield of pea (*Pisum sativum* L.) under greenhouse conditions in the University of Poonch Rawalakot Azad Kashmir. There were four P (0, 25, 50, and 75 kg P_2O_5 ha^{-1}) and four Mo (0, 0.5, 1.0, and 1.5 kg Mo ha^{-1}) levels. The pea variety "Meteor" was sown as a test crop in the experiment. Results showed that the application of the P, Mo, and P+Mo combination significantly increased the growth, nodulation, and yield of peas compared to the control. Co-application of 50 or 75 kg P_2O_5 +1.0 kg Mo ha^{-1} (P_2Mo_2) increased the growth characteristics and nodulation of pea with alone P, Mo, and combined P+Mo treatments. The yield and yield attributes of peas differed significantly with the application of P, Mo, and their combinations over their respective controls. In conclusion, the individual and combined application of P and Mo proved effective in improving growth, nodulation, and yield attributes by peas.

Keywords: Pea, Phosphorus, Molybdenum, Growth, Nodulation, Yield

RESPONSE OF BIOCHEMICALLY MODIFIED BIOCHAR TO IMPROVE CHICKPEA PRODUCTION ON SANDY SOILS

Hafiz Shahzad Ahmad[1], Tanveer Ul Haq[1*], Ahmad Mahmood[1], Muhammad Imran[1] and Muhammad Asif Shehzad[2]

[1]Department of Soil and Environmental Sciences, MNS University of Agriculture Multan 66000, Pakistan
[2]Institute of Plant Breeding and Biotechnology, MNS University of Agriculture Multan 66000, Pakistan

[*]Email: tanveer.ulhaq@mnsuam.edu.pk

ABSTRACT

Biochar is a carbon-enriched stable material produced from pyrolysis of organic materials. Its production and application sequester atmospheric carbon and increase the carbon footprints of soil. The efficiency of biochar can be improved by its enrichment with a variety of compounds. The current study aims to evaluate the response of biochemically modified biochar in improving chickpea production on sandy soils. There were five treatments of modified cotton sticks biochar viz. Control (T_0); Biochar @ 5 Mg ha^{-1} (T_1); Acid Modified Biochar @ 5 Mg ha^{-1} (T_2); Bacteria Modified Biochar @ 5 Mg ha^{-1} (T_3); Mycorrhizae Modified Biochar @ 5 Mg ha^{-1} (T_4); and Bacteria + Mycorrhizae Modified Biochar @ 5 Mg ha^{-1} (T_5). The experiment was arranged in a Randomized Complete Block Design with three replications. Two local chickpea varieties, Bittal-2016 (Desi) and Noor-2019 (Kabuli) were evaluated in this study. Results revealed that the use of biochar at 05 Mg ha^{-1} with Bacteria + Mycorrhizae Modified Biochar significantly improved the shoot fresh weight, shoot dry weight, root fresh weight, and root dry weight of both chickpea varieties. Under this treatment, a substantial increase in 100-grain weight (42.7% and 30.4%) and grain yield (33% and 16.1%) of chickpea was observed in Noor-2019 and Bittal-2016, respectively. It is concluded that modification of biochar with bacteria and Mycorrhizal fungi @ 5 Mg ha^{-1} could be an effective strategy to improve chickpea production in sandy soils.

Keywords: Cotton sticks, Biochar; Bacteria, Fungi, Chickpea, Coarse textured soils

ORGANIC SOIL AMENDMENTS PROVIDING ORGANIC SOURCES OF NITROGEN, PHOSPHORUS, AND POTASSIUM TO SOIL AND PLANTS

Abid Kamal[1*], Ishaq Ahmad Mian[1] and Muhammad Tariq[1]

1Department of Soil and Environmental Sciences, The University of Agriculture Peshawar.

*Email: akyses@aup.edu.pk

ABSTRACT

Soil organic matter depletion leads to soil structural degradation in cultivated ecosystems. Organic soil amendment helps to address soil organic carbon depletion and environmental issues, as inorganic fertilization hinders sustainable agriculture by affecting soil fertility and crop productivity. A two-year field experiment at the Agriculture Research Farm, University of Agriculture Peshawar-Pakistan, examined the effects of combining organic and inorganic amendments on maize variety Azam and hybrid CS 220, aiming to compensate for soil organic carbon loss. Treatments were Control, half (H) NPK, Full NPK, Legume Residues (LR) @ 10 tons ha^{-1}, Humic Acid (HA) @ 5 kg ha-1, Biochar (BC) @ 10 tons ha^{-1}, LR + HNPK, HA + HNPK, BC + HNPK, HLR +HHA+ HNPK, HLR + HBC + HNPK and HBC + HHA + HNPK. The study used a two-factorial randomized complete block design with three replications to study maize two-year data. Results showed significant cob lengths in HLR + HBC + HNPK treatment, while maximum results in plant population, 1000 grain weight, and biological yield were in HBC + HHA + HNPK treatment. The highest soil organic matter was recorded in plots with only BC application at 10 tons ha^{-1}, with the highest soil K recorded in BC + HNPK treatment. The hybrid CS 220 maize variety showed superior yield and component performance compared to the Azam variety, while the Azam variety yielded the best results in soil parameters. The maize production improved significantly in the second year compared to the first year. The study suggests that combining organic and half-inorganic fertilizers improves soil fertility, making it a viable strategy for crop yield regulation and sustainable maize production.

Keywords: Biochar, Humic acid, Legumes, Residues, Maize, Yield, Soil fertility

ROADMAP TOWARDS SUSTAINABLE NITROGEN MANAGEMENT IN PAKISTAN

Tariq Aziz[1], Muhammad Irfan Sohail[1], Muhammad Aamer Maqsood[2], Abdul Wakeel[2], Sana Ullah[2], Azhar Abbas[3], Masood I. Awan[1] and Muhammad Nasim[4]

[1]UAF Sub campus Depalpur Okara, University of Agriculture Faisalabad, Okara 56300 Pakistan
[2]Institute of Soil & Environmental Sciences, University of Agriculture, Faisalabad, Pakistan
[3]Institute of Agriculture and Resource Economics, University of Agriculture, Faisalabad
[4]Institute of Environment and Soil Chemistry, Ayub Agricultural Research Institute, Faisalabad

*Email: draziz@uaf.edu.pk

ABSTRACT

Nitrogen being one of the major factors of food production, is essential for the very existence of life on planet earth. To meet food, feed and shelter for ever-increasing population particularly in South Asia, the use of nitrogenous fertilizers have increased significantly during the last 4 decades. This has resulted in accumulation of reactive N compounds like NH_3, NO_3, NOx, N_2O in the environment causing a deterioration of soil, air and water quality, biodiversity loss, and climate change. Several factors including biomass burning, transport and energy sector, wastewater contribute towards N emissions in Pakistan, however agriculture sector contributes about 66% to total N emissions. Use of N fertilizers in the country has been increased exponentially during last three decades as more than 10-fold increase in N input has been observed from 1961 to 2021. Pakistan consumed 3835.2 thousand tons of mineral N in 2022 compared to 62.1 thousand tons in 1961 on same arable land. The N application per unit of land has increased to 112.89 kg/ha in 2021 compared to 1.36 kg N/ha in 1961. High N application has contributed to enhance cereal-based food security from 6.7 mt production to 42.7 mt in 2020. But excessive and inefficient use of N fertilizer has resulted in enhancing the N release in the environment (Nitrogen surplus). The nitrogen use efficiency has dropped from 50% to less than 30% in cereal based cropping system. The total nitrous oxide (N_2O) emission has increased from 63.99 to 1069 mt CO_{2eq}/yr in last 5 decades with about 82% share from agriculture sector. Similarly, the total NH_3 emission has increased from 0.28 mt/yr to about 1.44 mt/yr in last 5 decades. A broad and balanced approach is needed in making policies to mitigate climate and non-climate impacts of N pollution as mitigation of one component of N pollution (for example efforts to reducing NO_3 leaching and run off) can exacerbate emission of other components of N cascade (NH_3, NOx and N_2O emissions). The presentation will overview the nitrogen use in Pakistan, and in South Asia for the past 50 years and its role in crop production as well as environmental concerns, with draft roadmap for South Asia.

EVALUATING THE EFFECT OF DUAL SUPPLEMENTATION OF BORON AND SILICON ON SHEDDING OF FRUITING STRUCTURES AND QUALITY COTTON PRODUCTION UNDER CHANGING ENVIRONMENT

Abdullah Keerio*[1,2] Ghulam Murtaza Jamro[1], Zia-ul-hassan Shah1, Pir Ahmed Naqi Shah3, Javaid Ahmed Shah4

1Department of Soil Science, Sindh Agriculture University, Tandojam, Pakistan
2Plant Physiology/Chemistry Section, Central Cotton Research Institute, Sakrand, Pakistan
3Department of Agronomy, Sindh Agriculture University, Tandojam, Pakistan
4Soil and Environmental Sciences Division, Nuclear Institute of Agriculture, Tandojam, Pakistan

*Email: abdullahkeerio2003@yahoo.com

ABSTRACT

Shedding of squares and young bolls in cotton during crop development, can be influenced by adverse environmental conditions, including extreme temperatures. Elevated temperatures have the potential to induce abscission in cotton plants, resulting in notable yield losses and reduced cotton crop quality. Understanding the impact of temperature variation on shedding of fruiting structures of cotton and its mitigation through dual supplementation of boron and silicon was evaluated. The experiment was involved two factors, Factor-A: Temperature (^{0}C)-3 (35, 40, 45) and Factor-B: Dual supplementation–5 (T1: No fertilizer (control), T2: Recommended dose of fertilizer (RDF), T3: RDF+Boron (B), T4: RDF+Silicon (Si) and T5: RDF+B+Si) with three replications. Both factors, treatments, and temperature, significantly influenced all measured parameters. At different temperature levels (35°C, 40°C, and 45°C), variations were observed in plant height, sympodial branches, total number of fruiting points, bolls per plant, boll weight, seed weight, shedding, and seed cotton yield. Chlorophyll content, cell membrane stability, and proline levels were also affected by temperature changes. Additionally, fiber quality parameters, including staple length, fiber strength, micronaire value, and uniformity index, showed temperature-dependent fluctuations. Dual supplementation of boron and silicon demonstrated contrasting effects on several parameters compared to the control. In summary, this research provides valuable insights into the complex relationships between treatments, temperature, and diverse physiological and agronomic aspects of cotton plants, contributing to a comprehensive understanding of factors influencing cotton growth and yield.

Keywords: Cotton, changing environment, Temperature, Boron, Silicon

NITROGEN MINERALIZATION IN SOIL IN RESPONSE TO DIFFERENT ORGANIC AMENDMENTS: AN INCUBATION TRIAL AND POT EXPERIMENT

Memoona Ijaz[1*], Sarvet Jehan[1], Amna Nisar[1], Waseem ur Rahman[3], Sara Khan[3], Tanveer Iqbal[1], Mehwish Liaquat[2]

[1]Institute of Soil and Environmental Science PMAS-AAUR
[2]Department of Horticulture, PMAS-AAUR
[3]School of Environmental Science, Nanjing Normal University Jiangsu, China

*Email: memoonamalik1998@gmail.com

ABSTRACT

Organic amendments play an important role in soil production by enhancing the physical, chemical, and biological properties of soil. Our objective was to evaluate the effect of different organic amendments on soil nitrogen mineralization and the availability of other nutrients such as Phosphorus and Potassium. The applied treatments were i) Control, ii) Biochar @1t ha^{-1}, iii) Biochar @ 2t ha^{-1}, iv) Biochar @ 3 t ha^{-1}, v) Compost @ 5t ha^{-1}, vi) Compost @ 10t ha^{-1}, vii) Compost @ 20t ha^{-1}, viii) FYM @ 5t ha^{-1}, ix) FYM @ 10t ha^{-1}, x) FYM @ 20 t ha^{-1}. This study concluded that the maximum nitrogen mineralization rate was observed at the 21st day of incubation in Compost @ 20t ha^{-1} treated pots. Maximum soil pH was recorded in farmyard manure @ 20tha^{-1}. Soil EC, total nitrogen, Olsen Phosphorus, and Potassium were maximum in pots treated with farmyard manure @ 20t ha^{-1} as compared to compost and biochar treatments in both experiments. Maximum plant nitrogen, phosphorus, and potassium were observed in farmyard manure @ 20 t ha^{-1} as compared to other treatments in the pot experiment. The mean maximum mineralization of nitrogen was shown by compost treatment followed by Farmyard manure. Long-term studies are required to determine the mineralization potential of biochar for sustainable nutrient management.

Keywords: Organic Amendments, Nitrogen, Mineralization, Ammonia, Volatilization

MAIZE CROP RESILIENCE AND NUTRITIONAL ENHANCEMENT THROUGH ZN-CHITOSAN NANOPARTICLES AND ZINC SOLUBILIZING BACTERIA

Muhammad Aftab Akram[1]*, Tayyaba Samreen[1], Ghulam Fareed[1]

[1]Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad

Email: maftabakram14@gmail.com

ABSTRACT

Zinc (Zn) is an essential micronutrient and its deficiency is a leading cause of malnutrition in underdeveloped countries where the widespread population depends upon staple cereals for daily calorie intake. In Pakistan, more than 70% of soils are reported to be Zn deficient, primarily due to the alkaline-calcareous *nature of the soil* and increased phosphorus application*, leading to the* formation of insoluble Zn-phosphate complexes and reducing Zn availability. Low Zn turns into low grain Zn concentration, which harms human and animal health. Its deficiency in maize *(Zea mays)* affects crop yield, nutrition, and overall economic well-being as it plays an important role in enzyme activation and hormone regulation. To address this problem current research was conducted to explore the potential of two interventions. Zinc-solubilizing bacteria (ZSB) and Zn-chitosan nanoparticles (NPs) enhance nutrient use efficiency precisely Zn, promote crop development, increase production of maize crops, and support sustainable agriculture. The study used a methodical procedure that included extracting chitosan from crab shells, synthesizing Zn-chitosan NPs, and growing bacterial cultures. In a pot experiment, Zn-chitosan NPs were applied at doses of 25, 50, and 75% of the recommended Zn for maize. ZSB was used as a seed inoculant, and the effects of each treatment, individual and in combination, were evaluated. The result showed the positive impacts of Zn-chitosan NPs and ZSB on maize resulting in increased plant growth, chlorophyll content (SPAD-value), photosynthesis active radiation, fluorescence yield, Quantum yield, and electron transport rate. It significantly enhanced plant growth parameters and physiological parameters and increased soil microbial community. The study suggests that chitosan extraction promotes waste recycling and ecosystem revival; the application of Zn-chitosan NPs and ZSB boosts maize crop yield, ensuring food security.

Keywords: Zinc, Chitosan, Nanoparticles, Zinc Solubilizing Bacteria

EVALUATING THE EFFECT OF ZINC SOLUBILIZING BACTERIA AND APPLE PEEL FOR SUSTAINABLE PRODUCTION OF WHEAT

Tayyaba Samreen[1]*, Faraz Anjum[1], Sidra Tahir[1], Muhammad Aftab Akram[1], Muhammad Zulqernain Nazir[1], Muhammad Ahmad[1]

[1]Institute of Soil and Environmental Sciences University of Agriculture Faisalabad, Pakistan

Email: tybasamreen@gmail.com

ABSTRACT

Wheat (*Triticum aestivum* L.) is widely cultivated for its grain consumption throughout the world. In addition, zinc (Zn) uptake by plants is reduced because of alkaline-calcareous soils, and high application of P which results in the production of insoluble Zn-phosphate complexes and reduces Zn availability. The current study was designed to evaluate the effect of zinc solubilizing bacteria (ZSB) and apple peel (AP) on the sustainable production of wheat. In this study, 30 strains were isolated from which 10 showed zinc solubilization. The three most efficient ZSB isolates were named FS1, FS4 and FS9. The pot experiment was conducted to raise the Zn uptake in wheat through the application of ZnO, bacterial strains, and AP. The study was organized according to the completely randomized design (CRD) by using three strains (FS1,4 and 9), ZnO, and AP as an organic amendment, each with 3 replications. The maximum plant height of 89.43 cm (27% increase over control), plant dry weight of 19.19 g (52% increase over control), root dry weight of 5.62 g (66% increase over control), 100 grains yield of 6.13 g (57% increases over control) were observed by the combination of FS9, ZnO, and AP. Thus, the results demonstrated that the inoculation of FS with ZnO and AP has the potential to increase Zn solubility and improve Zn content in wheat, therefore, their efficient use can play an important role in sustainable agriculture, and in the management of environmental problems.

Keywords: Apple peel, Zinc solubilizing bacteria, Wheat yield, Sustainable agriculture

EFFICACY OF PGPR IN COMBINATION WITH COMPOST IMPROVING PRODUCTIVITY OF CUCUMBER (*CUCUMUS SATIVUS L.*) CROP

Usma Irshad*, Maqshoof Ahmad*, Abubakar Dar, Azhar Hussain, Shumaila Shahid

[1]Department of Soil Science, Faculty of Agriculture and Environment, The Islamia University of Bahawalpur, 63100 Bahawalpur, Pakistan.

***Email:** usma.irshad755@gmail.com

ABSTRACT

Modern agriculture is largely dependents upon fertilizers leading to unavoidable threat to agriculture. Chemical fertilizer plays an essential role in enhancing crop productivity and soil fertility, but the harmful effects of chemical fertilizers cannot be ignored. Limited information is available about the effectiveness of plant growth-promoting rhizobacteria (PGPR) and compost to decrease the use of chemical fertilizer. The beneficial effects of compost on plant growth is mainly associated with microbial biodiversity and the presence of bacteria with plant growth promoting effects. PGPR are considered eco-friendly, bio-fertilizer that reduce the use of chemical fertilizer and pesticides. As sustainable agriculture is the global target, an experiment was conducted to evaluate the plant growth promotion and suppressive activity against fungal diseases by using PGPR and compost without using any chemical fertilizer. Both inoculated and uninoculated cucumber seeds were sown in soil treated with different concentrations of peat, compost and silt. Nine treatments were tested using factorial design up to two way in pots. The experimental results revealed significant variations among treatments in respect of morphological characters; shoot length (18%), root length (25%), no. of leaves/plant, and leaf area with respect to uninoculated control. Similarly, net photosynthetic rate and SPAD value were higher in plants having seeds inoculated with consortium of *Basillus spp.*, *Bacillus subtilis*, *Bacillus aryabhattai* with 81.3% reduction in cucumber root-rot disease with increase in N, P, K, Mg and Mn content which were 67, 72, 84 and 85% respectively as compared with rest of the treatments. These experimental results revealed that morpho-physiological characters of cucumber could be modified by the application of PGPRs and organic fertilizer. This would be more beneficial in environmentally friendly cucumber cultivation and may be used as an alternative to inorganic fertilizers to enhance plant growth and reduce disease incidence subsequently, resulting in higher yield.

Keywords: PGPR, compost extract, cucumber, organic biofertilizer.

PEDOMETRIC MAPPING AND SATELLITE REMOTE SENSING BASED PREDICTION OF NITROGEN CONTENT IN KINNOW ORCHARDS OF DISTRICT SARGODHA

Humair Ahmed[1*], M.Z Khan[1], Ishtiaq Hyder[1], Raza Ullah Khan[1], Asim Hayat[1], Maria Niaz[2]

[1]Land Resources Research Institute, NARC, Islamabad, Pakistan.
[2] Institute of Soil and Environmental Sciences, PMAS, Arid Agriculture University Rawalpindi, Pakistan.

*E-mail: humair_uaar@yahoo.com

ABSTRACT

Kinnow is grown in Sargodha region of Pakistan. Nutrient management, particularly optimization of nitrogen (N) management is arduous to improve yield and quality of fruit while enhancing nitrogen use efficiency (NUE), and environment protection. Commonly used soil sampling, analytical techniques and handheld canopy sensors are used for nutrient management in agronomic crops, but use of these technologies for nutrient management in orchards is time consuming and laborious. Keeping in view the limitations of above-mentioned techniques a field survey was carried out for indexing Nitrate-N and total Nitrogen content in the citrus orchard of district Sargodha. Ninety geo-referenced soil along with associated foliage samples were collected. Based on Landsat 8 imagery, 43 vegetation indices (VIs) were calculated and interrelated with NO_3-N and total N content in the foliage. Ordinary kriging was found potential method for pedometric mapping of N status in the soils and foliage. Ratio vegetation indices (RVI 1,2,3) could be used to estimate NO_3-N variability up to 42-69% in the surface, sub-surface and lower soil depths.

Keywords: Foliage, Nutrient management, NUE, vegetation indices.

PERFORMANCE OF PREFERRED WHEAT VARIETIES FOR YIELD AND ZINC BIOAVAILABILITY AS A FUNCTION OF SOIL ZINC APPLICATIONS IN SINDH

Muhammad Asif Siddiqui[*1, 2], Saleem Maseeh Bhatti[1], Inayatullah Rajpar[1], Nizamuddin Depar[3]

[1]Department of Soil Science, Faculty of Crop Production, Sindh Agriculture University Tando Jam Pakistan.
[2]Soil Salinity and Reclamation Institute, Agriculture Research Center, Tando Jam Pakistan.
[3]Soil and Environmental Sciences Division, Nuclear Institute of Agriculture, Tando Jam Pakistan.

***Email:** asifsiddiqui@gmail.com

ABSTRACT

Zinc (Zn) malnutrition cutback by agronomic biofortification of cereals is an immediate and efficient pathway yet depends on many locale factors. A field experiment was executed where ten commonly grown wheat varieties of Sindh were tested for their performance for yield, Zn and phytic acid (PA) concentrations and Zn bioavailability with respect to soil Zn applications. Wheat varieties (Moomal-2002, Mehran-89, NIA-Amber, Abadgar-93, Anmol-91, NIA-Sarang, Sarsabz, Imdad-2005, TD-1 and TJ-83) were grown against soil Zn application rates of 0, 3.3, 6.6, 9.9 and 13.2 kg Zn ha^{-1}, as $ZnSO_4.H_2O$. The plants fertilized with various Zn rates significantly produced more straw and grain yield, Zn concentration and Total Daily Absorbed Zn (TAZ) values and reduced the quantity of PA and PA/Zn molar ratio than the plants where no Zn was fertilized. For defined parameters, the adequate values were observed with 13.2 and/or 9.9 kg Zn ha^{-1} among the Zn fertilized treatments. There was a significant variation among chosen wheat varieties for selected traits. Four varieties, TD-1, NIA-Sarang, NIA-Amber, and Anmol-91 outclassed in performance among the tested varieties. We advise that the Zn should be included in wheat crop cycle, and the professed four best performing wheat varieties with 13.2 kg Zn ha^{-1} should be grown in climatic conditions of Sindh to minimize Zn undernourishment.

Keywords: Zinc malnutrition, Agronomic biofortification, Yield, Zn bioavailability, Wheat

INTEGRATED NUTRIENT MANAGEMENT FOR IMPROVING AGRO-BOTANICAL GROWTH AND STIGMA YIELD OF SAFFRON (*CROCUS SATIVUS* L.)

Muhammad Sarfraz[1], Abdul Khaliq[2]

[1]Department of soil and Environmental Sciences, Faculty of Agriculture, University of Poonch, Rawalakot, Pakistan.
[2]Department of soil and Environmental Sciences, Faculty of Agriculture, University of Poonch, Rawalakot, Pakistan.

*Email: khaliqses72@gmail.com

ABSTRACT

Integrated nutrient management (INM) is an environment friendly and ecologically adoptable approach of plant nutrition to sustain crop productivity and maintain soil fertility on long-term basis. A three year field experiment on saffron was carried out in Abbaspur site of District Poonch comprising twelve treatments combinations; T_1= control; T_2= urea N @ 100 kg ha^{-1} (UN_{100}); T_3= Poultry manure (PM) @ equivalent to 100 kg total N ha^{-1} (i.e. PM_{100}); T_4= Farmyard manure (FYM) @ equivalent to 100 kg total N ha^{-1} (i.e. FYM_{100}); T_5= PM_{50}+FYM_{50}; T_6= UN_{75} + PM_{25}; T_7= UN_{50} + PM_{50}; T_8= UN_{25} + PM_{75}; T_9= UN_{75} + FYM_{25}; T_{10}= UN_{50} + FYM_{50}; T_{11}= UN_{25} + FYM_{75} and T_{12}= UN_{50} + PM_{25}+ FYM_{25}. Results displayed that sole application of PM or in combination with 50 % UN (UN_{50} + PM_{50}) were effective compared to the controls in increasing the number of flowers (72 %), flower dry weight (37 %), stigma length (78 %), dry weight of stigma (45 %), number of daughter corms plant^{-1} (44 %) and corm diameter (68 %) of saffron over three years. In addition the same treatment combination boosted corm weight (126 %), corm yield (126 %) and stigma yield (38 %) over controls across the years. This treatment combination was followed by UN_{50}+PM_{25}+FYM_{25}, while the sole application of UN_{50} did not perform better to the rest of the nutrient treatment combinations. These results showed that UN_{50} in combination with PM_{50} might be developed as potent strategy for improving the growth and yield attributes of saffron.

Keywords: Integrated nutrient management, Saffron, Manure, stigma yield, corm yield.

OPTIMIZING SOIL MOISTURE REDUCTION FOR ROOT AND SHOOT GROWTH OF MAIZE VARIETIES

Manzoor Ahmad[1] Asad Shah[2] and Roshna Ahmad[1]

[1]Department of Agriculture Bacha Khan University Charsadda, Pakistan.
[2]Assistant Director, Agriculture Khyber Pakhtunkhwa Peshawar, Pakistan.

***Email:** drmanzoor@bkuc.edu.pk

ABSTRACT

Maize is one of the most important summer crop of cereal based cropping system in Pakistan. Due to climate change on one hand, winter is squeezing and farming community started to extend its cultivation from spring to summer. On the other hand, water shortage becomes more sever. Root growth is crucial for better crop stand having water limited condition. Therefore, an experiment was designed to screen out the performance of root and shoot growth of different maize varieties in relation to reduction in soil moisture content in District Charsadda crop growing condition. Ten (10) maize varieties namely, Azam, Jalal, Pahari, Kaptaan, Saad, Iqbal, Edhi, Malhan, Bilal (Hybrid) and Azlan (Hybrid) were tested in four (04) different moisture condition i.e. 25%, 50%, 75%, and 100% soil moisture saturation. The experiment was organized in a Completely Randomized Design with three replications having total of 120 experimental units. The results revealed that when average across moisture treatments, maize varieties were found significant ($p<0.05$). Similarly, when average across maize varieties, reduction in soil moisture content significantly ($p<0.05$) effect maize plant growth and development. The findings of this research provide valuable insights into selecting suitable maize varieties for cultivation in the regions characterized by varying water availability.

Keywords: Pot maize, moisture levels, water-use efficiency, growth parameters, crop productivity.

ACIDIC PHOSPHATE FERTILIZERS SUSTAIN HIGHER NUTRIENT AVAILABILITY FOR BETTER CROP YIELD ON ALKALINE CALCAREOUS SOILS

Muhammad Akhtar*[1], Muhammad Yaqub[1], Muhammad Saleem[1], Muhammad Rizwan Khan[1], Arooba Ashraf[1], Ayesha Siddique[1]

[1]Soil &Environmental Sciences Division, Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad.

*Email: akhtarniab@gmail.com

ABSTRACT

Phosphorus (P) is a rare earth mineral and essential macro-nutrient for achieving optimum crop productivity. As the soils of this region are mostly alkaline calcareous, acidic fertilizers may have higher soil availability and consequent productivity of crops. The current study explored the performance of different phosphorus (P) sources i.e., Nutrient Enriched Manure Phosphate (NEM-P) and Superphosphate-plus (SSP-Plus) containing Selenium (Se) and Silicon (Si) and Di-ammonium phosphate (DAP) in rice (*Oryza sativa* L.) production. The P fertilizers were broadcasted and incorporated @ 60 kg P_2O_5 ha^{-1} at transplanting of seedlings and N was applied @ 120 kg N ha^{-1} in two equal splits, at transplanting and tillering stage. A randomized complete block design with four replications was adopted. Cumulative N losses in soil treated with different P fertilizers (DAP, SSP-Plus and NEM-P) after split urea application were assessed in cropped soil under field conditions. Overall, lower N-losses were observed after second split application of urea than that after first split application. Urea sole application caused maximum losses in both splits over that applied in association with P fertilizers. Urea sole application showed higher N losses (18% after first urea split) while urea application in soils fertilized with DAP, SSP-Plus and NEM-P showed lower ammonia losses (10.78, 9.73 and 8.66 %), respectively. Paddy yield was higher in NEM-P treatment when compared with other ones. Besides other quality parameters, paddy grain accumulated higher Se in NEM-P treatment (1346 μg kg^{-1}) while lower in DAP treatment (1074 μg kg^{-1}). Overall, current study revealed the effectiveness of NEM-P through lower N-losses, higher crop yield and improved nutrient availability for plant uptake that could benefit growers in terms of higher produce as well as consumers by getting quality food.

Keywords: Alkaline calcareous soil, NEM-phosphate, Nitrogen losses, paddy yield.

IODINE SOLUBILITY IN SOIL AND ITS UPTAKE BY MAIZE AS INFLUENCED BY IODINE SOURCES, SOIL LIMING AND HUMIC ACID APPLICATION

Asif Naeem*[1], Muhammad Aslam[1]

[1]Soil and Environmental Science Division, Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad, Pakistan.

***Email:** scoutuaf@gmail.com

ABSTRACT

Iodine solubility in soil and its uptake by plants is governed by the complex interaction among the iodine forms, soil pH and organic matter content. Thus, time-dependent water-soluble iodine (WSI) in soil, iodine concentration and uptake by shoots and grains of maize were investigated in limed and humic acid amended soil fertilized with zinc iodide and zinc iodate. Iodine was applied at the rate of 3 mg kg^{-1} soil while lime and humic acid were applied at the rate of 3 g kg^{-1} soil. The WSI in iodide fertilized soil achieved a steady state level within one month of incubation, except for limed soil where it showed a slight decline even after two months of incubation. In iodate fertilized soil, WSI was 2–6 folds higher than iodide fertilized soil and it gradually decreased from 938 µg kg^{-1} soil after one-month of incubation to 562 µg kg^{-1} soil after 3 months of incubation. Humic acid did not affect WSI in iodide fertilized soil but decreased it by 24–48% in iodate fertilized soil. Iodine application had a non-significant negative effect on grain yield, leaf and stalk dry matters. Compared to iodide treatment, iodate fertilized soil resulted in 5 to 7 folds higher iodine concentration in leaves and 5–11 folds higher concentration in stalks. Iodate fertilization to limed soil resulted in 2 folds higher iodine concentration in leaves and up to 3 folds higher in stalks than iodide fertilized soil. A minor quantity of iodine was translocated to grains, and the maximum achieved concentration (200 µg kg^{-1} with iodate) could support one-third of the recommended dietary allowance (RDA). It is concluded that soil iodine fertilization to maize could partially contribute to RDA of iodine, while using iodine enriched shoots as animal fodder could generate substantial iodine intake through secondary route.

***Keywords**:* Biofortification; Humic acid; Iodine; Lime; Maize; Zinc Iodide; Zinc Iodate

EVALUATING WHEAT YIELD AND NITROGEN-UPTAKE IN RELATION TO VARYING LEVELS OF SOIL AND FOLIAR APPLIED UREA

Mazhar Ali Khaskheli[1], Khalid Hussain Talpur[*1], Ziaul Hassan Shah[1], Niaz Ahmed Wahocho[2], and Rija Fatima[1]

[1]Department of Soil Science, Sindh Agriculture University Tandojam, Pakistan.
[2]Department of Horticulture, Sindh Agriculture University Tandojam, Pakistan.

***Email: khtalpur@sau.edu.pk**

ABSTRACT

Modern high-protein wheat varieties need more N fertilizers, which can harm the environment by leaching and emitting gases and also cost a lot. This study aimed to evaluate how varying levels of soil and foliar applied urea fertilizers affect the wheat yield and nitrogen-use-efficiency. The experiment was conducted at the Crop Sciences Institute's experimental field, Agriculture Research Centre, Tandojam. The research design was a randomized complete block with factorial combination of soil and foliar nitrogenous fertilizer treatment through urea fertilizer, i.e. Factor A: Soil nitrogen application: (N1= 0% of recommended dose control, N2= 50% of recommended dose, N3= 75% of recommended dose, N4= 100% of recommended dose), Factor B: Foliar nitrogen application: (F_1= 0% N applied through foliar spray of urea Control, F_2= 2% N applied through foliar spray of urea, F_3= 3% N applied through foliar spray of urea), were used in triplicate. A significant influence of varying levels of soil and foliar applied urea was observed on the tested parameters of wheat. Among the examined treatments, Results revealed that plant height ranged between (53.98-62.05 cm), spike length (7.46-12.57 cm), no. of spikelets per spike (11.60-18.60), number of grains per spike (33.43-48.27), number of tillers m^{-2} (260.33-377.67), 1000-grains weight or seed index (30.12-42.48 g), grain yield (3589.00-5736.30 kg ha^{-1}), straw yield (3538.70-5430.30 kg ha^{-1}), N% in grain (0.58-2.60), N% in straw (0.32-0.86), N uptake in grain (20.77-149.37), N uptake in straw (11.23-46.63). The combination of soil applied nitrogen + foliar applied nitrogen @ the rate of 100% + 3% N kg ha^{-1} respectively, produced better results than the other treatments.

Keywords: Wheat yield, Nitrogen uptake, Soil and foliar nitrogen application.

EFFECT OF DIFFERENT NITROGENOUS AND PHOSPHATIC FERTILIZER SOURCES ON WHEAT YIELD AND MICRONUTRIENTS ACCUMULATION

Rija Fatima*[1], Khalid Hussain Talpur[1], Muhammad Saleem Sarki[1], Ambrin Rajput[2], and Mazhar Ali Khaskheli[1]

[1]Department of Soil Science, Sindh Agriculture University Tandojam, Pakistan.
[2]Soil Fertility Research Institute, Agriculture Research Center Tandojam, Pakistan.

*Email: khtalpur@sau.edu.pk

ABSTRACT

The current study aimed to assess the impact of various nitrogenous + phosphatic fertilizer sources application on wheat yield and micronutrient accumulation. The study was executed at the experimental field of Soil Fertility Research Institute, Agriculture Research Center Tandojam. The experiment was laid out in randomized complete block design with five treatments and four replications. T1: Control (No fertilizer use), T2: NP+CAN, T3: NP +Urea, T4: DAP + CAN, and T5: DAP + Urea, A significant influence of various sources of N and Pwas observed on the tested parameters of wheat. The combined application of DAP + CAN produced better results than the application of NP + CAN, NP + Urea, DAP + Urea as well as control treatment. The results revealed that plant height ranged between (79.507- 87.373cm), spike length (14.298-17.542 cm), number of spikelets spike-1 (5.897-10.006), number of grains spike-1 (20.176-32.994), number of tillers m-2 (269.76-360.95), 1000- grains weight or seed index (31.158- 39.285g), grain yield (4029.4 -5346.6 kg ha^{-1}), straw yield (2752.1-3549.5kg ha^{-1}), Cu% in grain (7.1092-7.1743), Cu% in straw (12.291- 12.370), Fe % in grain (17.631-17.817), Fe % in straw (21.660-22.232), Mn % in grain (23.905-24.230), Mn % in straw(18.772-18.964), Zn % in grain (21.743-22.069), Zn % in straw (11.949-12.212), Cu uptake in grain (218.57-220.46 kg ha^{-1}), Cu uptake in straw (660.36-664.21 kg ha^{-1}), Fe uptake in grain (533.94-538.61 kg ha^{-1}), Fe uptake in straw (1170.6-1181.9 kg ha^{-1}), Mn uptake in grain (737.34-740.00 kg ha^{-1}), Mn uptake in straw (740.00-1018.2 kg ha^{-1}) Zn uptake in grain (665.39-677.51 kg ha^{-1}), and Zn uptake in straw (547.60-557.35 kg ha^{-1}) respectively. Wheat growth and yield were found to be improved with the DAP + CAN (T4) treatment than with any other.

Keywords: Wheat yield, Nitrogenous and phosphatic fertilizer sources, Micronutrients accumulation

EFFECT OF B-FORTIFIED DAP FERTILIZER ON GROWTH AND YIELD PERFORMANCE OF MAJOR CROPS

Aftab Naseem[1], M. Abbas Aziz*[1], Shafiq ur Rehman[1], Imran Khaliq[1], Noman Ali Tahir[1]

[1]Agri Services Department, Marketing Group, Fauji Fertilizer Company Limited, Lahore, Pakistan.

***Email**: abbas_aziz@ffc.com.pk

ABSTRACT

Boron is an essential micronutrient which plays vital roles in reproductive as well as vegetative stages of plant growth and development. Available soil analysis data suggest that nearly 60% of the cultivated soils are B deficient in Pakistan. Presently micronutrient use is very low compared to the occurrence of soil deficiency. Although use of micronutrients especially zinc (Zn) and B has increased, it is very difficult to ensure uniform field application of these nutrients. But in many instances micronutrient deficiencies go unnoticed in the form of hidden hunger. In order to promote the use of micronutrients, fortification/value addition of micronutrients in conventional macronutrient fertilizers is the ultimate solution. For farmers' convenience in uniform application of Boron micronutrient to crops, FFC has developed Boron fortified DAP (B-DAP) through incorporation of B in each granule (B fortified formulated DAP). A number of trials on crops to evaluate the effect of B-DAP (B 0.1%) on growth and yield performance of rice, wheat, potato and sugarcane crops were conducted. Trials were conducted on B deficient trial sites and test products were standard DAP, Boron fortified DAP and DAP+B (as Borax). All DAP variants were applied on the basis of recommended rates of DAP application. Application of B as either B-DAP or in combination with DAP had positive impact on yield contributing growth parameters and significantly improved crop yield compared to the standard DAP application. With B-DAP application, yield of rice, potato, sugarcane and wheat increased by 8.43%, 1.88%, 5.67% and 7.30%, respectively compared to standard DAP. Compared to standard DAP, application of DAP+B yield increase was 7.63, 2.60, 2.08 and 5.05 % for rice, potato, sugarcane and wheat crops, respectively. This increase in yield is attributed to uniform application of B, enhanced efficiency and B availability to the plants along with phosphorus.

Keywords: Boron fortified DAP, Micronutrients, Fortification, Hidden hunger

PEDOMETRIC MAPPING AND SATELLITE REMOTE SENSING BASED PREDICTION OF POTASSIUM CONTENT IN APPLE PRODUCING REGION OF DISTRICT SWAT

Maria Niaz[1*], M. Tariq Siddique[1], Khalid Saifullah[1], Ishfaq Ahmad Hafiz[1], Humair Ahmed[2], Muhammad Iqbal[3]

[1]Institute of Soil and Environmental Sciences, PMAS, Arid Agriculture University Rawalpindi, Pakistan.
[2]Land Resources Research Institute, NARC, Islamabad, Pakistan.
[3]Space and Upper Atmosphere Research Commission, Rawalpindi, Pakistan.

***Email:** niazmaria1390@gmail.com

ABSTRACT

Average yield of fruit orchards in Pakistan i.e., 9 tonnes per hectare is alarmingly low when compared to world's average yield i.e., 25 tonnes per hectare. While average yield of apple orchards in Pakistan is 6.1 tonnes per hectare which is very low when compared to other apple producing countries. There might be several reasons for lower average yield of apple orchards in Pakistan, but nutrient deficiency is one of the main reasons. Keeping in view the limitations of classical statistics for explaining spatial heterogeneity, a survey in the farmer grown apple orchards was conducted for indexing K content using geo-statistics and GIS as a diagnostic tool. Geo-referenced soil samples were collected from 60 apple orchards. Recently matured leaves were sampled from associated apple trees. Our results indicated that 90% of orchards were categorized as low to marginal in extractable K content. Total K content in the foliage were deficient in the surveyed area. The moderate to strong spatial dependence of K content in soil provided an opportunity to prepare contour maps for classifying the whole area into various management zones based on having differential K content for regional scale information. Based on Landsat 8 imagery, 10 vegetation indices (VIs) were calculated and interrelated with extractable K content and total K content in the foliage. Ordinary kriging was found as a potential method for pedometric mapping of K status in the soils and foliage. Ratio vegetation indices (RVI 1,2,3) could be used to estimate K variability up to 50-75% in the surface and sub-surface soil depths. Normalized difference Vegetation Index was found promising for total K prediction.

Keywords: Potassium, Apple, Geo-references, Geo-statistics, Swat.

RESPONSE OF MAIZE VARIETY *DADU-1* TO VARIABLE RATES AND INTERACTION OF PHOSPHORUS AND POTASSIUM

Zeeshan Mashori[*1], Farhan Nizamani[1], Saima Kalsoom Babar[1], Hassan Ali Shujrah[1]

[1]Department of Soil Science, Sindh Agriculture University Tandojam, 70060, Pakistan.

*Email: Zeeshanmashori01@gmail.com

ABSTRACT

Considering their likelihood for fixation and losses, phosphorus (P) and potassium (K) are required comparatively in greater amounts for vegetative growth, crop quality, and grain yield. Phosphorous and K interaction is just negligible in the agriculture system. To determine how different rates of P and K fertilizer application affect maize growth and yield, this research was conducted. In this regard, a field experiment was conducted at the Statistics Section of the Agriculture Research Institute Tandojam, Pakistan. This study examined the effects of five treatments and three replications on one variety of maize Dadu-1 using a randomized complete block design (RCBD). Treatment regime was set as T1, control/no fertilizer, T2, P2O5=60 kg ha-1+K2O=50 kg ha-1, T3, P2O5=90 kg ha-1+K2O=50 kg ha-1, T4, P2O5=60 kg ha-1+K2O=60 kg ha-1, T5, P2O5=90 kg ha-1+K2O=60 kg ha-1. Experimental findings showed that maximum numbers of grains cob-1 (468.46), weight of cob (285.13g), 1000 grains weight (344 g), grains yield (4861 kg ha-1), and concentration of P (1.86%), concentration of K (0.42%) were observed in T5. While minimum numbers of grains cob-1 (349.13), weight of cob (150 g), 1000 grains weight (224 g), grains yield (4054 kg ha-1), concentration of P (1.46%) and concentration of K (0.18%) were observed in control/No fertilizers application (p<0.05). Phosphorus and K applied at the rate of (90+60 kg ha-1) were found significant as compared to the rest of the other treatments on maize. Therefore, assuming adequate soil and crop management can improve growth and yield components.

Keywords: Macronutrient; Synergism, Alkaline soil, Local variety; Cereal crop.

EVALUATION OF SUNFLOWER GENOTYPES FOR K-USE EFFICIENCY AT EARLY GROWTH STAGE

Hajra Khan[1], Zia-ul-hassan[2*], Javed Ahmed Shah[3] and Ghulam Murtaza Jamro[2]

[1]Oil Seed Research Institute, Agriculture Research Centre, Tandojam, Pakistan.
[2]Department of Soil Science, Sindh Agriculture University, Tandojam, Pakistan
[3]Soil Science Division, Nuclear Institute of Agriculture, Tandojam, Pakistan.

*Email: hajraimran2006@gmail.com

ABSTRACT

Sunflower genotypes may vary in ability to perform under inadequate soil potassium (K) availability due to their varied nutrient use efficiency (NUE). In order to classify genotypes for KUE, varied criteria is adopted based on deficiency symptoms, biomass production, plant nutrient concentration and uptake etc. With accelerated release of crop varieties, there is need to develop sound criteria to categorize genotypes as nutrient responsive and non-responsive, efficient and non-efficient, ensuring validity of the results used in the breeding programs. This research was mainly aimed at evaluating 45 sunflower genotypes for K-use efficiency under field conditions. In K-adequate plots, recommended rate (60 kg K ha^{-1}) was applied; while in control (K-deficient), the soil was kept untreated for applied K. K deficiency generally reduced sunflower growth; however, K-efficient genotypes accumulated more biomass due to higher K uptake. Genotype HO-1revealed excellent adaptation potential in terms of high shoot dry weight under both K regimes and ranked as the only most desirable, "efficient-responsive" genotype. Genotype Euroflore produced low shoot dry weight under low K condition and ranked as "non-efficient." Genotype Sputnik produced low shoot dry weight at adequate K level and ranked as "non-responsive."The validity of results was ensured through the use of two different methods for genotype ranking.

Keywords: Helianthus annuus, K-concentration, NUE, Index scoring technique.

EFFECT OF PHOSPHORUS FROM DIFFERENT SOURCES ON THE COMPOSTING PROCESS, PHOSPHORUS FRACTIONATION, AND CROP YIELD IN CALCAREOUS SOILS

Dost Muhammad[1], Muhammad Waheed[2], Maria Mussarat[1] and Zaryab Khan[1]

[1]Department of Soil and Environmental Sciences, The University of Agriculture, Peshawar, Pakistan.
[2]Soil Survey, Directorate General of Soil and Water Conservation, Khyber Pakhtunkhwa, Pakistan.

*Email: dost@aup.edu.pk

ABSTRACT

Phosphorus transformation, fractionations and availability to plants vary with sources of P fertilizer in addition to several other soil and climatic factors. In this regard a series of laboratory and field experiments were conducted during 2017-19 to evaluate the influence of pretreatment of composting materials with phosphorus sources on compost quality, P fractionation, bioavailability and its resultant effects on wheat-maize yields. Wheat straw and farmyard manure were pretreated with varying amounts of phosphorus from RP (rock phosphate) or TSP (triple super phosphate fertilizer) and left to decompose for 150 days in closed pits. The prepared composts were then applied to fields for wheat and maize yields and P use efficiency. The results showed that pretreatment delayed the thermophilic stage in both composting materials, facilitating decomposition for a longer period. The decline in total organic carbon and narrowing in the C:N ratio was faster in P-treated composts, with a more prominent effect in wheat residue than FYM. Labile phosphorus tended to transform into non-labile phosphorus with incubation time, possibly due to mineral P conversion into organic P or adsorption onto exchange sites on organic residues. Similarly, results of field studies showed that pre-treatment of compost with P resulted in higher wheat and maize plant growth and yields. When applied alone or in conjunction with FYM, TSP performed significantly better but upon pre-treatment with compost, RP and TSP performed at par or even the RP-enriched compost performed better than TSP enriched compost in residual crops revealing lasting effect and slow release of P from RP sources and less conversion to non-labile fraction. These results suggest that enrichment of compost with P is viable and feasible option to enhance composting process and quality, and minimize the bulk of compost otherwise required for optimum P availability and crop yield.

Keywords: Composting, Enriched compost, Phosphorus fractionation, P use efficiency, rock phosphate.

LOWER NH_3 EMISSION FROM BORON COATED UREA IMPROVES PRODUCTIVITY OF WHEAT GROWN ON ALKALINE SOILS

Sajid Mahmood*[1], Basit Haider[1], Muhammad Akhtar[1]

[1]Soil and Environmental Sciences Division, Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad, Pakistan.

*Email: smwatto@yahoo.com

ABSTRACT

Urea is widely applied to agricultural crops as a source of nitrogen (N), however, a large portion of applied N (about 40-60%) is lost to the environment through nitrification/denitrification losses, surface runoff and leaching below root zone. Boron (B) is a micronutrient and about 31% of world soils and 49% of Pakistani soils are B deficient. The boron coated urea (BCU) may be applied to compensate B requirements of crop plants as well as help decrease N losses in alkaline soils. Present study was aimed to decrease ammonia (NH_3) volatilization losses and boron fortification of wheat grown under natural field conditions. Different formulations of BCU were applied at 150 kg N ha^{-1} to wheat crop in three equal splits in comparison with plain urea and NH_3 volatilization losses were measured after application of each split. The urea coated with borax (at 1% using mustard oil) resulted in lower NH_3 volatilization losses (up to 37%) and improved grain yield of wheat (up to 13%) as compared to plain urea. Moreover, BCU also improved B uptake by wheat grains over plain urea treatment. The current findings suggested application of boron coated urea for enhancing nitrogen use efficiency, B fortification and crop productivity by curtailing environmental contamination from applied fertilizer as NH_3 volatilization.

Keywords: Coated urea, Boron uptake, Ammonia losses, Wheat.

IMPACT OF TRYPTOPHAN APPLICATION ON GROWTH AND YIELD OF *Lycopersicum esculentum* L.

Noor ul Ain[1]*, Hafiz Tanvir Ahmad[2], Muhammad Salik Ali Khan[1], Ghulam Rasul[1], Fariha Amin[1] and Imran Latif[1]

[1]Soil and Water Testing Laboratory for Research, Lahore, Pakistan.
[2]National Cotton Breeding Institute (NCBI), the Islamia University of Bahawalpur, Pakistan.

*Email: noorulainkate94@gmail.com

ABSTRACT

In addition to its culinary significance, tomatoes hold immense nutritional value, contributing essential vitamins and antioxidants to human diets. The incorporation of tryptophan, an essential amino acid, into tomato cultivation not only enhances plant development but also adds nutritional value to the resulting fruits. Tryptophan, an essential amino acid vital for plant growth and development, plays a key role in the biosynthesis of plant compounds. Serving as the primary precursor of indole acetic acid, a crucial regulator in plant growth, it positively influences various physiological processes in plants. This study aimed to assess the impact of foliar application of tryptophan on tomato (*Lycopersicum esculentum* L.) plants, utilizing a randomized complete block design with five different concentrations. The results indicated that optimal tryptophan levels significantly enhanced both the growth and yield of tomato plants. Morpho-physiological parameters were observed across different growth stages, and chemical analysis post-harvest revealed positive effects on fruit development. Statistical analysis using statistix 8.1 confirmed that tryptophan application positively influenced the overall growth and yield of tomatoes, highlighting its potential as a valuable supplement in tomato cultivation.

Keywords: Tunnel, Tryptophan, Auxin, Tomato.

ENHANCING GARLIC GROWTH AND YIELD VIA PGPR-ENRICHED VERMICOMPOST

Muhammad Rizwan Khan*[1], Tauseef Tabassam[2], Dost Muhammad[1] , Farmanullah Khan[1,3], Muhammad Sharif[1]

[1]Department of Soil and Environmental Sciences, The University of Agriculture Peshawar, Pakistan.
[2]Land Resources Research Institute, National Agricultural Research Centre (NARC), Islamabad, Pakistan.
[3]Directorate General Soil and Water Conservation, Agriculture Department, Government of Khyber Pakhtunkhwa, Peshawar, Pakistan.

*****Email: drmuhammadrizwankhan@gmail.com

ABSTRACT

A pot experiment was conducted to determine the effect of vermicompost enriched with different microbial strains on the growth and yield of garlic. The experiment was laid out in Completely Randomized Design (CRD) in three replications during the year 2019-2020. Vermicompost enriched with PGPR strains [(*Pseudomonas stutzeri* (S-I), *Pseudomonas aeruginosa* (S-II) and *Pseudomonas putida* (S-III)] was added @ 10 t ha^{-1} before sowing. Results showed significant ($P \leq 0.05$) improvement in various growth and yield parameters. Chlorophyll content increased by 23% in garlic plants with vermicompost enriched with S-III. Maximum plant height of 51.6 cm was observed in treatment where S-III was inoculated with vermicompost, showing 32% increase over control. Fresh and dry weights of garlic plants were increased by 41% and 29% respectively in treatment where vermicompost was inoculated with S-III. Maximum and significantly ($P \leq 0.05$) improved garlic bulb yield of 17.91 g pot^{-1} with 40% increase and diameter of 3.62 cm with 23% increase over control were recorded in treatment of VC enriched with S-III. Post harvest soil pH values were slightly affected. Maximum shoot N, P and K concentrations were recorded as 4.06 %, 1558 mg kg^{-1} and 27088 mg kg^{-1} respectively. In garlic bulbs, bacterial inoculation with vermicompost showed the highest values of N, P and K concentrations as 2.33 %, 1191 mg kg^{-1}, and 21161 mg kg^{-1}, respectively which were 54%, 69% and 53% more than control which had un-inoculated vermicompost. Highest values for macronutrient uptake were recorded as 0.35 g pot^{-1}, 0.015 g pot^{-1}, and 0.263 g pot^{-1}, with percent increase of 87%, 114%, 91% for N, P and K respectively, Results showed that microbially enriched vermicompost has potential to improve garlic yield. Inoculation of *P. putida* (S-III) with VC proved the most effective strain to improve garlic yield under the prevailing conditions.

Keywords: PGPR, Garlic, Vermicompost, Microbial inoculation.

MODIFIED NITROGEN RECOMMENDATIONS OF FINE RICE FOR PUNJAB: INSIGHTS OF AGRONOMIC AND ECONOMIC EFFICIENCY

Muhammad Nadeem Iqbal*[1], Samina Hamid[1], Zia Chishti[1], Abdul Ghaffar[1], Muhammad Akram Qazi[1], Hafiz Riaz Ahmad[1], Sajid Ali, Nadeem Raza[1], Abdul Waheed[1]

[1]Soil Fertility Research Institute, Lahore, Pakistan.

*****Email: nadeemiqbal66@gmail.com

ABSTRACT

A substantial increase in fertilizers prices in the last few years and the introduction of high-yielding varieties has urged to revamp the fertilizer recommendations to rationalize the use of fertilizers to meet the production target in the most economical way. For this purpose, field studies were conducted in rice and central zones of Punjab, Pakistan to determine the response of fine rice to increasing nitrogen doses. In brief, during the first two years of study (2017-18), seven graded doses (0, 28, 56, 84, 112, 140, 168 kg ha^{-1}) of nitrogen application at transplanting were tested at different locations. Phosphorus and potash were applied @ 90 and 60 kg ha^{-1}, respectively as basal doses in all treatments except the control. Results of the study revealed that by increasing nitrogen level up to 140 kg ha^{-1}, a significant increase in paddy yield. However, further increase in N application did not result in increase in yield; rather it decreased the paddy yield. Agronomic efficiency and partial factor productivity of N decreased to 9.3 and 30 respectively at N application rates of 140 and 168 kg ha^{-1}. Economic analysis of N showed decreasing marginal rate of return (MRR) with increasing doses on N and it was 5.0 and 2.5 respectively for Rice and Central zones at 140 kg N ha^{-1}. Above this level of N, the MRR became negative. Therefore, it was concluded that soil application of 140 kg N ha^{-1} was the most optimum dose for obtaining an economic yield for current fine varieties of rice.

Keywords: Agronomic efficiency, Nitrogen, paddy yield, economics, fine rice.

POTENTIAL OF BIOCHAR AND MINERAL NUTRIENTS ON PLANT RESISTANCE TO STRESSES AND DISEASE MANAGEMENT

Abdul Basit*[1,3], Mueen Akram[1], Kashif Ali Khan[1], Faizan Bashir[1], Huzaifa Luqman[1], Saira Irum[4], Sammar Abbas[1]

[1]Department of Soil Science, University of Layyah, Layyah, Pakistan
[2]Department of Soil Science, FAS&T, BZU, Multan, Pakistan
[3]Department of Fertilizer Quality Control, Evyol Group, Pakistan
[4]Department of Plant Pathology, PMAS, AAUR, Rawalpindi, Pakistan

*Email : sheikhu.ab@gmail.com

ABSTRACT

Synthetic chemicals for pathogens (SCPs) facilitate remarkable plant growth in relation to plant defense management (DM). However, SCPs impart few negative impacts on the plant by the accumulation of harmful chemicals, giving rise to significant health risks and malnutrition issues. Undesirable effects of SP begin during production, generating hazardous byproducts that worsen environmental pollution. Additionally, the application of SCPs induces adverse effects on soil physiochemical and biological properties. On the other hand, biochar and mineral nutrients have positive effects on soil health and DM (*Ralstonia solanacearum, Phaeoacremonium minimum, Fusarium oxysporum,* and *numerous additional*). Biochar of various crop residues (poultry and animal manures), and micro- and macro-nutrients increase plants' metabolic and enzymatic activities (MEA) and play a vital role in DM. DM involves the comprehensive management of plants' defense, including root and foliar disease management. The availability of certain nutrients is crucial for DM, and biochar and mineral nutrients follow an integrated pathogen and pest management system (IPPM) by supplying essential nutrients for plants' MEA. Using soil amendments containing mineral nutrients is a promising approach that contributes significantly to IPPM and soil health and is in line with the circular economy's zero-waste strategy. Therefore, to completely comprehend the effects of biochar mineral nutrients and identify the best practices for its application for DM, toxicological risk assessments and research are essential.

***Keywords*:** Soil Health, Synthetic Chemicals, Biochar and Mineral Nutrients, Integrated Pathogen and Pest Management, Plant Defense Management

ROCK PHOSPHATE SOLUBILITY CAN BE IMPROVED BY VERMICOMPOSTING AS CONFIRMED BY NUTRIENT UPTAKE AND ONION GROWTH

Fazli Wahid [1*], Amjad Ali [1,2*], Rafiullah[1], Muhammad Adnan[1,] Hidayat Ullah[1], Muhammad Azim Khan[3], Ishaq Ahmad Mian[3], , Muhammad Javed[4]

[1]Department of Agriculture, University of Swabi, Anbar 23561, Pakistan.
[2]School of Environmental and Municipal Engineering, Xi'an University of Architecture and Technology, Xi'an 710055, China.
[3]The University of Agriculture Peshawar, Peshawar-25130, Pakistan
[4]Office of Assistant Director Agriculture Extension, Khagwani Hazro-43440, Attock, Pakistan.

*Email : fazliwahid@uoswabi.edu.pk

ABSTRACT

Vermicomposting can be adopted as a cost-effective climate smart technology for improving P mineralization from rock phosphate (RP) and increasing soil-plant health. The current study was conducted to convert the RP-blended degradable organic wastes into phosphorus (P) rich vermicompost through earthworms and phosphate solubilizing microbes (PSMs) and assessed its role on onion growth and soil health. Three types of RP-enriched vermicomposts were produced by mixing powdered RP with biodegradable wastes in the presence of earthworms and PSMs in vermi-boxes, pits, and piles. The efficiency of each vermicompost was evaluated on onion growth and nutrient uptake in a pot trial. Then, the most efficient vermicompost selected for pot trial was further assessed on onion growth parameters and soil health under field conditions. The results expressed that under pot trial, half fertilization of RP-enriched vermicompost together with half doses of inorganic fertilizers (Urea, SSP, SOP) significantly enhanced shoot biomass (17.66 g pot^{-1}), bulb weight (94.65 g pot^{-1}), plants height (34.33 cm) as well as N (242.33 mg pot^{-1}) and P (20.06 mg pot^{-1}) uptake by onion as compared to control. Similarly, compared to sole RP vermicompost, the N and P uptake, shoot dry biomass, height, and bulb weight of onion plants under field conditions were also significantly improved by the treatments supplemented with half doses of both inorganic fertilizers and RP-enriched vermicompost. The current experiments concluded that half dose of RP-enriched vermicompost in combination with half inorganic fertilizers has great potential to improve soil health, nutrient uptake, and growth parameters of onion under pot and field conditions. The RP-enriched vermicompost can be used as a cost-effective and climate-smart strategy to increase vegetable growth and minimize the usage of chemical fertilizers in alkaline calcareous soils.

Keywords: Onion growth, Organic wastes, Nutrient uptake, Rock phosphate, Vermicomposting

SUNFLOWER RESPONSE TO POTASSIUM APPLICATION IN ARTIFICIALLY DEVELOPED CALCAREOUSNESS

Abdul Aleem Memon[1*], Inayatullah Rajpar[2], Ghulam Murtaza Jamro[2], Javaid Ahmed Shah[3], Hafeezullah Babar[1], Muhammad Suleman Memon[1], and Ambrin Rajput[1]

[1]Soil Fertility Research Institute, Agriculture Research Center, Tandojam, Pakistan
[2]Department of Soil Science, Faculty of Crop Production, SAU, Tandojam, Pakistan
[3]Soil and Environmental Sciences Division, NIA, Tandojam, Pakistan

[*]E-mail: memonaaleem@gmail.com

ABSTRACT

High soil calcareousness and poor potassium (K) availability are significant growth-limiting factors for sunflower plants. Understanding the interactions between soil calcareousness and K supply is critical for enhancing sunflower growth and K fertilizer use efficiency. The objective of this study was to investigate the influence of interactions between soil calcium carbonate levels and potassium application rates on the early growth of sunflower plants grown in a wire-house in silty clay soil. The targeted calcium carbonate levels were 5, 10, 20, and 30% of the soil, and K application rates were 60 and 120 kg K_2O ha^{-1} in the form of SOP. The pot experiment was designed in a completely randomized design with four replications. In sunflower seedlings, increasing calcium carbonate levels reduced growth metrics such as shoot height, root length, fresh shoot weight, dry shoot weight, fresh root weight, and dry root weight. Similarly, increasing soil calcium carbonate reduced shoot K content and chlorophyll concentration in leaves in contrast to the control. The higher rate of K fertilizer relieved the limiting effects of soil calcareousness on sunflower chlorophyll concentration, shoot K concentration, and growth to some extent. The shoot K content was increased by 21.91% and total chlorophyll concentration increased by 17.31% with the higher K application rate (120 kg K_2O ha^{-1}) over control. The results showed that under calcareous soil conditions, sunflower plants perform better at the early stage when fertilized with 120 kg K_2O ha^{-1}.

Keywords: Calcareous soils, potassium application rate, Sulphate of potash, K nutrition, sunflower seedling

MODIFYING EFFECT OF MINERAL NITROGEN, PHOSPHORUS, AND CELLULOSE ON BIOCHAR INDUCED CHANGES IN SOIL HEALTH INDICATORS

Shemawar[1], Tanvir Shahzad[*1]

1Department of Environmental Sciences, Government College University Faisalabad

*Email: tanvirshahzad@gcuf.edu.pk

ABSTRACT

The effects of adding cellulose on a variety of soil health indices are explored, as well as the intricate interactions between biochar, essential soil elements including mineral nitrogen and phosphorus, and biochar. Due to their ability to improve soil conditions, biochar's unique physicochemical properties have generated a great deal of attention. In order to evaluate the effects of biochar, mineral nitrogen, phosphorus, and cellulose on microbial activity, nutrient cycling, pH dynamics, and the potential for carbon sequestration, we designed lab research. Following the addition of the required amounts of wheat straw biochar, corncob cellulose, and chemical nitrogen and phosphorus to per gram soil, microcosms of 80 g of dry-equivalent fresh soils were incubated in mason jars for 26 days. Following 26 days of incubation, we found that across the cellulose treatments, mineral P and mineral N caused 18.5% and 18.1% greater cumulative C mineralization, respectively. Therefore, both of our hypotheses were proven correct: adding chemical fertilizers N and P increased the advantages of biochar and adding cellulose encouraged carbon mineralization while also increasing the availability of nutrients in the soil. Our research revealed intricate relationships between these variables, which had an impact on soil health indices both synergistically and antagonistically. Biochar is already being used, which highlights its benefits for improving nutrient retention, encouraging microbial diversity, and assisting carbon sequestration. However, the presence of mineral phosphorus and nitrogen, together with cellulose, causes pH shifts, nutrient availability variations, and microbial breakdown rates to fluctuate dynamically. The significance of specialized soil management techniques that consider the complexity of amendments is highlighted by these interactions. In order to better understand how these interactions affect soil health and offer suggestions for improving sustainable agriculture practices, we are able to decipher these complex linkages. Such findings open the door for well-informed decision-making in soil management for increased productivity and environmental stewardship as global agricultural systems confront rising challenges.

Keywords: Microbial biomass carbon, soil respiration, extracellular enzyme activity, soil phosphorus, Mineral nitrogen.

IMPACT OF ZINC SOAKING ON THE GERMINATION OF WHEAT SEEDS

Saibrina Sethar[1,2], Dr. Hafeezullah Babar[1], Dr. Mahendar Kumar Sootahar[1,2], Muhammad Aslam Panhwar[1,2], Khalid Hussain Khokhar[1,2] and Abdul Qudoos Abbasi[1,2]

[1]Soil Fertility Research Institute Sindh Agriculture Research Center, Tando Jam, Pakistan
[2]Department of Soil Science Sindh Agriculture University, Tando Jam, Pakistan

*Email: saibnoor90@gmail.com

ABSTRACT

Zinc (Zn) is an element that is necessary for various enzymatic, ionic, and metabolic processes, particularly during seed germination. This study aimed to assess the impact of various zinc-soaking solutions on the germination of wheat seeds. The field investigation was conducted at the Soil Fertility Research Institute in Tandojam. Randomized complete block design with a plot size of 4×5 meters (20 m^2) were employed. T1 consisted of distilled water without zinc; T2 included 2% zinc sulfate; T3 contained 2% zinc nitrate; and T4 had 2% zinc chelate solutions. Each treatment had three replications. The results showed that soaking seeds in zinc significantly improved seed germination. T2 (zinc sulfate) had the greatest germination rate, which reached 89%. It had a robust root length of 2.0 cm, demonstrating rapid seedling growth. T4, which had an average root length of 1.9 cm and an 87% germination rate. T3 (zinc nitrate) showed 1.7 cm of root growth along with an increased germination rate of about 85%. The control (T1) had the lowest seed germination (75%), the smallest root length (1.4 cm), and relatively weaker seedling vigor. In conclusion, zinc soaking treatment, especially with zinc sulfate and zinc chelate, showed a clear and beneficial effect on wheat crop seed germination, root length, and general seedling vigor. These results highlight the potential advantages of supplementing with zinc to maximize crop productivity.

Keywords: zinc compounds, wheat seed germination, seed soaking

GLUCOSE ADDITION PATTERNS INFLUENCE SOIL MICROBIAL BIOMASS CARBON, CARBON DIOXIDE ACCUMULATION AND PROPERTIES OF BLACK SOIL IN CHINA

Muhammad Suleman Memon[1], Hafeez. B[1], Ambrin Rajput[1] , Abdul Aleem Memon[1], Aijaz Ali Odhano[1], Mehrunissa Memon[2],Nizamuddin Depar[3] and Minggang Xu[4].

[1]Soil Fertility Research Institute, Agriculture Research Centre Tandojam 70060, Pakistan.
[2]Department of Soil Science, Sindh Agriculture University Tandojam, Pakistan.
[3]Soil & Environmental Sciences Division, Nuclear Institute of Agriculture, Tandojam, Pakistan
[4]Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences, Beijing 100081, China.

Email : sulemanyousufmemon@gmail.com

ABSTRACT

An incubation study was conducted in the black soil of Jilin province of China to determine the effects of glucose addition patterns (single and repeated additions) on soil microbial biomass carbon (SMBC), CO_2 accumulation, and soil properties. Forty gram air-dried soil was filled into 250 mL Schott bottles and the bottles were arranged in factorial-CRD with 5 replications. Single addition received all amounts of glucose at the start of the experiment while repeated addition received the same amount of glucose in five splits. Control received water only. Five different types of black soil were used in the study. Thereafter, a C-labeled glucose (2%) solution was added dropwise to the soil. The additions pattern showed variable impact on soil microbial biomass, CO_2 release, and soil properties. Single and repeated additions increased SMBC by 25.6% and 11.9% compared to control. The highest CO_2-C concentration was produced in the second week after glucose addition. It was observed that different addition patterns (single and repeated) endorsed variable impact on SOC concentration depending on soil type, and time since glucose was added. The single addition showed higher SMBC, CO_2 evolved and accumulation in the initial incubation period (2nd week), later on, up to the 16th week repeated additions showed higher soil microbial biomass and CO_2 accumulation.

Keywords: Addition patterns, Soil Microbial biomass, CO_2, Single addition, Repeated addition

FERTILIZATION AND SALICYLIC ACID APPLICATION FOR GROWTH ENHANCEMENT AND RUST DISEASE MANAGEMENT OF WHEAT

Ambrin Rajput[1*], Hafeezullah. Babar[1], Muhammad Suleman Memon, Ajaz Ali Odhano, Qurban Ali Panhwar, Shazia Pathan, Hassan Bux Rashidi and Abdul Aleem Memon

[1]Soil Fertility Research Institute Tandojam, Agriculture Research Center, Tandojam, Pakistan
[2]Soil & Environmental Sciences Division, Nuclear Institute of Agriculture Tandojam, Pakistan

*Email: ambrin2004@gmail.com

ABSTRACT

Wheat (*Triticum aestivum* L.) is one of the most important edible foods for the human. However, its yield is restricted by insufficient nutrient availability. Wheat stem rust (*Puccinia graminis*) is a serious threat to wheat production all over the world. Salicylic acid (SA) is a defensive plant hormone that regulates plant immunity and its effects on the resistance to biotic stress including plant pathogens (rust disease). A study was conducted to evaluate foliar spray of SA with soaked and unsoaked seeds with NPK to improve wheat yield and control rust disease. Thrice replicated treatments included: T1 NPK (168-90-60 kg ha^{-1}), T2 Soaked seed 1% SA + NPK, T3 3FS (Foliar spray at 30, 60, and 90 DAS of SA +NPK), T4 Soaked Seed 1% SA + 3FS at 30, 60, and 90 DAS +NPK. The results showed that the maximum production of spikelets (23) and number of tillers per m^2 (257), 1000-grain weight (47 g), grain yield (5255 kg ha^{-1}) in T4 (NPK + Soaked seed 1% SA + 3FS) and minimum were in T2 (NPK+ soaked seed 1% SA). The addition of salicylic acid with foliar and soaked seed increased relative water content (54.9 %) and chlorophyll content (37.15 %), and N (79.8), P (12.9) and K (74.4) uptake in kg ha^{-1}. The rust disease gradually increased with the period. Two types of disease response based on a disease rating scale of 1-9 were observed i.e. resistant and moderately resistant. The analysis of variance of the data showed the moderately resistance disease rating scale at the treatment T1 NPK and T2 NPK + Soaked seed where foliar spray of SA was not applied. Thus, salicylic acid of foliar spray with balanced fertilization was observed to establish positive responses in the plants.

Keywords: plant nutrition, growth hormone, plant growth, physiological parameters, grain yield, rust infestation

EFFECT OF DIFFERENT PHOSPHATIC FERTILIZERS ON GROWTH AND YIELD OF LATE-SOWN WHEAT VARIETIES

Khalid Hussain Khokhar[1], Mahar-un-nisa Memon[2], Hafeezullah Babar[1], Ambreen Baby Rajput[1] Mahendar Kumar Sootahar[1], Saibrina Sethar[1], Muhammad Aslam Panhwar[1]

[1]Soil Fertility Research Institute Sindh Agriculture Research Tandojam 70010, Pakistan
[2]Department of Soil Science Sindh Agriculture University Tandojam 70010, Pakistan

Email: khokharkh@gmail.com

ABSTRACT

Wheat is the most widely cultivated crop in the world and it plays a significant role in global food security. Phosphatic fertilizers can play a crucial role in promoting wheat growth and yield. This study focused on different phosphatic fertilizers (DAP, NP, and SSP) that were applied to wheat varieties (TD-1. SKD-1, and TJ-83). The results of the present study revealed that spike length, the number of grains/spikes, seed index, and grain yield significantly increased with P (DAP, NP, and SSP) sources. The results of this study generally suggest that NP and DAP have behaved equally and show better performance over SSP. The data showed that TJ-83, being a taller variety, gave better plant height. In addition, grain yield was maximum (3345 kg/ha) for SKD-1 in the NP-applied treatment, followed by the same variety in the DAP-applied treatment (3343 kg/ha). TD-1 applied with NP resulted in a yield of 3330 kg/ha, while TD-1 applied with DAP resulted in a yield of 3236 kg/ha, with the minimum yield observed in the control (1234 kg ha^{-1}). P sources observed significant effects on N and P contents in straw. The P content in straw was much higher (0.07%) in SSP-applied treatment compared to DAP and NP (0.4%). The three wheat varieties did not differ in N content in grains and straw and K content in straw. The P and K in grains were highest in TD-1 followed by SKD-1, and TJ-83, which behaved equally. Whereas P content in straw was highest in TJ-83.

Keywords: Phosphatic Fertilizer, Wheat varieties

EDAPHO-VEGETATION RELATIONSHIPS IN THARPARKAR, PAKISTAN

Irfan Ahmed Sahito[1*], Muzafar Hussain Sirohi[1], and Nizamuddin Depar[2]

[1]Department of Botany, Shah Abdul Latif University, Khairpur, Pakistan
[2]Nuclear Institute of Agriculture Tandojam, Hyderabad, Pakistan

Email: Ia5933637@gmail.com

ABSTRACT

Soil plays an influential role in the growth and distribution of plants. It provides the mechanical support and also nutrients necessary for plant growth including potassium (K), phosphorus (P), and nitrogen (N). Twenty-two samples of different Tharparkar soils were collected for analysis at the Water Testing Laboratory, Nuclear Institute of Agriculture (NIA), Tandojam. Plant and soil sampling approach and a detailed topography survey were combined to evaluate the edapho-vegetation relationship and its influence on plant distribution. The quadrate sampling method is one of the most adequate methods for vegetation surveys. The research used ten (10) quadrates per site; each quadrate was 12.6 feet. Every species of a plant was counted, and all quadrates were separated from each other by 50 m. At the study location, the plants were identified using available literature. Although Tharparkar is predominantly a sandy desert, there exists a small proportion of clay. The soil's nutrient levels were found to be deficient, as per the recorded data. The average organic matter content was considerably lower than the standard level, measuring below 0.5%. The percentage of nitrogen was also below the recommended level for healthy plant growth. In about half of the samples, the potassium content was less than 100 mg/kg. These findings indicate that the soil may not be conducive to supporting healthy plant growth and requires appropriate intervention to replenish the nutrient levels. The distribution of plant species was affected by various soil parameters. Among these parameters, the parentage of silt, organic matter, and potassium had a relatively higher impact on vegetation dynamics in the area.

Keywords: Edapho-vegetation Relationship, Soil sampling, Analysis, Soil Texture, Chemical Analysis, Macronutrients

WHEAT (*Triticum aestivum* L.) GROWTH IN RESPONSE TO ACTIVATED CARBON-TO-NITROGEN RATIOS UNDER CALCAREOUS SOIL CONDITIONS

Sajid Masood[1]*, Muhammad Abid Ali Khan[1], Mubashir Hussain[2*], Niaz Ahmed[1], Muhamad Ashraf[3], Khalid Saifullah Khan[4]

[1]Department of Soil Science, Faculty of Agricultural Sciences and Technology, Bahauddin Zakariya University, 60800-Multan, Pakistan
[2]Institute of Agronomy, Faculty of Agricultural Sciences and Technology, Bahauddin Zakariya University, 60800-Multan, Pakistan
[3]Department of Soil and Environmental Sciences, Faculty of Agriculture, University of Sargodha, 40162-Sargodha, Pakistan
[4]Institute of Soil and Environmental Sciences, PMAS Arid Agriculture University, 46300-Rawalpindi, Pakistan

*Email : sajidmasood@bzu.edu.pk

ABSTRACT

Maintaining carbon to nitrogen ratio (C:N ratio) is crucial in agricultural soils, particularly under extensive cultivation to avoid soil nitrogen (N) depletion. So far, incubation studies paid attention to the relationship between the C:N ratio and N mineralization using only organic amendments as a source of C. The present study thus examined how activated C influences N availability under urea-fertilized-wheat with increasing C:N ratios. A pot experiment was carried out in a warehouse with wheat under calcareous soil conditions. Plants were subjected to the carbon at the rate of 0, 1, 5, and 10% of the recommended N till harvesting. A narrow C:N ratio (1% of the recommended N) enhanced the soil organic carbon (SOC), soil moisture, and N-availability in the soil-plant system. Moreover, the narrow C:N ratio resulted in increased leaf P and Mg accumulation and improved the plant growth attributes and yield. Higher levels of C or wider C:N ratios though enhanced the SOC, these decreased the available soil N, plant biomass, and yield. Applying large quantities of activated C reinforced the effect of C:N ratios on wheat growth and yield. It is thus concluded from our results that the supply of activated C at the rate of 1% or narrow C:N ratio promotes the growth and yield of plants due to increased SOC and soil moisture (%). Consequently, N-availability in the soil-plant system is enhanced resulting in the improvement of plant nutrient uptake, growth, and yield of wheat.

Keywords: Activated carbon; Available N; Nutrient uptake; Soil organic carbon; Soil moisture; Wheat yield

EFFECT OF LONG-TERM APPLICATIONS OF ORGANIC AND INORGANIC FERTILIZERS ON ORGANIC MATTER, AMINO SUGARS AND AMINO ACIDS IN A SANDY LOAMY SOIL

Zarina Bibi[1*] and Qudratullah Khan[2]

[1]Department of Soil Science, University of Agriculture, Dera Ismail Khan, Pakistan
[2]Department of Soil Science, Gomal University, Dera Ismail Khan, Pakistan

*Email : bibizarina100@uad.edu.pk

ABSTRACT

Microbes are known to be a key driver of C cycling and contribute to biological residues in soils. However, the contribution of amino acids and microorganism-derived amino sugars to SOC under different fertilization regimes remains poorly understood. A long-term field trial had treatments fertilized for 23 years with compost (CM), half compost nitrogen (N) plus half inorganic fertilizer N (HCM, split on total N basis), inorganic N-phosphorus-potassium (NPK), NP, NK, and PK fertilizers, and no fertilizer (control). In this study, soil samples (0-20 cm) were used to evaluate the dynamics of amino acids, microbe-derived amino sugars and SOC content. Long-term amendment with CM, HCM and NPK significantly ($P<0.05$) increased the SOC by 176%, 110% and 58%, respectively, compared with the control. Increased SOC under compost amendment promoted macro-aggregation (>250 µm), while NPK had no apparent effect. The individual amino sugar content in all the treatments ranked as follows: glucosamine > galactosamine > muramic acid > mannosamine. Compost amendment alone increased the abundance of microbes (especially bacteria), and significantly ($P<0.05$) increased the muramic acid content, which was significantly ($P<0.05$) correlated with the abundance of gram-positive bacteria (especially PLFAs i16:0 and a16:0). In contrast, the content of fungi-derived glucosamine and galactosamine were higher in the NPK treatment than in the CM and HCM treatments. The total amino sugar content in the control was 193.0 mg kg^{-1}, and significantly ($P<0.05$) increased to 298.6-358.4 mg kg^{-1} in the CM and HCM treatments and 392.2 mg kg^{-1} in the NPK treatment. In conclusion, our results suggested that microbial residue C contribution to organic C decreased with increasing SOC content, which was associated with a decrease in fungal residue C content, and the increase of organic C in the test soil. This primarily depended on the accumulation of inputted organic C by the preservation of aggregation under compost amendment. In contrast, compost amendment more efficiently increased the concentration of amino acids especially D-amino acids, which was mainly correlated with gram-positive bacteria.

Keywords: Amino acids; Amino sugars; Compost; Macro-aggregates; Microbes; Organic carbon

DECOMPOSITION DYNAMICS OF SURFACE APPLIED INDIVIDUAL AND MIXED *TRIFOLIUM* AND *POPULUS* LEAF RESIDUES

Majid Mahmood Tahir*, Juveria Mushtaq, and Abdul Khaliq

Department of Soil and Environmental Sciences, Faculty of Agriculture, University of Poonch, Rawalakot, Azad Jammu and Kashmir

*Email : majidmahmood@upr.edu.pk

ABSTRACT

The breakdown of organic matter, known as residue decomposition, plays a crucial role in linking the cycling of nutrients and their availability in low-input agricultural systems. Despite its importance, there has been limited research on how this process is affected when tree leaf residues are combined with legume crop residues. Therefore, we investigated the decomposition dynamics of surface-applied individual and mixed leaf residues of *Trifolium* and *Populus* in soil in the native environment and also in arable soil under laboratory incubation conditions. Surface soil was collected from an arable field, a *Trifolium* field, and a *Populus* field. The experiment setup was based on two factors, i.e., treatments and incubation periods. Treatments were: T_1: arable soil with no amendment; T_2: white clover soil without any amendment; T_3: popular soil without any amendment; T_4= clover soil + clover leaves; T_5= arable soil + clover leaves; T_6 = popular soil + popular leaves; T_7= arable soil + popular leaves; T_8= arable soil +clover leaves + popular leaves. The six incubation periods were 0, 15, 30, 45, 60 and 75 days. The incubated soil jars were removed after 15, 30, 45, 60, and 75 days to determine mass loss, total organic carbon and nitrogen of leaf residues and soil organic carbon, soil mineral nitrogen, and soil pH. *Trifolium* leaf residues decomposed faster compared to *Popular* leaf residues, both in native and arable soil. Compared to individual residues, mixed residues showed accelerated decomposition. The residue quality, residue mixing, and soil played important roles in their residue decomposition. Our study suggests that a better understanding of the mixed residue decomposition away from their environment will help to identify suitable management strategies for improving soil quality.

***Keywords*:** *Trifolium*, *Populus*, Leaf residues, Residue mixture, Residue decomposition

ORGANO-MINERAL FERTILIZATION REGIMES TRIGGER GROWTH AND STIGMA YIELD OF TEMPERATE SAFFRON (*Crocus sativus* L.)

Muhammad Sarfraz[1]*, Abdul Khaliq[1], Majid Mahmood Tahir[1] and Sair Sarwar[2]

[1]Department of Soil and Environmental Sciences, Faculty of Agriculture, University of Poonch, Rawalakot, Azad Jammu and Kashmir
[2]National Agriculture Research Center Islamabad, Islamabad, Pakistan

*Email : khaliqses72@gmail.com

ABSTRACT

Integrated nutrient management (INM) is an environment-friendly and ecologically adaptable approach to plant nutrition to sustain crop productivity and maintain the soil fertility of fragile agricultural ecosystems. A three-year field experiment on saffron was conducted involving 12 fertilization regimes: control; urea (UN) at 100 kg ha^{-1}; poultry manure (PM) at 100 kg ha^{-1}; farmyard manure (FYM) at 100 kg ha^{-1}; PM50 + FYM50; UN75 + PM25; UN50 + PM50; UN25 + PM75; UN75 + FYM25; UN50 + FYM50; UN25 + FYM75; and UN50 + PM25+ FYM25. Results showed that PM alone and combined with 50% UN (UN50 + PM50) were effective compared to the respective controls in increasing the number of flowers (58%), flower dry weight (59%), stigma length (70%), dry weight of stigma (40%), number of daughter corms plant-1 (35%), and corm diameter (71%) of saffron over years. In addition, the same treatment combination increased corm weight (96%), corm yield (96%), and stigma yield (35%) over controls across the years. This treatment combination was followed by UN50 + PM25 + FYM25, while UN50 alone did not perform at par with the rest of the fertilization regimes. These results showed that UN50 + PM50 might be developed as a potent strategy for boosting the growth and yield (stigma and daughter corms yield) of saffron in temperate climatic conditions.

***Keywords*:** Synergistic fertilization, Cash crop, Poultry manure, Farmyard manure, Stigma yield, Corm yield

SOIL INCORPORATION OF CHILLA (*Casearia tomentosa*) PLANT RESIDUES INHIBIT NITRIFICATION AND IMPROVE NITROGEN USE EFFICIENCY OF MAIZE (*Zea mays* L.)

Khalid Mehmood[1*], Siddique Aslam[1], Majid Mahmood Tahir[2], Muhammad Shehzad[1] and Hira Abbasi[1]

[1] Department of Agronomy, Faculty of Agriculture, University of Poonch Rawalakot AJK, Pakistan.
[2] Department of Soil and Environmental Sciences, Faculty of Agriculture, University of Poonch Rawalakot AJK, Pakistan

*Email : khalidmehmoodagro@upr.edu.pk

ABSTRACT

Exploring suitable organic amendments can help improve nitrogen use efficiency and crop yields. The potential of an indigenous plant chilla in comparison with dicyandiamide (DCD) was evaluated for nitrification inhibition and maize growth by conducting incubation and greenhouse experiments. The influence of soil amendment of chilla plant materials (leaf and bark powder), added at 1% and 20% on nitrogen (N) transformation process, fate and recovery of N in the soil, and its effect on maize growth was studied. The treatments comprised of T_1-(control)-soil with no amendment, T_2-Urea nitrogen (UN), T_3-UN + 2 mg/kg (DCD), T_4-UN + 40 mg/kg leaf powder (LP), T_5-UN + 40 mg/kg bark powder (BP), T_6-UN + 20 mg/kg LP + 20 mg/kg BP. The soil amended with treatment materials was incubated for 60 days to observe N transformation and the same treatment material at the same rate was applied to soil in the pots and maize plants were grown using a completely randomized design (CRD) in the greenhouse. There was a significant difference in the dynamics of NH_4^+-N and NO_3^--N during incubation, therefore compared to control the urea-treated soil singly or in combination with DCD or plant material exhibited its effect on the growth parameter of maize grown in a greenhouse. We concluded that the tested plant chilla has the potential to inhibit nitrification and thereby retain N in the soil to improve the N use efficiency of the crop. Among all treatments, the leaf power of selected plant material was superior to better growth and increased N recovery efficiency than bark material or synthetic nitrification inhibitor (DCD). Therefore, owing to the nitrogen inhibition capacity of chilla, the residues of the plant can be incorporated as a useful soil amendment to improve N use efficiency and crop yield.

Keywords: Nitrogen transformation, Nitrification inhibition, Maize growth, N use efficiency

EVALUATION OF DIFFERENT ORGANIC SOURCES OF NITROGEN FOR ENHANCING FERTILIZER USE EFFICIENCY IN WHEAT (*Triticum aestivum* L.)

Shazia Pathan[1], Rabia Asma Memon[1], Saeed Akhtar[1] and Nizamuddin Depar[2]

[1]Institute of Plant Sciences, University of Sindh, Jmshoro, Pakistan
[2]Soil & Environmental Sciences Division, Nuclear Institute of Agriculture, Tandojam, Pakistan

*Email: zk793685@gmail.com

ABSTRACT

Wheat is the most important cereal food crop in Pakistan. Wheat genotypes are inherently low in nutrients, particularly protein, and differ in their potential to uptake nitrogen (N) and nitrogen-use-efficiency (NUE). A field experiment was conducted at the Agriculture Research Center (latitude25º25´26″N and longitude 68º32´47″E) to test the efficacy of different organic amendments (cluster bean, sesbania, and farmyard manure) for enhancing N uptake potential and NUE of wheat. Five genotypes (Imdad, TD_1, Kiran-95, Khirman, and V-11005) were grown and supplied with three organic sources [cluster bean at 9 tons ha^{-1}, sesbania at 15 tons ha^{-1} and farmyard manure at 10 tons ha^{-1}, on a dry weight basis]. The treatments were arranged according to spilt plot design, organic sources in main plots and genotypes in sub-plots, with three repeats. Results revealed that the organic sources highly significantly affected and increased the agronomic traits (plant height 12.8%, tillers 53%, grains $spike^{-1}$ 32%, biomass yield 20%, grain yield 16%, N uptake in grain 34%, and total N uptake of 47%). Farmyard manure (FM) proved best organic source followed by sesbania and cluster bean. Wheat genotypes were highly responsive to organic amendment and improved grain yield by 17% in Kiran-95 and grain N uptake of 25.5% in Khirman compared to TD_1, which proved as the least responsive. Based on grain yield and N uptake, the genotypes were classified into grain yield and nitrogen efficiency groups. Kiran-95 was categorized as a high yield-medium NUE, Khirman medium yield-high NUE, and V-11005 as a medium yield-medium NUE. Moreover, Imdad and TD_1 were ranked in the medium yield-medium NUE and low yield-low NUE categories, respectively. Finally, it is concluded that the FM, among the used organic sources, is the best followed by sesbania. Kiran-95 proved to be the highest yielding, Khirman had the highest NUE and V-11005 was the most responsive. Hence, these genotypes may be utilized in wheat breeding programs for efficient N uptake.

Keywords: organic sources, inorganic fertilizer, grain yield uptake, and wheat crop

IRON BIOFORTIFICATION THROUGH INTEGRATED AGRONOMIC APPROACHES FOR CEREAL CROP

Ifra Saleem*[1], Qudsia Nazir[1], Nisa Mukhtar[1], Ana Aslam[1], Allah Nawaz[1], Muhammad Arfan ul Haq[1], Muhammad Arif[1], Muhammad Nasim[1]

[1]Soil Chemistry Section, Ayub Agricultural Research Institute, Faisalabad

*Email : ifrasaleem17@gmail.com

ABSTRACT

Biofortification of crops is an effective and sustainable approach to reduce global malnutrition. Iron (Fe) is one of the key micronutrients essential for plant growth, yield, and quality. It is present abundantly in soil but its bioavailability to plants is often low. To produce biofortified wheat grains with improved crop production, eight treatments [viz. NPK (RD), NPK + 10 kg ha^{-1} SA- Fe (Soil applied Fe), NPK + 20 kg ha^{-1} SA-Fe, NPK + 0.2% FA-Fe (Foliar applied), NPK + SI (seed Inoculation), NPK + 10 kg ha^{-1} SA-Fe + SI, NPK + 20 kg ha^{-1} SA-Fe + SI and NPK + 0.2% FA-Fe + SI] were tested in completely randomized block design (RCBD) with three repeats. The results of the field study revealed that the application of NPK + 20 kg ha^{-1} of SA-Fe + SI significantly increased the grain yield of wheat crop. The improved P (13% increase) and K (5.7% increase) content in wheat grains were observed in NPK + 20 kg ha^{-1} SA-Fe + SI treatment compared to non-inoculum treated treatment. The application of NPK + 0.2% FA-Fe + SI enhanced the Fe concentration (45.7 µg g^{-1}) in wheat grains compared to control. It is concluded that the application of chemical fertilizers along with siderophore-producing bacteria is an effective approach for improved growth and quality of wheat grains.

Keywords: Biofortification, Foliar application, Iron, malnutrition, Seed inoculum

GROWTH AND YIELD PERFORMANCE OF WHEAT CROP AFFECTED BY DIFFERENT CUTTING METHODS

Mukhtiar Khatoon Solangi*[1], Hafeezullah Babar[1], Suleman Memon[1], Ambrin Rajput[1], Aijaz Ali Odhano[1]

[1]Soil Fertility Research Institute, Tandojam, Pakistan

*Email : ambrin2004@gmail.com

ABSTRACT

Wheat (*Triticum aestivum* L.) is a major crop in Pakistan. It plays a crucial role in food security, with over one-third of the population relying on it as a primary food source. The crop losses during harvesting, threshing, and transportation are quite significant. In current years, the cutting methods have gained attention as a promising alternative for wheat cultivation to reduce post-harvest losses. This experiment was carried out during the winter season of 2022- 2023 at the experimental field of Soil Fertility Research Institute, Tandojam. The experiment was laid out in randomized complete block design (RCBD) with four replications having a plot size of 3×5m^2. The four treatments consisted of no cut, one cut, two cut, and three cuts, at the growth stage after 35 days, 65 days, and 75 days respectively. Based on morpho-physiological characters, the following parameters were studied: plant height (cm), no of tillers plant^{-1}, spike length, plants-m^2, seed index, and biological yield. The data regarding the analysis of variance were significant for all the parameters studied. For parameters like plant height, the number of tillers plant^{-1}, spike length, plants m-^{2}, seed index, and biological yield, the highest values were recorded in T_2 at one cutting (81.60, 17.73, 12, 159.17, 50.86, and 526.60) followed by T1 with no cutting (79.73, 15.86, 10.13, 106.53, 55.59 and 254.45). However, the lowest mean was recorded in T_4 at the third cutting for the same parameters. From all the findings, it may be concluded that one cutting is optimum to produce a higher grain yield followed by no cutting. It may also be concluded that one cutting can reduce the lodging risk factor in wheat crop.

Keywords: Physiological parameters, yield, lodging factor, cutting methods and wheat crop

BORON-COATED UREA AS SLOW-RELEASE NITROGENOUS FERTILIZER FOR IMPROVING YIELD AND QUALITY PARAMETERS OF CANOLA CROP

Qudsia Nazir*, Ifra Saleem, Sajid Mahmood, Muhammad Rafay, Ana Aslam, Amina Kalsom, Arfan ul Haq, Muhammad Aftab, Muhammad Nasim and Muhammad Arif

[1]Soil Chemistry Section, ISCES, AARI, Faisalabad, Pakistan

*Email: sbqnazir@gmail.com

ABSTRACT

As the slow-release fertilizer, boron-coated urea (BCU) can not only slow down nutrient loss but also have outstanding advantages in controlling the N release and addition of B to the soil. This experiment systematically investigated the best-performing level of boron coating on urea. Three levels of boron coatings (0.5, 1, and 1.5%) on urea were evaluated under a wirehouse. From the results, it was indicated that 1% BCU showed maximum response in all physical parameters including plant height and biomass production. After that, lower levels of 1% BCU i.e. (90, 85, and 80% of RD of BCU concerning standard urea) were evaluated under field conditions on canola crop. Data regarding physical, chemical, and quality parameters were recorded. From the recorded results, it was observed that 85% of BCU showed statistically similar results concerning standard urea. The plots where the standard urea was applied produced total biomass and grain yields of 4.70 t ha^{-1} and 965 kg ha^{-1}, respectively. The application of 85% BCU increased biomass and grain yields by 4.71 t ha^{-1} and 966 kg $ha^{-1,}$ respectively. Similarly, 10% to 15% improved results of quality parameters i.e. crude proteins, crude fat, crude fiber, and ash contents were obtained with the application of 85% BCU as compared to control where no Zn with plain urea was applied. In conclusion, it is stated that 85% of recommended urea as 1% BCU is effective in improving the yield and quality parameters of canola crops.

Keywords: Boron-coated urea, Canola, Quality, and Yield

IMPACT OF POTASSIUM FERTILIZER ON POTASSIUM UPTAKE AND USE EFFICIENCY IN ONIONS (*Allium cepa* L.)

Syeda Fatima Qamer[1], Farooque Ali Bughio[1] and Nizamuddin Depar[2*]

[1]Institute of Plant Sciences, University of Sindh, Jamshoro, Sindh, Pakistan
[2]Nuclear Institute of Agriculture, Tando Jam, Sindh, Pakistan

*Email: syfatimabukheri612@outlook.com

ABSTRACT

This research carries a fieldwork to investigate the impact of potassium (K) fertilizer on K uptake and K use efficiency in onion variety Nasarpuri during *kharif* 2022. The experimental layout was a randomized complete block (RCB) design with three treatments of K (50, 75, and 100 kg K_2O ha^{-1}) along with a control treatment (no K fertilizer). Soil samples were collected from the field before transplanting of seedlings and were analyzed for physical and chemical properties. The soil was silty clay loam, non-saline (EC, 0.51 dS m^{-1}), alkaline (7.5), low in organic matter (0.603 %), deficient in N (0.035 %), and marginal to deficient in extractable-K (130 mg/kg) respectively. The extensively higher K uptake in leaf and bulb was reported (125.4 kg ha^{-1} and 1349 kg ha^{-1}) in 100 kg K_2O ha^{-1} over the control. The maximum total K recovery in the onion plant was reported (1473.5 kg ha^{-1}) in 100 kg K_2O ha^{-1} over the control treatment. The physiological use efficiency of K fertilizer in onion plants was reported higher in 50 kg K_2O ha^{-1}, as the rate of K fertilizer increased to 100 kg K_2O ha^{-1}, decreasing the physiological use efficiency (19.8 kg kg^{-1} to 40.5 kg kg^{-1}). The maximum chemical and biological use efficiencies of K fertilizer were, respectively, 1303.3 % and 330.7 kg ha^{-1} at 100 Kg K_2O ha^{-1} over 75 and 50 Kg K_2O ha^{-1}. The maximum value-cost ratio (VCR) (77.9) with a net profit of Rs. 407,489 was calculated at 100 kg K_2O ha^{-1}. Therefore, the current study concluded that the highest dose of 100 kg K_2O ha^{-1} is the most suitable rate, which promotes K uptake and K use efficiency and proved profitable for higher income and net profit. It suggested that farmers and growers may use potassium application, as a monetary return with satisfaction.

***Keywords**:* Impact of potassium, K uptake, K fertilizer use efficiency, value-cost ratio, soil conditions

EFFECTS OF NANO-BIOCHAR-AMENDED BIOGAS SLURRY ON SOIL CHARACTERISTICS, SORGHUM YIELD, AND AMMONIA EMISSIONS IN RAINFED AGRICULTURE

Muhammad Ramzan*[1], Ghulam Abbas Shah[1], Ahsan Yasin[1]

[1]Department of Agronomy, Pir Mehr Ali Shah Arid Agriculture University Rawalpindi 46300, Pakistan

*Email : dr.ramzanjani2@gmail.com

ABSTRACT

The rapid increase in the global human population, expected to reach 9.7 billion by 2050, necessitates a 59-98% rise in food demand. This challenges agriculture to enhance productivity while limiting the risks of land degradation, nutrient depletion, and biodiversity losses due to excessive use of chemicals. Therefore, there is a need to explore alternative options like organic fertilizers, including biogas slurry that can offer sustainable nutrient uptake with minimal losses. Our study aimed to assess the impact of biogas slurry amended with nano-biochar on soil biochemical characteristics, sorghum yield, and ammonia emissions under rainfed conditions. Treatments were (i) control (untreated), (ii) inorganic N fertilizers (IF) applied at 90 kg N ha^{-1}, (iii) biogas slurry (BS) applied at 90 kg N ha^{-1}, (iv) IF (87.5% of applied N) + poultry manure nano-biochar (PMB) at 12.5% of applied N, and (v) BS (87.5% of applied N) + PMB at 12.5% of applied N. Sorghum was sown as test crop. Soil samples were taken before sowing and after harvesting of the crop and analyzed for their biochemical characteristics. Crop yield and its attributes were examined. In a parallel pot experiment, NH_3 emissions were monitored for 72 hours after treatment application using passive flux samplers. Results indicated that the combined application of BS+PMB boosted soil mineral N by 17% compared to sole BS. Besides, this treatment significantly elevated soil microbial biomass carbon (MBC) by 37%, and microbial biomass nitrogen (MBN) by 42% compared to sole IF. The application of sole IF and BS significantly increased shoot dry matter yield by 56% and 17%, respectively, compared to the control. Adding PMB to BS increased shoot dry matter yield by 22% compared to sole BS. Similarly, BS+PMB enhanced shoot N uptake by 46% compared to sole BS. Notably, PMB and BS+PMB substantially decreased NH_3 emissions by 43% and 41%, respectively, compared to sole IF. It is concluded that the use of biogas slurry with nano-biochar is a sustainable agricultural practice that can improve soil biochemical characteristics and crop productivity with minimum effect on the environment.

Keywords: Biogas slurry, Nano-biochar, NH_3 emissions, Soil characteristics, Crop yield

STATUS AND SOIL PROPERTIES WITH BIOCHAR, COMPOST AND CO-COMPOSTED BIOCHAR DERIVED FROM FRUIT VEGETABLE MARKET WASTE

Ghulam Mujtaba[1*], Mukhtar Ahmad[2], Ghulam Qadir[2], Qaiser Hussain[1], Rifat Hayat[1*]

[1] Institute of Soil & Environmental Sciences, Pir Mehr Ali Shah - Arid Agriculture University, Rawalpindi, 46300
[2] Department of Agronomy, Pir Mehr Ali Shah - Arid Agriculture University, Rawalpindi, 46300

*Email: mujtabaqaisrani@gmail.com

ABSTRACT

A large amount of organic waste is generated from fruits vegetable markets (Sabzi mandi), which can be converted into useful material instead of being dumped in landfill sites and reduce the environment and economic problems. The conversion of organic wastes into useful by-products such as biochar (BC), compost (COM), and co-composted biochar (BCC), through pyrolysis and composting process, could be used as soil amendments to improve soil fertility. A 2-year mung bean-wheat crop rotation study was designed to test fruits vegetables waste (FVW) derived BC (20 t ha^{-1}), COM (20 t ha^{-1}) and BCC (20 t ha^{-1}) for determining the residual impact of organic amendments on the soil fertility, microbial biomass (MBC and MBN), enzymes activities and mung bean-wheat crops yield under rainfed condition. Results indicated that BCC remained changed by significantly increasing soil organic carbon (33%), nitrate- nitrogen (84%) available P, available K along with micro-nutrients, and moisture contents in the surface soil in both legume-cereal cropping seasons 2017-19. Additionally, the MBC (28%) and MBN (36%) were pronouncedly increased in organic materials amended plots compared to control. Soil enzymes activities such as urease and dehydrogenase were significantly higher under the application of BCC. Similarly, addition of BC, COM and BCC amendments increased mung bean (37%, 43% and 44%, respectively) and wheat (29%, 28% and 35%, respectively) grain yield as compared to control during both years. In conclusion, BC and BCC had prolonged residence time which sustained nutrients status, improved crop growth and yield over 2-years. Moreover, compost had greater degradability as compared to BC and BCC and thus had higher initial availability of both macro and micronutrients.

Keywords: Biochar, Compost, Co-compost Biochar, Mung bean-Wheat

NANOBIOCHAR-COATED DAP FERTILIZER ENHANCES NUTRIENT DYNAMICS IN THE SOIL AND MAIZE CROP PRODUCTIVITY

Ghulam Abbas Shah[1*], Khubra Shoukat[1], Muhammad Ramzan[1], Ahsan Yasin[1] and Muhammad Zain[1]

[1]Department of Agronomy, Pir Mehr Ali Shah Arid Agriculture University Rawalpindi 46300, Pakistan

*Email: shahga@uaar.edu.pk

ABSTRACT

Recent advancements in fertilizer technology suggest that nanobiochar integration with organic fertilizers can mitigate nutrient losses and improve crop productivity. This study explores the potential of a novel nanobiochar-coated DAP as "smart" chemical fertilizer with improved nutrient utilization efficiency and reduced nutrient losses. Nanobiochar-coated DAP granules were developed to regulate nutrient release kinetics, particularly targeting improved phosphorus (P) dynamics in the soil, ending in better maize crop yield and enhanced P utilization efficiency. Laboratory experiments assessed varying concentrations (2.5%, 5%, and 10% w/w) of nanobiochar coating on DAP granules, evaluating control release kinetics of P and N. The confirmation of nanobiochar coating was established via discrete carbon peaks in X-ray diffraction analysis and FTIR spectroscopic examination, revealing a smooth and uniform coating on DAP granules. Semi-field trial consisted of five treatments: i) control, ii) uncoated DAP, iii) 2.5% nanobiochar-coated DAP, iv) 5% nanobiochar-coated DAP, and v) 10% nanobiochar-coated DAP, to maize crops. Remarkably, application of 2.5% nanobiochar-coated DAP exhibited substantial soil improvement-enhancing microbial biomass carbon and nitrogen by 104% and 147%, while enriching available P, N, and K levels by 40%, 70%, and 46%, respectively, compared to control. This treatment led to an 88% boost in maize shoot dry matter yield, accompanied by remarkable increments of 229%, 205%, and 67% in P, N, and K uptakes by maize. In contrast, other coating treatments failed to surpass uncoated DAP in augmenting these parameters. Thus, 2.5% nanobiochar coating demonstrated the potential to improve N and P utilization in maize crops, significantly enhancing soil biochemical characteristics and crop productivity. This research highlights nanobiochar as a promising alternative to hazardous coating materials, offering the dual advantage of boosting economic gains while contributing to environmental sustainability.

***Keyword*: Nanobiochar, DAP, Nutrient uptake, Maize yield.**

MORPHO-PHYSIOLOGICAL CHARACTERISTICS OF HISTORICAL BREAD WHEAT PANEL OF PAKISTAN AT DIFFERENT LEVELS OF SALINITY AT SEEDLING STAGE

Zarlish Fayyaz[1]*, Kainat Naeem[1], Mehreen Kanwal[1], Rizwana Kousar[1], Sadia Latif[1]*

[1]Department of Biology, Allama Iqbal Open University, Islamabad Pakistan

*Email: sadia.latif@aiou.edu.pk

ABSTRACT

Bread Wheat (***Triticum aestivum*** L.) a staple cereal of one third of world population, is rank third in terms of production with ~770 million tonnes of annual global yield from a cultivated area of 219 million hectares. To meet future food demand, crop production needs to be enhanced by 70% by the end of 21st century. Among various abiotic factors that limit crop production, salinity is a major obstacle to wheat production in many parts of world. In Pakistan, over 2.5 million hectares of irrigated land are affected by severe surface salinity. Higher salinity increases the concentration of Na^+ and Cl^- ions, this ionic imbalance causes disequilibrium of nutrients that declines germination, and adversely affects the subsequent metabolic processes. In the present study, a total of 28 wheat genotypes with different genetic background that included land races, green revolution, post green revolution and elite cultivars were screened against different levels of salinity stress. Morphophysiological traits such as chlorophyll (C-C), seedling length (SD-L), shoot length (SH-L), root length (R-L), seedling fresh weight (SD-FW), shoot fresh weight (SH-FW), root fresh weight (R-FW), seedling dry weight (SD-DW), shoot dry weight (SH-DW) and root dry weight (R-DW) were recorded. The analysis of variance (treatments, treatments* genotypes, treatment* year of release) for C-C, SD-L, SH-L, R-L, SD-FW, SH-FW, R-FW, SD-DW, SH-DW and R-DW showed a significant difference ($p<0.05$) between treatments and treatments*genotypes. Under high salinity treatment (16ds/m) all the traits showed a significant decline. Correlation analysis showed a positive correlation of SH-DW with C-C, SD-FW, SH-FW and R-FW with values equal 0.513, 0.702, 0.735 and 0.582 under control. Chlorophyll under high salinity treatment (T2) showed a positive correlation with SH-L, SD-FW and SH-FW with r values equal to 0.625, 0.565 and 0.644. Seedling length showed a positive correlation with SD-FW, SH-FW, SD-DW, SH-DW and R-DW with r values equal to 0.537, 0.709, 0.710, 0.684 and 0.595 under T2. Principal Component Analysis (PCA) divided the data into ten factors, the first three components contributed 83% of total variation. The PCA also depicted the least variation between C-C, SD-DW, SH-DW and SH-FW. The genotypes **Maxipak-65, Suleman-96**, **Yecora**, **Lyp-73** and **Shalimar-88** performed well under high salinity conditions. These genotypes can be used in future breeding programs for production of new germplasm and can be cultivated in areas influenced by salinity stress.

CROP RESIDUES MANAGEMENT UNDER RICE-WHEAT CROPPING SYSTEM FOR IMPROVING SOIL PROPERTIES AND CROP YIELD

Muhammad Arfan ul Haq*[1], Muhammad Nasim[1], Ifra Saleem[1], Ana Aslam[1], Allah Nawaz[1], Qudsia Nazir[1], Amina Kalsom[1], Farah Rasheed[1], Raheela Naz[1]

[1]Soil Chemistry Section, Institute of Soil Chemistry & Environmental Sciences, AARI, Faisalabad

*Email: arfanp85@gmail.com

ABSTRACT

Burning wheat and rice straws is a common practice among agricultural communities. Moreover, applied phosphorus transforms to unavailable residual form that is the major cause of limited P-supply to the plants. The experiment was conducted at Soil Chemistry Section, Ayub Agricultural Research Institute Faisalabad, to evaluate the different crop residue management techniques and to calculate different soil-P fractionations under different crop residues management techniques. Four treatments (0, 50, 75 and 100% of recommended dose of fertilizers), four different residues management techniques (traditional harvesting, burning, rotavation and surface application of residues) were tested with split plot design. Among main plots, maximum rice paddy and wheat grain yield (5.47 and 3.98 t ha^{-1}, respectively) were produced where crop residues were rotavated. Burning of crop residues resulted in minimum rice paddy and wheat grain yield (4.52 and 3.37 t ha^{-1}, respectively). The treatment with 100% NPK fertilizer gave best rice paddy and wheat grain yield (6.50 and 4.82 t ha^{-1}, respectively). Among different treatments, the treatment with 100 % fertilizer rate resulted in maximum soil organic matter (SOM) and Olsen, water-soluble and Ca +Mg fractions of soil P (0.79 %, 13.88, 3.36 and 406.2 mg kg^{-1}, respectively). A comparison of methods of cultivation, showed that maximum SOM and Olsen, water-soluble and Ca +Mg fractions of soil P (0.89 %, 11.12, 4.38 and 403.0 mg kg^{-1}) was given by the rotavation method. Hence, it is concluded that rotavation of crop residues not only improves soil physicho-chemical properties of soil but also increases yield on sustainable basis.

Keywords: Residue management, Rotavation, Rice-Wheat rotation, P-fractionation

PREPARATION AND EVALUATION OF ORGANIC WASTE COMPOST FOR MAIZE PRODUCTION

Muhammad Noman Rafiq[1], Arshad Nawaz Chaudhry [1]*, Tajwar Alam [2], Rimsha Sadaf [1], Musaver Abbas [1], Sabiha Kanwal [1]

[1]Institute of Soil and Environmental Science, PMAS Arid Agriculture University. Rawalpindi 46000, Pakistan
[2]Institute of Hydroponic Agriculture, PMAS Arid Agriculture University, Rawalpindi 46000, Pakistan

*Email: arshadnawaz@uaar.edu.pk

ABSTRACT

Composting is an attractive solution for recycling invaluable organic waste into valuable soil nutrients. In fact, the lately awakened global awareness has recognized composting's feasibility as a solution for sustainable nutrient management and also helps to overcome the waste pollution. Cover crops add organic matter to soil and improve soil fertility. The composting experiment was conducted by using various organic wastes, viz., green crops, vegetable waste and farmyard manure, and poultry manure. Parameter recorded for compost was pH, EC, TOC and NPK. Results showed treatment (green waste + vegetable waste+ poultry litter + farmyard manure) showed around neutral pH and yielded higher nutrient contents. The treatment combination for pot experiment was T_0 (control), T_1 (half NPK recommended dose), T_2 (NPK recommended dose), T_3 (green waste compost), T_4 (vegetable waste compost), T_5 (green waste compost + vegetable waste compost) T_6 (mix compost + urea), T_7 (mix compost + ammonium sulphate). Plant parameters, viz., plant height, fresh- and dry shoot weight, fresh- and dry root weight, and nutrient contents (N, P and K). Results of this study revealed that treatment T_7 (compost + ammonium sulphate) improved all crop growth attributes along with nutrient concentration in maize plants.

Keywords: Compost; Organic Waste; Soil Fertility; Organic Matter

SCREENING OF BENGAL AND ASSAM AUS PANEL (BAAP) OF RICE IN PAKISTAN: CHARACTERIZATION BASED ON PHENOTYPIC DATA

Hassan Sajjad[1], Dr. Muhammad Aamer Maqsood[1], Dr. Tariq Aziz[1], Dr. Abdul Wakeel[1], Dr. Muhammad Sana Ullah[1], Dr. Aysha Kiran[2], Dr. Abdul Qadeer[1], Dr. Hamaad Raza Ahmad[1] and Zunaira Bano[2].

[1] Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad, Pakistan.
[2] Department of Botany, University of Agriculture, Faisalabad, Pakistan.

Email: hassansajjad389@gmail.com

ABSTRACT

Nitrogen (N) is essential for metabolic activities and helps in growth promotion. Low nitrogen uses efficiency (NUE) due to imbalanced fertilization causes heavy losses of N from agriculture which imparts both economic and environmental consequences. NUE can be improved by the cultivation of rice genotypes that use N more efficiently. Different rice (*Oryza sativa* L.) genotypes have different genetic potential to use nitrogen. Therefore, 268 rice genotypes, which includes 257 from BAAP and 11 from Pakistan germplasm were screened in field condition for two years (Kharif-2021 and 2022) with 50 and 100% of recommended N at a rate of 127 kg ha^{-1}. Urea was used as N source. Chlorophyll content (SPAD value), plant height (cm), days to flowering, relative N concentration, grain yield (g/six plant) and shoot biomass (g/six plant) were recorded. A two-way analysis of variance (ANOVA) was performed on the entire dataset, and a very significant ($p<0.05$, $p=0.001$) influence of treatment on genotypes and vice versa were disclosed. The genotypes were grouped into three classes efficient (E), medium (M) and in-efficient (I). The genotypes were allocated 3 to "E", 2 to "M" and 1 to "I" for each parameter, for a total score of 18 per parameter, 36 each year and 72 over two years. During a two-year period, the following genotypes were ranked in the top twenty: Chenab Basmati, Azucena, Super Gold 2019, DOM SUFID, Boraya, SXC 290, Dumsia 81, AUS 364, KS-282, BINA dhan 5, AUS 74, Basmati 515, Pk-1121 Aromatic, Minghui 63, BRRI dhan 50, Lakhai, AUSMERI, Early Sutarsar 39, Kali boro 41-1 and KSK-434. In contrast, the genotypes that were rated in the lowest twenty were Gohama Bhhadri, AUS 68, AUS 169, Chandra Kana, Bhingha, DM 59, IARI 6621, AUS 180, AUS 204, AUS 411, ARC 10392, AUS 453, AUS 209, MTU 18, AUS 130, Motzhul, ARC 10376, Dhala Shaitta and CN2-175-5-31. Furthermore, the identification of N responsive candidate genes is now being carried out using the genome-wide association mapping of this phenotypic data. This aims to provide prospects for breeders to enhance NUE without compromising yield.

Keywords: Soil Fertility, Nitrogen, Genotypes, Rice, NUE, BAAP

EFFECT OF COMPOST AND BIOCHAR IN PHOSPHORUS MANAGEMENT FOR WHEAT

Muqarrab Ali[1*], Abdul Latif[2], Muhammad Saleem Ullah[2], Rehan Jamil[2], Amar Matloob[1], Ahmad Mahmood[1], Muhammad Imran[3], Omer Farooq[4], Imran Khan[5], Khurram Shahzad[6] and Abid Hussain[3]

[1]Department of Climate Change, Faculty of Agriculture and Environmental Sciences, MNS University of Agriculture, Multan, Pakistan
[2]Department of Agronomy, Faculty of Agriculture and Environmental Sciences, MNS University of Agriculture, Multan, Pakistan
[3]Department of Soil and Environmental Sciences, Faculty of Agriculture and Environmental Sciences, MNS University of Agriculture, Multan, Pakistan
[4]Department of Agronomy, Faculty of Agricultural Sciences, Bahudin Zikaryia University, Multan, Pakistan
[5]Department of Agronomy, Faculty of Agriculture, University of Agriculture, Faisalabad, Pakistan
[6]Department of Soil and Environmental Sciences, Faculty of Agriculture, Lasbella University of Agriculture, Water and Marine Sciences, Lasbella, Pakistan

*Email: muqarrab.ali@mnsuam.edu.pk

ABSTRACT

Wheat is grown at large scale in Punjab and Sindh provinces of Pakistan. Integrated nutrient management is of great importance. The prices of phosphatic fertilizers are very high while phosphorus use efficiency (PUE) is very low. A field experiment was conducted at Research Farm of MNS-University, Multan during 2020-2021. The compost (1 Mg ha^{-1}) and biochar (0.5 Mg ha^{-1}) were applied only during wheat sowing. Three levels of phosphorus (0, 75%, and 100%) were applied. The phosphorus levels, compost and biochar were applied alone and in combination. Overall, combined application of 75% recommended phosphorus + compost + biochar showed better results as compared to sole applications of organic amendments and phosphatic fertilizer. In wheat, combined application of P @ 75% of recommended phosphorus + compost + biochar showed 20.4%, 19.7% and 9.4% more values for chlorophyll content (SPAD value), plant height and 1000 grain weight, respectively, as compared to control. Thus, P @ 75% + compost + biochar can be recommended to the farmers in Multan Region in wheat to get higher crop productivity.

Keywords: Organic amendments, Phosphorus use, Nutrient management.

MUSTARD ROOT ARCHITECTURE AND YIELD IN RESPONSE TO PHOSOHORUS APPLICATION AND AAC-DEAMINASE RHIZOBACTERIAL SEED INOCULATION

Hajra Khan[1], Nazakat Abbas Lighari [2], Zia-ul-hassan Shah[2], Inayatullah Rajpar[2], Naheed Akhter Talpur[2]

[1]Oil Seed Research Institute, Agriculture Research Centre, Tandojam
[2]Department of Soil Science, Sindh Agriculture University, Tandojam, Pakistan

*Email: hajraimran2006@gmail.com

ABSTRACT

Phosphorus nutrition plays a significant role in developing an efficient root system. This filed experiment was conducted to evaluate mustard root architecture and yield in response to phosphorus application and ACC-deaminase rhizobacterial seed inoculation. The experiment was conducted in a two-factor randomized complete block split plot design with three replications. Factor A comprised of two phosphorus doses, i.e. P_1 = No P fertilizer, i.e. Control and P_2 = 85 kg ha^{-1} (100% recommended P fertilizer). Factor B included three treatments involving different rhizobacterial strains, i.e. St_0 = Control (No rhizobacterial seed inoculation), St_1 = seed inoculation with *Pseudomonas fluorescens* containing only ACC-deaminase activity, St_2 = seed inoculation with *Pseudomonas fluorescens* biotype F containing both ACC-deaminase and P-solubilizing activities P doses and rhizobacterial seed inoculation significantly affected ($p<0.05$ to 0.01) root weight, tap root length, tap root diameter, number of braches per root, number of pod per plant, seed yield and grain P accumulation of mustard. However, their interaction was significant only for root weight ($p<0.01$) and tap root diameter ($p<0.05$) of mustard. Adequate P nutrition increased various plant traits of mustard against control, i.e. root weight (47%), tap root length (58%), tap root diameter (73%), number of branches per root (78%), number of pods per plant (90%), seed yield (37%) and P accumulation (61%). Seed inoculation of *Pseudomonas fluoresens* with single activity of ACC-deaminase increased various plant traits of mustard against control, i.e. root weight (33%), tap root length (29%), tap root diameter (25%), number of branches per root (24%), number of pods per plant (16%), seed yield (11%) and P accumulation (10%). The maximum increase due to the interaction effect of two main sources of variance in various plant traits of mustard was noted only for root dry weight (2.4-fold) and tap root length (2.8-fold). The study concluded that seed inoculation with *Pseudomonas fluorescens* having dual activities of ACC-demainase and phosphate solubilization enhances root growth and thereby seed yield, both under phosphorus deficient and adequate conditions

Keywords: Mustard, Phosohorus Application, ACC-Deaminase Rhizobacterial, Seed Yield

AGRONOMIC EVALUATION OF BIOLOGICAL ACTIVE SUBSTANCES FOR ENHANCING THE EFFECTS POTASSIUM ENRICHED COMPOST ON MAIZE PRODUCTION

Pir Ahmed Naqi Shah1, Muhammad Nawaz Kandhro1, Zia ul Hassan Shah2, Ghulam Murtaza Jamro2, Awais Ahmed Naqi Shah1, Zulifqar Ali Abbasi3, Muhammad Mahmood ur Rahman Jamro3

[1]Department of Agronomy, Sindh Agriculture University Tandojam, Pakistan
[2]Department of Soil Science, Sindh Agriculture University Tandojam, Pakistan

*Email: naqishah@sau.edu.pk

ABSTRACT

Potassium (K) is a major essential nutrient required for plant growth and development. However, its use is negligible or minimal in current agricultural practices of Pakistan. In view of the significance of K, K enriched compost (KEC) was prepared from the market waste and the solution of biological active substances (BAS) including auxin precursor L-tryptophan (L-TRP), indole acetic acid (IAA), gibberellic acid and kinetin. The BAS were applied onto the surface of organic fertilizer @10 mg L-TRP kg^{-1} of compost and were compared with the treatment having no blending of these BAS or with the treatment where only inorganic K fertilizer was applied @ 60 kg ha^{-1} in field condition. The data of study indicated that the blending of L-TRP to 300 kg KEC and its application @ 45 kg K ha^{-1} was found to be the most effective developed organic K fertilizer treatment for enhancement in growth and yield traits of maize. Further, this treatment also improved the K concentration of maize straw and grain. The results of the study concluded that the application of L-TRP could improve the effectiveness of the KEC and production of hybrid maize.

Keywords: Potassium, hybrid maize, potassium, enriched compost, L-TRP.

FOSTERING MANGO (*Mangifera Indica*) YIELD AND QUALITY: ASSESSING MICRONUTRIENT (Zn, B, & Cu) APPLICATION TECHNIQUES

Niaz Ahmed[1]*, Zee Shan Ali[1], Muhammad Abid Ali Khan[1], Sajid Masood[1], Muhammad Arif Ali[2], Muhammad Tariq Malik[3], Javed Iqbal[4]

[1]Department of Soil Science, Faculty of Agricultural Sciences and Technology, Bahauddin Zakariya University, 60800-Multan, Pakistan,
[2]Department of Environmental Sciences, Faculty of Science, Bahauddin Zakariya University,
[3]Mango Research Institute, Multan, Pakistan.,[4]Mango Research Station Shujabad, Pakistan.

***Email:** niaz.ahmad@bzu.edu.pk

ABSTRACT

Mango stands as the 6th most crucial fruit cultivated in tropical regions, yet its growth faces potential setbacks due to micronutrient deficiencies. In Pakistan, the majority of agricultural soils grapple with micronutrient scarcities, notably zinc (Zn), boron (B), and copper (Cu). This study aims to ascertain the most effective nutrient application approach to sustain mango plant growth and optimize fruit production within the orchards of Mirpur Khas district, Sindh, Pakistan. The research delved into evaluating the yield and physiological responses of 15 to 20-year-old mango plants when subjected to various methods of micronutrient application (B, Zn, and Cu) via foliar and soil applications. The combined application of Zn, B, and Cu showcased remarkable improvements in plant chlorophyll content, photosynthesis rate, transpiration, and stomatal conductance. Additionally, fruit numbers, weight, and overall yield showed significant enhancement through the foliar spray of 0.8% Zn, 0.8% B, and 0.5% Cu. This combined micronutrient application not only elevated ash content but also augmented total soluble solids and sugar content while significantly reducing titratable acidity. Furthermore, it bolstered nutrient availability, thereby enhancing the metabolism of macronutrients. However, it's noteworthy that foliar micronutrient application did not impact soil nutrient availability. The results strongly advocate for the efficacy of foliar application involving 0.8% Zn, 0.8% B, and 0.5% Cu, complemented by NPK and farmyard manure administered before flowering, as an effective strategy to elevate mango growth and optimize yield. There was 19% more fruit yield obtained when plants receive combined foliar spray of micronutrients. This insight offers valuable implications for sustainable mango cultivation practices.

Keywords: Fruit quality; fruit yield; photosynthesis; soil application; foliar spray, nutrient availability.

MAIZE GROWTH AND PHOSPHORUS UPTAKE MODULATION BY ORGANIC AMENDMENTS IN THE FACE OF SALINITY VARIABILITY

Tayyaba Naz[1,2*], Muhammad Qasim[1,2], Muhammad Umair[1,2], Iqra Ghafoor[1,2], Maham Naeem[1,2], Muhammad Anwar-ul-Haq[1, 2], Muhammad Mazhar Iqbal[3], Muhammad Saqib[1,2]

[1]Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad.
[2]Saline Agriculture Research Center, University of Agriculture Faisalabad.
[3]Department of Soil and Environmental Sciences, University of Sarghoda–Pakistan.

*****Email: tayyabanaz@uaf.edu.pk

ABSTRACT

Salinity is an important abiotic stress affecting the growth, yield, and grain quality. Phosphorus is an essential macronutrient that plays a major role in plants' metabolic processes. Phosphorus ranks the most often limiting macronutrients in saline soils. It is involved in censorious plant functions including energy transfer, photosynthesis, sugar and starch processing and nutrient flow within the plant. A pot experiment was conducted to evaluate the impact of organic and inorganic sources of P on the growth and yield of maize grown in saline soil conditions at the wire house of Institute of Soil and Environmental sciences (ISES), University of Agriculture Faisalabad (UAF). Maize variety Hybrid FH-1046 from Ayub Agricultural Research Institute (AARI) was used for this experiment. This genotype had been examined under normal condition as well as under salt stress (Control, 6 and 10 dSm^{-1}). The treatments included T1= 100% P application through DAP, T2= 50% P application through DAP +50% P application through FYM, T=3 50% P application through DAP +50% P application through Poultry Manure, T4= 50% P application through DAP +50% P application through compost. These treatments were tested at control, 6 and 10 dSm^{-1} with three replications and arranged according to completely randomized design. The physiological (Relative water contents, Membrane stability index, SPAD-value) were studied at the completion of vegetative growth stage. The crop was harvested at maturity and data regarding growth and yield parameters was collected. To examine the recorded data, suitable statistical procedures were used. The results showed detrimental effect of salinity on the growth and yield of Maize. Application of organic amendments along with inorganic P sources significantly enhance the P uptake and mitigated the adverse effect of salt stress.

Keywords: Maize, Salinity, Compost, Poultry Manure, Farmyard Manure, Phosphorus, DAP

ALLELOPATHIC IMPACT OF SELECTED FERTILE SOILS LOVING WEEDS ON GROWTH AND YIELD PARAMETERS OF WHEAT CROP GROWN IN DISTRICT BHIMBER, AZAD KASHMIR

Tanveer Hussain*[1], Muhammad Ishtiaq[1], Muhammad Ajaib[1], Madiha Kabir[1], Rawish Sikander[1]

[1]Department of Botany, Azad Jammu and Kashmir, University of Bhimber -10040 (AJK), Pakistan

*Email: tanveer.botany@must.edu.pk

ABSTRACT

Four fertile soils growing weed species named as *Chenopodium album, Fumaria indica, Lantana camara* and *Anagallis arvensis* were used to check their allelopathic effects against growth and yield parameters of *Triticum aestivum*. All the weed powder treatments indicated significant effects on fresh and dry root and shoot weight of wheat plant. Some treatments exhibited inhibitory effects on seed germination and plant growth, while others showed stimulatory effects. The speed of seed germination varied among the treatments, with some showing faster or slower germination rates compared to the control. Result of this study revealed that higher concentration of weed invitro treatments suppressed the growth of *Triticum aestivum* significantly. The allelopathic effects varied depending on the type and quantity of the weed leaf powder used. These results suggested that the allelopathic effects of weed extracts indicated negative impacts on the seed germination and growth of wheat crop. Hence, many different weed management strategies were recognized in agricultural practices. Further the research was explored the specific mechanisms involved in these allelopathic interactions and assessed the long-term effects on crop productivity.

Keywords: Allelopathic Effects, *Chenopodium album, Fumaria indica, Lantana camara, Anagallis arvensis,* District Bhimber, Azad Kashmir, Wheat Crop.

CADMIUM ACCUMULATION IN FODDER MAIZE IS PARTIALLY MITIGATED THROUGH GREEN MANURING AND SOIL ZINC APPLICATION

Muhammad Intissam Rana[1], Raza Abbas*[1], Shahid Hussain[1], Ammara Basit[1]

[1]Department of Soil Science, Faculty of Agricultural Sciences and Technology, Bahauddin Zakariya University, Multan-60800, Pakistan

*Email: hdaniyal072@gmail.com

ABSTRACT

Cadmium (Cd) contamination in agricultural soils threatens plants, animals and human health due to its accumulation in crop plants. Besides heavy metal contamination, zinc (Zn) deficiency in alkaline calcareous soils is another major issue nowadays, leading to Zn deficiency in crops. The present study hypothesized that cultivation of maize on green manured soil and supplied with soil Zn application would decrease Cd accumulation and increase Zn accumulation in maize plants. To test this hypothesis, maize was grown on two soils (fallow and green manured) contaminated with two levels of Cd (0 and 8 mg Cd kg^{-1}) and supplied with two rates of Zn (0 and 8 mg Zn kg^{-1}) through soil. Results revealed that as compared to non-spiked soil, Cd-spiking significantly decreased the plant yield and plant Zn concentration and increased plant Cd concentration in both fallow and green manured soil. Contrarily, soil Zn application compared to no Zn application increased the plant yield, plant Zn accumulation and decreased plant Cd concentration. Overall, plants grown on green manured soil accumulated low levels of Cd as compared to those grown on fallow land soil. The positive effect of green manuring and soil zinc application on reducing Cd accumulation and improving Zn uptake in crops highlights the significance of environmentally friendly agricultural practices. Moreover, these findings highlight the potential of employing green manure and soil zinc application as a strategy to reduce Cd contamination and enhance Zn uptake in maize, offering promise for sustainable agricultural practices and reduced health risks associated with heavy metal contamination in crops.

Keywords: Accumulation, Cadmium, Green manuring, Maize, Soil, Zinc

PARTIAL SUBSTITUTION OF EXOGENOUSLY APPLIED PHOSPHATIC FERTILIZERS BY PHOSPHATE SOLUBILIZING BACTERIA IN MAIZE UNDER CALCAREOUS SOIL

Muhammad Adnan*[1,2], Hajira[1], Yousaf Jamal[1]

[1]Department of Agriculture, The University of Swabi, Khyber Pakhtunkhwa Pakistan
[2]Collage of Food, Agricultural and Environmental Sciences, The Ohio State University, USA

Email: madnanses@gmail.com

ABSTRACT

Phosphorus (P) availability is the major constraint in obtaining optimum crop yield in calcareous soils due to its precipitation as dicalcium and octacalcium phosphate by reacting with Ca^{+2} and Mg^{+2}. Therefore, we explored the role of phosphate solubilizing bacteria (without and with PSB @ 2 kg ha^{-1}) in optimizing maize yield and P availability from soluble and insoluble P sources applied @ of 100 kg P_2O_5 into calcareous soil. Mainly, PSB inoculation significantly improved maize plant height (5.6%), 1000 grain weight (11%), dry matter (7.5%), stover (10.8%) and grain yield (6.8%), plant P concentration (10.1%) and uptake (18.6%), extractable P (3.1%), agronomic (48%) and uptake (53%) P use efficiency over un-inoculated plots. Phosphorus application significantly improved maize yield, soil health and agronomic P use efficiency (4.84 times over control), however, its impact was more pronounced when applied as 50% P each from farmyard manure (FYM) and single super phosphate (SSP). On the basis of overall performance, the sources were ranked as 50% FYM + 50% SSP > 50% rock phosphate (RP) + 50% SSP> 100% SSP>75% FYM + 25% SSP > 75% RP +25% SSP > 100% FYM > 100 RP > control. Interactively, a significant and maximum increased over absolute control in most of the soil and plant tested characteristics were observed when 100 kg P_2O_5 ha^{-1} was supplemented 50% each as FYM and SSP along with PSB inoculation which was followed by 50% P each as FYM and SSP demonstrating that PSB were effective in enhancing RP solubilization under calcareous soil. Maximum value cost ratio of 3.1 was observed for 50% P each as FYM and SSP + PSB which was similar to 100% P as FYM + PSB and 75% FYM+ 25% SSP + PSB. Therefore, in calcareous soil P shall be amended 50% each as organic and mineral source with PSB for its efficient utilization and obtaining optimum yield of maize.

Keywords: Calcareous soil; farmyard manure; maize; phosphorus use efficiency; rock phosphat

ALLEVIATION OF FOOD SECURITY UNDER CHANGING CLIMATE BY IMPROVING THE EFFICIENCY OF MAIZE CROP LEADS TO GREEN GOVERNANCE

Sadia Afzal*[1], Sajid Hussain[1,2], Muhammad Zeshan Mansha[3], Dilshad Hussain[1], Muhammad Ramzan[1], Nabeel Arslan[1], Naseem Abbas[1] and Muhammad Sameed[1]

[1]Department of Agronomy, Faculty of Agriculture, University of Layyah, Layyah, Pakistan
[2]Carbon Management and Sequestration Center, School of Environment and Natural Resources, 414B Kottman Hall, 2021 Coffey Road, Ohio State University, Columbus, OH 43210, USA
[3]Department of Plant Protection, Faculty of Agriculture, University of Layyah, Layyah, Pakistan

*Email: sadiaafzal335@gmail.com

ABSTRACT

Malnourishment is an increasing apprehension in the underdeveloped countries, brings about in miscellaneous health and social problems, such as mental problems, disruption in the immune system and inclusively poor health. Lack of water availability and malnutrition are serious threats to world food security and survival of living organisms. To address and overcome these issues a pot experiment was designed to improve the productivity and grain bio-fortification of spring maize (*Zea mays* L.) through zinc nutrition under limited moisture supply. Thirty-two pots were placed in rain sheltered net house under the Faisalabad, Punjab, Pakistan climatic conditions during spring 2021 and 2022. A completely randomized design (CRD) in factorial arrangement was designed with four replicates. The treatments consist of two drought levels having well-watered (70% water holding capacity), and drought stress with (35% water holding capacity), while factor B contains two genotypes DK-6525 (Monsanto), and High corn-8288 (ICI) and two levels of zinc treatments Z_1 = 0 mg kg^{-1} of soil Z_2 = 10.0 mg kg^{-1} of soil. The results revealed that zinc treated pots with 10 mg kg^{-1} soil had significant ($P<0.05$) results with 18.6 g root fresh weight $plant^{-1}$, 32.5 cm leaf length, 0.83 (-MPa) leaf water potential, and 33.90 mg kg^{-1} grain zinc contents over control. Among the two genotypes DK-6525 performed better as compared to High corn 8288 under maximum zinc application in respect of morphological and physiological parameters. It was concluded from this study that application of Zn @ 10.0 mg kg^{-1} of soil under well-watered conditions improve growth, productivity and grain zinc contents as compared to moisture stress condition under semiarid climates.

Keywords: Zinc, Nutrition, Growth, Yield, Cultivars

PHYSIOLOGICAL EFFECTS OF DIFFERENT GROWTH PROMOTING HORMONES ON WHEAT CROP AND THEIR EFFECTS ON PRODUCTIVITY AND YIELD

Sajid Hussain[*1, 2], Muhammad Zeshan Mansha[3], Muzamil Jawad[1], Muhammad Usman[1], Muhammad Zubair[1], Kashif Raza[1], Muhammad Aatif[1], Danial Akhtar, Muhammad Afaq[1], Yousra Kalsoom[1] and Wajahat Ali[1]

[1]Department of Agronomy, Faculty of Agriculture, University of Layyah, Layyah, Pakistan
[2]Carbon Management and Sequestration Center, School of Environment and Natural Resources, 414B Kottman Hall, 2021 Coffey Road, Ohio State University, Columbus, OH 43210, USA
[3]Department of Plant Protection, Faculty of Agriculture, University of Layyah, Layyah, Pakistan

*Email: drsajidhussain@ul.edu.pk

ABSTRACT

Leading crop simulation models used by a global team of agricultural scientists to simulate wheat production up to 2050 showed large wheat yield reductions due to climate change for South Asia, where food security is already a problem. Research trails was conducted to check the effect of different growth hormones on yield of wheat crop, because in current situation due to increase in population, we must get maximum yield of staple crop by using minimum resources to meet the requirements of humans. Basically, there were three treatments isabion, quantis and MLE (Moringa Leaf Extract) respectively are applied in 9 plots with the mingling of these hormone. Isabion is a chemical with amino acids and peptide which promotes root growth and vigorous development of buds. Isabion is a result of transformation of natural collagen through a process that meets the highest standards of production and quality. Quantis is also bio-stimulant and is combination of carbons, calcium and energy source carbohydrates, in the form of sugars and amino acids. MLE was prepared by me (took leaves of moringa, freeze them at 5 centigrade for 10 hours and then grind them in grinder by using water is well). This promotes wheat growth and productivity by affecting senescence and source sink relationship. The trial design was RCBD with the two varieties akbar and champion respectively. The variance was shown in height of plant and no of grains per spike as well because of application of isabion due to its good ingredients in this. The results are also good but isabion remained incredible due to its capacity to absorb on the wheat when it applied. All of them are good and must be used commercially for the good production of wheat crop under changing climate of semi-arid conditions.

Keywords: Food safety, Hormone, Isabion, Quantis, MLE, Growth, Senescence, Yield

NUTRIENT RETENTION AFTER CROP HARVEST IN A TYPIC HAPLUDULTS AMENDED WITH BIOCHAR TYPES UNDER NO-TILLAGE SYSTEM

Qamar Sarfaraz[*1,2], Leandro Souza da Silva[2], Mohsin Zafar[3], Gerson Laerson Drescher[4]

[1]Lasbela University of Agriculture, Water and Marine Sciences, Uthal – Balochistan
[2]Department of Soil Science, Federal University of Santa Maria, Brazil
[3]Mirpur University of Science and Technology (MUST) Mirpur – AJK
[4]University of Arkansas System Division of Agriculture, Fayetteville, AR 72704, US

*Email: qamar.sarfaraz@luawms.edu.pk

ABSTRACT

The utilization of biochars as soil amendments for enhancing nutrient retention in subsoils present potential limitations. To address this issue, we conducted a greenhouse experiment to assess the effects of various biochar's derived from animal manures (swine manure, poultry litter, cattle manure) and plant residues (rice straw, soybean straw, corn straw) when applied to surface of an acidic soil. Our study focused on wheat crops under a no-tillage system, with a subsequent evaluation of the residual impacts on soybeans. The experimental design involved the application of biochar's at different rates i.e. 10 and 20 Mg ha^{-1}, followed by the assessment of their influence on NPK levels, pH, and exchangeable Al in stratified soil layers (0-5, 5-10, 10-15, and 15-25 cm). Furthermore, we investigated the interplay between biochar doses and the application of nitrogen (N) in the top 5 cm of soil, specifically examining NO_3^-, NH_4^+, P and K levels. Our findings revealed that in the top 5 cm of soil, biochar doses and N application significantly affected NO_3^-, NH_4^+, P and K concentrations. However, in deeper soil layers, no significant differences were observed among biochar doses or N application. Interestingly, K levels were impacted throughout all soil depths, regardless of the presence or absence of NH_4^+ fertilizer application. Moreover, biochar application up to a 5 cm depth induced favorable changes in soil pH and reduced exchangeable Al. In contrast, deeper layers experienced a decrease in soil pH and an increase in exchangeable Al following biochar treatment. In conclusion, our study demonstrates that biochar's can effectively retain NPK nutrients, enhance soil pH, and decrease exchangeable Al, independent of the type and dosage of application under a no-tillage system. Nonetheless, the efficacy of biochar amendments may vary with soil depth and type of nutrient, warranting careful consideration for maximizing their benefits in sustainable agricultural practices.

Keywords: *Biochar, Stratification, pH, Exchangeable Al, Primary Nutrients*

IMPACT OF CO-COMPOSTED BIOCHAR ON GROWTH AND PRODUCTIVITY OF MAIZE GROWN UNDER NICKEL AND CHROMIUM-CONTAMINATED SOIL

Asadullah[1] and Allah Ditta[1,2*]

[1]Department of Environmental Sciences, Shaheed Benazir Bhutto University Sheringal, Dir Upper, Khyber Pakhtunkhwa 18000, Pakistan
[2]School of Biological Sciences, The University of Western Australia, 35 Stirling Highway, Perth, WA 6009, Australia

*Email: allah.ditta@sbbu.edu.pk

ABSTRACT

Accumulation of HMs affects the biological and physicochemical properties of soil that result in poor nutrient supply and eventually lower agricultural production. Due to its stable nature, affordability, and environment-friendly nature, biochar (BC) is becoming more and more popular in recent years for the restoration of metal-contaminated soils and carbon sequestration for a longer period. It is pertinent to devise an economical, easily available, or environment-friendly strategy to mitigate the toxic impact of Cr on the growth and productivity of crop plants. The present study hypothesized that co-composted biochar could restore Cr-contaminated soils and subsequently enhance the growth and productivity of crop plants. Based on this hypothesis, the present study was conducted to prepare co-composted biochar using compost prepared from plant leaves or biochar from walnut peels and to investigate the potential of prepared co-composted biochar on the restoration of artificially spiked Cr- and Ni-contaminated soil and the growth and productivity of maize. A pot experiment was conducted in the greenhouse of the Department of Forestry, Shaheed Benazir Bhutto University Sheringal. There were eight treatments, arranged in completely randomized design in triplicate. The results showed that the maximum plant growth, yield and yield parameters were recorded with the application of co-composted biochar under Cr (25 ppm) and Ni (90 ppm) stresses. The minimum Ni concentration in the shoot (5.0 mg kg^{-1} DW), and root (2.33 mg kg^{-1} DW) portions were recorded with the application of co-composted biochar under Cr (25 ppm) and Ni (90 ppm) stresses and it was 60.5 and 18.9%, 57.6 and 51.7% less in comparison to the controls with and without Cr and Ni stresses, respectively. Similarly, the minimum Cr concentration in the shoot (8.83 mg kg^{-1} DW) and root (6.17 mg kg^{-1} DW) portions were recorded with the application of co-composted biochar under normal conditions and it was 45.4 and 4.8% and 38.3 and 15.9% less in comparison to the controls with and without Cr and Ni stresses, respectively. Regarding the remediation efficiency, the maximum remediation factor for Ni (0.05%) and Cr (0.21%) was recorded with the application of compost under combined stresses of Cr and Ni and these were 140.7 and 307.3%, and 141.5 and 247.4% more in comparison to the controls with and without Cr and Ni stresses, respectively. In conclusion, the application of co-composted significantly alleviates the Cr and Ni stress in maize and improves the growth, physiological, and bioaccumulation of Cr and Ni in maize tissues.

Keywords: C*ompost; biochar; heavy metals, nickel; chromium; cereals*

"Soil Health: A Key to Food Security"

20th INTERNATIONAL CONGRESS OF SOIL SCIENCE

20-22 February 2024, Rawalpindi, Pakistan

SOIL SCIENCE SOCIETY OF PAKISTAN -SSSP-

SOIL & ENVIRONMENTAL POLLUTION AND THEIR REMEDIATION

ORGANIC FERTILIZERS: A POTENTIAL SOURCE OF MICROPLASTICS ENTRY INTO FOOD CHAIN

Aamna Naeem[1], Aamir Alaud Din[1], Muhammad Ansar Farooq[1]*

[1]Institute of Environmental Sciences and Engineering (IESE), National University of Sciences and Technology (NUST), Islamabad, Pakistan

*Email: ansar@iese.nust.edu.pk

ABSTRACT

Organic fertilizers have become an important source of microplastics (MPs) and nanoplastics (NPs) entry into agricultural soils. These small-sized plastics are of great concern as they enter the food chain causing potential damage to the growth of edible plants, as well as to human health. The present study aimed at quantification and characterization of MPs in three different types of composts i.e., municipal solid waste (MSW) compost, Leaf compost (LC) and organic compost (OC) and also focused on its impact on growth of Lettuce (*Lacuta sativa*). Results showed that MPs abundance (size 50-500 µm) in compost samples (n=8) varied depending upon the source of compost, with MSW compost having the highest abundance i.e., 19800 ± 565 MPs/kg, followed by LC and OC having 9700 ± 424 and 5100 ± 989 MPs/kg. Fragments and Fibers were the most dominant shape type of MPs. The Fourier Transform Infrared Spectroscopy (FTIR) results revealed that Polyethyelene (PE), Polypropylene (PP) and Polyethylene terephthalate (PET) were the most common polymers. Concentration of heavy metals (Cr, Cd, Ni, Pb), organic matter, nitrogen and phosphorous, excluding potassium, were all found within the limits provided by Soil Fertility Research Institute (SFRI) under the Fertilizer and Allied products standards. Fisher's LSD test showed that the growth of Lettuce plant was most adversely affected by MSW compost, which led to a significant ($P < 0.05$) decline in leaf length, no. of leaves, leaf fresh and dry weight as well as Membrane Stability Index (MSI) in comparison to OC and LC plants. SEM images showed accumulation of MPs in all leaf samples, with the highest occurring in lettuce grown on MSW compost. Hence, it is highly important to standardize the plastic content in commercially available compost samples as they are entering the major food crops and plants, polluting the agroecosystems, and threatening the survival of humans.

Keywords: Organic fertilizers, Heavy metals, Microplastics, Food security, Lettuce

ASSESSMENT AND CHARACTERIZATION OF METAL-ENRICHED DUST PARTICULATE MATTER ALONG JARANWALA ROADSIDE SOILS, FAISALABAD: SPATIAL DISTRIBUTION PATTERNS AND ENVIRONMENTAL IMPLICATIONS

Hamaad Raza Ahmad*[1], Muhammad Aamer Maqsood[1], Muhammad Zia ur Rehman[1], Muhammad Sabir[1], Nadeem Ashraf[1], Muhammad Safraz[2]

1Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad
2Soil Salinity Research Institute Pindi Bhattian, Hafizabad

***Email:** khamaad@gmail.com

ABSTRACT

Metal-containing dust do not degrade biologically and accumulated on the surfaces of plant tissues. Metal present in urban roadside soils and surface dust may be originated from traffic, industrial processes, fuel combustion, fertilizers, and construction activities. Health risks associated with metal containing dust were assessed on soil quality and plant growth along 23 Km long Jaranwala road, Faisalabad having an Air Quality Index > 400. Soil, plant, and water samples were collected and Particulate Matter along the road was also monitored with Microdust Pro. Total Suspended Particles (TSP) values from edge of Jaranwala road vary from 944-1504 µg m^{-3}, PM2.5 ranged from 67-831µg m^{-3}, PM10 ranged from 581-981 µg m^{-3}. The chlorophyll contents in Sorghum plant of Jaranwala road varies from 33.2-57.7 SPAD. The soil concentration of AB-DTPA Cu, Mn, Ni, Pb, and Cd were found within the safer limits. Although the result indicated that all metal values were within safer limits but Particulate matter (TSP, PM10, PM2.5) were higher compared to USEPA (2012) standards. Practical strategies like reduction of emissions, keeping wet surfaces, timely tuning of vehicles and urban traffic jams for controlling HMs pollution are required to reduce the health risks associated with exposure to these toxic substances.

***Keywords*:** Heavy metals, High-way, Roadside soils, Health risks.

SOIL ZINC APPLICATION DECREASES ARSENIC AND INCREASES ZINC CONCENTRATION IN GRAINS OF ZINC-BIOFORTIFIED WHEAT CULTIVARS

Ammara Basit*[1], Shahid Hussain[1]

[1]Department of Soil Science, Faculty of Agricultural Sciences and Technology, Bahauddin Zakariya University, Multan 60800, Pakistan

*Email: ammarabasit738@gmail.com

ABSTRACT

Arsenic (As) is a noxious metalloid for plants, animals and human health. Elevated levels of As in soils may accumulate toxic levels in wheat grains. The long-term consumption of such grains can deteriorate human health. Moreover, the vulnerable population groups in developing countries intake only inadequate dietary zinc (Zn) which is strongly linked to cereal-based diets. The present study evaluated the effect of soil Zn application on decreasing As and increasing Zn accumulation in wheat grains. For this, two Zn-biofortified wheat (Akbar-2019 and Zincol-2016) cultivars were grown on soil spiked with diverse levels of As [0 (distilled water control), 5 and 25 mg As kg^{-1}]. Two rates of Zn [0 (no Zn application) and 8 mg Zn kg^{-1} (soil Zn application)] were also applied to the soil. Arsenic spiked soil decreased plant dry matter yields, chlorophyll pigments, and P and Zn accumulation but increased As accumulation in wheat. Contrarily, soil Zn application enhanced crop yield, and increased P and Zn accumulation with a simultaneous decrease in As accumulation in both cultivars. Compared to no Zn, soil Zn application decreased grain As concentration by 26%, 30% and 32% in soil spiked with 0, 5, and 25 mg As kg^{-1}, respectively. Thus, applying Zn to As-spiked soil mitigates the harmful effects of As by increasing Zn and decreasing As concentration in wheat, resulting in improved grain quality for human consumption. In conclusion, Zn application should be recommended for addressing the health implications associated with As-contaminated crops and human Zn deficiency.

Keywords: Akbar-2019, Arsenic, Contamination, Spiking, Soil application, Wheat, Zinc, Zincol-2016

INTEGRATED NUTRIENT MANAGEMENT EFFECTS ON NUTRIENT AVAILABILITY, LABILE CARBON FRACTIONS, AND YIELD OF HYBRID MAIZE (*Zea mays* L.)

Sajjad Ali Shah[1], Ghulam Murtaza Jamro[1], Nazia Rais[2], Javaid Ahmed Shah[3], Mehrunisa Memon[1], Asif Ali Mastoi[1], Sohail Ahmed Qureshi[2]

1Department of Soil Science, Sindh Agriculture University Tandojam, Pakistan
2Soil and Environment Research Institute, Agriculture Research Center, Tandojam Pakistan
3Soil and Environmental Sciences Division, Nuclear Institute of Agriculture Tandojam Pakistan
*Email: naziarais81@gmail.com

ABSTRACT

Nutrient depletion from soil has become a serious constraint for sustainable crop production. This situation is very critical, and it has drastically affected crop yields, deteriorated soil quality, and labile carbon (C) fraction in soils. A field experiment was conducted to investigate the effects of integrated nutrient management effects on nutrient availability and labile carbon fractions and yield of hybrid maize (*Zea mays* L.) in a randomized complete block design (RCBD) and replicated three times, involving 17 treatments of different organic manures and mineral fertilizers. The treatments included T_1: control (without manure and fertilizer), T_2: 100% farm yard manure (FYM), T_3: 100% poultry manure (PM), T_4: 100% sugarcane filter cake (SF), T_5: 100% banana waste compost (BWC), T_6: 100% wheat straw (WS),T_7: 100% recommended dose of fertilizer (RDF) T_8: FYM + 75% RDF, T_9: PM + 75% RDF, T_{10}: FC + 75% RDF , T_{11}: BWC + 75% RDF, T_{12}: WS + 75% RDF, T_{13}: FYM + 50% RDF, T_{14}: PM + 50% RDF, T_{15}: FC + 50% RDF, T_{16}: BWC + 50% RDF and T_{17}:WS + 50% RDF).The integration of the recommended dose of fertilizer (RDF) and different organic manures significantly increased, growth, yield contributing traits and grain yield. Further, the integration of RDF and organic manures increased, nutrients (N, P and K) content in index tissue, organic matter content, total N, AB-DTPA P and K, labile SOC fractions, and soil bacterial populations at harvesting. The result revealed that the overall maximum grain yield was obtained in T_7: RDF 100% and T_{11} BWC+RDF 75% (70 maunds ha^{-1}). Maximum organic matter was found in T_{11} BWC+RDF 75% (1.08%) and minimum was in control (0.45%). Maximum N content (0.045%), P content (8.66 mg kg^{-1}) and K content (301.67 mg kg^{-1}) was found in T_{11} BWC+RDF 75%. A significant enhancement in labile C fractions in surface soil was observed as compared to over control plots where integrated chemical fertilizer and organic manures were applied. As compared to control, maximum labile C fraction was found in T_{11} BWC+RDF 75% (12.95 mg g^{-1}). All manuretreatments increased soil bacterial population significantly, but the greatest was found at T_{11} BWC+RDF 75%. It is suggested that integrated nutrient management is the best strategy to maximize maize growth and yield, organic matter content (%), increase nutrients (N, P and K) availability and labile SOC fractions.

***Keywords*:** IPNMS, Banana waste compost, Carbon fractions, Bacterial population.

INFLUENCE OF IONIC CERIUM AND CERIUM OXIDE NANOPARTICLES ON MAIZE (*Zea mays*) SEEDLINGS GROWN WITH AND WITHOUT CADMIUM

Muhammad Ashar Ayub*[2,5], Muhammad Zia-ur-Rehman[1], Hamaad Raza Ahmad[1], John-Paul Fox[2], Preston Clubb[3], Alan L. Wright[4], Muhammad Anwar ul Haq[1], Muhammad Nadeem[4,5], Cyren M. Rico[3] and Lorenzo Rossi[2]

[1]Institute of Soil and Environmental Sciences, University of Agriculture, 38000, Faisalabad, Punjab Pakistan
[2]Horticultural Sciences Department, University of Florida, Institute of Food and Agricultural Sciences, Indian River Research and Education Center, Fort Pierce, Florida 34945, USA
[3]Department of Chemistry and Biochemistry, Missouri State University 901 S National Ave, Springfield, MO, 65897 USA
[4]Department of Soil, Water, And Ecosystem Sciences, University of Florida, Institute of Food and Agriculture Sciences, Indian River Research and Education Centre, Fort Pierce, Florida 34945, USA
[5]Institute of Agro-Industry and Environment, Faculty of Agriculture and Environment, The Islamia University of Bahawalpur, 63100, Punjab, Pakistan

*Email: ashar.ayub@iub.edu.pk

ABSTRACT

Cerium (Ce^{4+}) and cerium oxide nanoparticles (CeO_2-NPs) have diversified reported effects on plants. Once dispersed in the environment their fate is not well understood, especially in co-existence with other pollutants like cadmium (Cd). The effect of co-application of Ce and Cd is reported in various studies, but the role of Ce source (ionic or bulk) and nanoparticle size is still unknown in cereal plants like maize (*Zea mays*). To better understand the synergistic effects of Ce and Cd, 500 mg kg^{-1} Ce coming from ionic (Ce^{4+} as $CeSO_4$) and CeO_2 nano sources (10 nm, 50 nm, and 100 nm) alone and in combination with 0.5 mg Cd kg^{-1} sand were applied to maize seedlings. Growth, physiology, root structure, anatomy, and ionic homeostasis in maize were measured. The results revealed that Ce^{4+} resulted in an overall decrease in seedling growth, and biomass and resulted in higher heavy metal (in control sets) and Cd (in Cd spiked sets) uptake in maize seedlings' root and shoot. The effects of CeO_2-NPs were found to be dependent on particle size; in fact, under Cd-0 (non-Cd spiked sets) CeO_2-100 nm showed beneficial effects compared to the control. While under co-application with Cd, CeO_2-50 nm showed net beneficial effects on maize seedling growth parameters. The Ce alone, and in combination with Cd, altered the root suberin barrier formation. Both ionic and nano Ce sources alone and in co-existence with Cd behaved differently for tissue elemental concentrations (Ce, Cd, micronutrients like B, Mn, Ni, Cu, Zn, Mo, Fe, and elements Co, Si) suggesting a strong influence of Cd-Ce coexistence on the element's uptake and translocation in maize. The Ce application has a divergent effect on maize crops depending upon the Ce source under Cd stress conditions. Further investigations are needed to properly understand the mode of transport and action of Ce-based nanomaterials.

Keywords: Heavy Metals, Maize, Micronutrients, Nanotechnology, Root barrier.

ENVIRONMENTAL MONITORING OF SELF-SUSTAINING ARTIFICIAL MICRO ECOSYSTEM

Anum Fatimah[1]*, Samia Qadeer

[1]Department of Environmental Science, Allama Iqbal Open University, Islamabad Pakistan

*Email: anumfatimah27@gmail.com

ABSTRACT

The microecosystem provides biodiversity dynamics within confined ecosystems that helps in conservation efforts and the preservation of diverse species. Further such concepts can be applied for botanical research within these systems can shed light on plant-microbe interactions. The current study was designed with the concepts of development and supervising climate change factor and sustaining itself with help of available nutrients. The terrarium concept was applied in 6-inch, 12 inch and large capacity glass jars, including the biotic factors snails, earthworms, mosses, small plants and beetles where abiotic components consisted of soil, pebbles, stones, and charcoal. The system was held enclosed with no further addition of moisture or nutrients. The self-sustaining system sustained for 15 days in 6inch beaker indicating the decline phase due to temperature fluctuations, however the moisture and the other nutrient factors remained sustainable. Critical observations were the plants displayed measurable size increase. The snail population dwindled for unknown reasons where the moss underwent a chromatic deepening. Where in the larger container the plant exhibited measurable growth in its physical dimensions. Slightly change in moss color, the number of snail eggs expanded, and the snail eggs started showing signs of movement. The overall system indicated to follow the Leibig's Principle "The growth is regulated by a limiting factor, i.e. the scarcest resource, rather than by the total resources available". In current research it was found that the system if remained undisturbed with proper proportion of biotic components has capacity to self-sustain until the ecological overshoot is being reached. However in a closed ecosystem the food and energy cycles have enough capacity to sustain for longer duration and recycle the nutrients for itself.

ANTIBIOTIC RESISTANCE GENES AND GENETIC ELEMENTS IN LIVESTOCK MANURE: A THREAT TO SOIL HEALTH

Luqman Riaz*[1]

[1]Department of Environmental Sciences, Kohsar University Murree, 47150, Punjab, Pakistan
*Email: luqman.riaz@kum.edu.pk

ABSTRACT

The presence of antibiotic resistance genes (ARGs) and mobile genetic elements (MGEs) in livestock manure raises significant concerns regarding their impact on soil health. Composting, often utilized to manage manure, presents an opportunity to study the fate of these elements and their potential implications for future environments. Throughout the composting process, the fate of ARGs and MGEs is a complex interplay influenced by multiple factors. Temperature, moisture, oxygen levels, and microbial activity all contribute to the transformation and degradation of these elements. While some ARGs may decrease due to degradation or loss of MGEs, certain conditions within the composting environment might favor the survival and persistence of resistant genes. Understanding the dynamics of these elements during composting is crucial for evaluating their risks to soil health. The potential transfer of ARGs from compost to soil ecosystems can disrupt microbial communities, alter nutrient cycles, and pose threats to environmental and human health. Consequently, mitigating these risks necessitates comprehensive assessments of composting practices and their efficacy in reducing the abundance and transferability of ARGs. Efforts focused on monitoring and managing composting processes can aid in designing strategies to minimize the dissemination of antibiotic resistance. Moreover, integrating technologies that facilitate the targeted degradation or elimination of ARGs during composting holds promise in mitigating these threats. In conclusion, comprehending the behavior and persistence of antibiotic resistance genes and mobile genetic elements during livestock manure composting is pivotal for assessing their potential impact on soil health. Proactive measures, informed by scientific insights, are imperative to mitigate these threats and preserve the integrity of our ecosystems.

Keywords: Antibiotic resistance, Livestock, Gene, Manure, Soil health

INTEGRATED STRATEGIES FOR EFFECTIVE CARBON SEQUESTRATION: A HOLISTIC APPROACH TO MITIGATE GLOBAL CLIMATE CHANGE

Hasham Fatima, Ahmad Mahmood*, Shahzadi Bibi, Mehak Gull, Laiba Tassawar

1Department of Soil and Environmental Sciences, MNS-University of Agriculture, Multan.
*Email: ahmad.mahmood@mnsuam.edu.pk

ABSTRACT

The escalating global average atmospheric temperature, attributed to carbon-induced global warming, poses severe threats to the Earth's climate, ecosystems, and biodiversity. The consequences include the melting of polar ice caps, rising sea levels, and the disruption of natural habitats for various species. This rapid environmental transformation is exacerbated by continued human emissions of heat-trapping greenhouse gases (GHGs), with carbon dioxide (CO_2) being a critical Anthropogenic contributor due to its abundance and long atmospheric persistence. In response to these challenges, we advocate a primary focus on Carbon Sequestration as a pivotal strategy to mitigate carbon emissions. Carbon Sequestration involves the removal of carbon from the atmosphere and its deposition in reservoirs, thus curbing global warming and related environmental issues. The various reservoirs, known as carbon pools, can be natural or human-induced. Notable strategies for carbon sequestration include carbon capture at power plants, membrane gas separation, carbon capture and conversion, bioenergy with carbon capture and storage, chemical looping, afforestation, reforestation, improved forestry, or agricultural practices, and revegetation. Protecting and enhancing natural carbon pools, including soil, ocean, forest, and the atmosphere, are also critical components of these strategies. This prospective highlights the importance of adopting an integrated approach that combines natural and technological strategies for comprehensive and sustainable carbon sequestration. It delves into the challenges, opportunities, and potential synergies among different sequestration methods, emphasizing the need for interdisciplinary collaboration, policy support, and technological advancements. The successful implementation of these strategies is crucial for achieving a resilient and sustainable future, addressing the global climate crisis effectively.

Keywords: Carbon sequestration, Global warming, Greenhouse gases, Climate change, Sustainable practices,

SUSTAINABLE WASTE MANAGEMENT THROUGH HOUSEHOLD-LEVEL COMPOSTING: A PATHWAY TO ENVIRONMENTAL HEALTH AND AGRICULTURAL PROSPERITY IN PAKISTAN

Shahzadi Bibi[1], Aliza Riaz[1], Hasham Fatima[1], Shakeel Ahmad[1], Ahmad Mahmood[1], Muhammad Arif[1], Tanveer-ul-Haq[1]

1Department of Soil and Environmental Sciences, MNS-University of Agriculture, Multan.
***Email: ahmad.mahmood@mnsuam.edu.pk

ABSTRACT

The annual waste of 36 million tons of food in Pakistan, with 40 percent being food waste, poses a significant environmental and sustainability challenge. Outdated practices such as burning and open dumping persist, contributing to pollution and greenhouse gas emissions. A mere 2% of individuals engage in composting, and only half of the waste is recycled, further exacerbating environmental issues. We propose a transformative solution at the household level by introducing an automatic compost bin that segregates garbage at its source. Composting, a controlled and aerobic process, facilitates the natural decomposition of organic materials into a nutrient-rich mulch or soil supplement. The resultant compost, a crumbly, black material with an earthy aroma, can be a valuable resource for enhancing plant development, preventing soil erosion, and improving overall soil quality. By diverting waste from burning to landfills, this approach significantly reduces strong greenhouse gas emissions, contributing to a cleaner environment. The composting process not only addresses waste management challenges but also offers additional benefits, including the balancing of pH levels, carbon sequestration, and the promotion of biodiversity. This comprehensive methodology involves systematic stages such as garbage collection, layering with soil, mixing, and temperature monitoring. Critical components, including air and water moisture, oxygen, and a balanced ratio of carbon-rich (brown waste) to nitrogen-rich (green waste) materials at 25-30:1, ensure the effectiveness of the composting process. Implementing household-level composting as a sustainable waste management practice has the potential to revolutionize waste disposal habits in Pakistan.

***Keywords**:* Composting, Food waste, Automated composting bin, Household waste

PRELIMINARY ASSESSMENT OF HEAVY METAL CONTAMINATION IN CROPS GROWN WITH WASTEWATER IN PUNJAB, PAKISTAN

Ana Aslam[1*], Muhammad Nasim[1], Farah Rasheed[1], Nisa Mukhtar[1], Qudsia Nazir[1], Muhammad Aftab[1], Allah Nawaz[1], Sarfraz Hussain[2]

1Soil Chemistry Section, Institute of Soil Chemistry & Environmental Sciences, Ayub Agricultural Research Institute, Faisalabad, Punjab, Pakistan
2Institute of Soil Chemistry & Environmental Sciences, Kala Shah Kaku, Punjab, Pakistan

*Email: anaaslam1704@gmail.com

ABSTRACT

Intensive cultivation of crops and scarcity of fresh water have resulted in the increased use of untreated wastewater for irrigation in developing countries, especially Pakistan. Untreated wastewater usually contains a wide range of heavy metals. Once crops are exposed to this contaminated water, they accumulate heavy metals in their edible parts and risk to humans and animals. Therefore, there is a dire need of time to assess the heavy metal content in wastewater-irrigated crops. The present survey study was conducted to monitor the heavy metals including lead (Pb), cadmium (Cd), nickel (Ni), and chromium (Cr) in crops grown with untreated wastewater in urban and peri-urban areas of Punjab, Pakistan. Heavy metal contents were determined using a flame atomic absorption spectrophotometer. Results showed that among the crops grown with untreated wastewater, 61.3% were contaminated with Cr, 55.4% with Pb, 54.6% with Cd, and 14.6% with Ni when compared with the permissible limit. However, maximum degree of contamination was observed in crops of district Gujranwala compared to crops grown with wastewater in other districts. Based on these results, it is concluded that a substantial amount of heavy metals was found in crops irrigated wastewater. Hence, it is recommended that wastewater should be treated before irrigation on agricultural land.

Keywords: Sewage water, Heavy metal, Bioaccumulation, Edible part,

IMPACT OF UNTREATED TEXTILE EFFLUENT ON GROWTH OF RICE (*Oryza sativa L.*)

Tajwar Alam[1*], Tanzeem-Ur-Rehman[2], Muhammad Ikram[3], Rimsha Sadaf [3], Muhammad Noman Rafiq[3]

1Institute of Hydroponic Agriculture, PMAS-Arid Agriculture University, Murree Road-46300, Rawalpindi, Pakistan
2Institute of Soil & Environmental Science, University of Agriculture Faisalabad, Pakistan
3Institute of Soil & Environmental Science, PMAS-Arid Agriculture University, Murree Road-46300, Rawalpindi, Pakistan

*Email: tajwaralam@uaar.edu.pk

ABSTRACT

Degradation of soil and water from discharge of untreated industrial effluent is alarming in Pakistan. Therefore, buildup of heavy metals in soil from contaminated effluent, their entry into the food chain and effects on rice yield were quantified in a pot experiment. Wastewater samples were collected from two different industries and treatments were comprised as, control, Textile effluent of Rashid Printing Textile (RPT) 100%, RPT with 40% dilution of tap water, Textile effluent of Mamtaz Mehal Textile (MMT) 100%, MMT with 40% dilution of tap water, and RPT+MMT effluents collectively with 50% dilution of tap water with industrial effluents applied as irrigation water. Effluents, initial soil, different parts of rice plants and post-harvest soil were analyzed for various elements, including heavy metals. Application of elevated levels of effluent contributed to increased heavy metals in pot soils and rice roots due to translocation effects, which were transferred to rice straw and grain. Results indicated that heavy metal toxicity may develop in soil because of contaminated effluent application. Heavy metals are not biodegradable, rather they accumulate in soils, and transfer of these metals from effluent to soil and plant cells was found to reduce growth and development of rice plants and thereby contributed to lower yield. Moreover, a higher concentration of effluent caused heavy metal toxicity as well as reduction of growth and yield of rice, and in the long run, a more aggravated situation may threaten human lives, which emphasizes the obligatory adoption of effluent treatment before its release to the environment, and regular monitoring by government agencies needs to be ensured.

Keywords: Biomass, Crop yield, Heavy metals, Industrial effluent, Soil pollution.

BIOMARKERS ANALYSIS IN THE SOIL IMPREGNATED WITH OIL SEEPS OF POTWAR PLATEAU

Suleman Orakzai[1], Samina Siddiqui[1*]

1National Centre of Excellence in Geology-University of Peshawar
*Email: sulemanorakzai@gmail.com

ABSTRACT

Biomarkers are biological precursors which are derived by the decay of C3 or C4 or mixed vegetation types undergone degradation process millions of years before. The aim of the study was to understand the paleoenvironmental and climate reconstruction from biomarkers in the soil and oil seeps. For that purpose, oil seep and soil impregnated with oil was collected from the oil seeps exposed in the Kohat and Potwar Plateau. It was observed that from GC-FID chromatogram nC15-nC31 normal alkanes shows the moderate thermal maturity of the organic matter because light hydrocarbons are present but high concentration of nC22-nC26 alkanes are also present. Pr/nC17 and Ph/nC18 ratios are 0.45 and 0.30 respectively (<0.5) indicates the non-biodegraded OM. OEP_{29} value is 0.95 indicates the thermal maturity of the OM. TAR value is 1.91 indicates high terrestrial organic matter input in the source. Terpanes is present in which marine organic matter input seems dominant because marine biomarker C23 is in high concentration as compared to terrestrial organic matter biomarkers C19 and C20. C19/C19+C23 ratio is 0.09 which indicates the high marine organic matter input. Ts/Ts+Tm ratio is 0.52 which indicates that organic matter is thermally mature, C28,30 Bisnorhoane is in very high concentration. C29/C30 ratio is 1.82 (>1) indicated the carbonate lithology and a high ratio of G/C30 indicated the hypersaline depositional environment. Oleanane index is also high almost 50% which leads towards the high terrestrial input in organic matter. Homohopanes Index (H32S/ H32S+ H32R) value is 0.63, which also reinforces the evidence of thermal maturity of organic matter. The sample is thermally mature because C29ββ/C29ββ+C29αα and C29S/C29S+C29R ratios are in the range of 0.40-0.55, so sample is falling in the thermally mature zone or oil window. The sample has mixed organic matter input because C27/C29 ratio is 0.51, indicate that marine biomarker C27 steranes and terrestrial biomarker C29 steranes are almost equal concentration so mixed source of organic matter. This is concluded that the presence of all biomarkers except for n-alkanes is from oil and oil is the source of such biomarkers in the soil.

***Keywords*:** Biomarkers, Marine, Terrestrial, Terpanes, Hopanes.

SEDIMENTS BOUND PHOSPHORUS FRACTIONS AND ALGAL AVAILABILITY FROM CONNECTING SOURCES OF RIVER JHELUM PAKISTAN

Mohsin Zafar*[1], Gulfam Mohi-ud-Din[2], Qamar Sarfaraz[3]

1Department of Environmental Sciences, Mirpur University of Science and Technology (MUST), Mirpur 10250 Azad Jammu and Kashmir-Pakistan
2School of Water and Environment, Chang'an University, Shaanxi, People's Republic of China
3Department of Soil Science, Faculty of Agriculture, Lasbela University of Agriculture, Water, and Marine Sciences, Uthal, Balochistan - 90150, Pakistan

*Email: mohsinses@gmail.com

ABSTRACT

Freshwater sediment may act as an internal source of legacy bound phosphorus (P) that can induce algal production and decline overall water quality. This study assesses the mobility, bioavailability, and origin of phosphorus in a diverse rural catchment of River Jhelum, Azad Jammu and Kashmir (AJ&K). The sampling includes seven monitoring stations during summer to autumn 2020 at sub-catchments scale and delineation was carried by using GIS terrain analysis tools. The time integrated sediment samples were installed and three samplings (Summer-July, Autumn-September and Fall-December) was carried out. Results indicated that TP contents from highest to lowest for seasons as; summer (1657.9 mg kg^{-1}) > autumn (1619.5 mg kg^{-1}) > autumn (1387.4 mg kg^{-1}). The overall sediment TP contents for land use followed the pattern from highest to lowest as; anthropic (2352.2 mg kg^{-1}) > waste dumping (2296 mg kg^{-1}) > agriculture (1540.7 mg kg^{-1}) > D1(1320.6 mg kg^{-1}) > D2(1299.4 mg kg^{-1}) > outlet (1282.8 mg kg^{-1}) > forest (792.7 mg kg^{-1}). Similarly, the overall inorganic P (P_{in}) the values for seasons were as; summer (1535.8 mg kg^{-1}) > autumn (1507.8 mg kg^{-1}) > fall (1328.4 mg kg^{-1}). The overall sediments P_{in} content for locations followed the pattern from highest to lowest were like that of TP. Individually, the anthropic and city waste dumping site sediments showed highest concentrations of P during summer and autumn seasons, respectively. The sediment bioavailable P (anion exchange resin extractable P) content when ranked highest in sediments from waste dumping site (53.34 mg kg^{-1}) ≥ anthropic (50.12 mg kg^{-1}) > agriculture (29.36 mg kg^{-1}) ≥ D1(27.47 mg kg^{-1}) > D2(21.51 mg kg^{-1}) > outlet (17.88 mg kg^{-1}) > forest (3.75 mg kg^{-1}). Individually, higher bioavailable P was noted in anthropic sediments followed by the waste dumping site during summer posing serious threats to water quality.

***Keywords*:** Sediment, Phosphorus release, Fractions, Bioavailability, Land use.

AIR QUALITY IMPACT ASSESSMENT OF CO AND CH_4EMISSIONS FROM HATTAR INDUSTRIAL ESTATE USING SPATIO-STATISTICAL ANALYSIS

Sumbal Zaheer[1]

1Institute of Soil and Environmental Sciences, PMAS-AAUR
*Email: sumbalzaheer11@gmail.com

ABSTRACT

Atmosphere is the important part of our environment that sustains life on earth. The atmosphere contains different types of gases in different quantities. All these gases are vital for living organisms. Any dynamic change in the quantity of these gases affects the natural state of the environment. Over the last few decades, due to increase in urbanization and industrial development combined with more energy consumption, Asian countries have experienced vast changes in the environment. In Pakistan, as compared to international standards energy consumption is very low but the quality of air is deteriorating day by day. The major outcomes of this research involved measuring the CO and CH_4 concentrations at various sites across the Hattar industrial area. In this study, the pollution concentration levels in two buffer zones at 100 and 200 meters from the study area were measured using GIS interpolation techniques. This study also determined safe zones with less greenhouse gases emissions. For calculating property values at locations outside the range of the data points, IDW interpolation method was used. Moran's 1 indicator was used to explain the overall distribution of pollutants and whether they exhibit clustering properties. The Getis-Ord Gi* statistic for each pollutant in the current study was generated using the Hot Spot Analysis tool. There were hardly any methane reports. The results showed that both pollutants had a random distribution pattern, and in buffer zone 2 the concentration level of pollutants was lower than in buffer zone 1. This research showed that the pollutants ranges were within the permitted limit. Road traffic, energy production and burning of solid waste were causing emissions of CO and CH_4. To control the concentration levels of these gases there is a need to launch eco-friendly Initiatives to regulate, safeguard, and improve ambient air quality so that people can live healthy and productive lives.

Keywords: Greenhouse gases, Methane, Carbon monoxide, Air quality, Hattar industrial estate.

EFFECT OF APPLIED BOUNDARY CONDITIONS AND TREATMENT TIME ON THE ELECTRO-RECLAMATION OF SALT-AFFECTED SOILS

Kashif Kamran*[1], Abdul Ahad Hussain[1], Maryam Hina[2], Muhammad Imran[1]

1Department of Physics, University of Agriculture Faisalabad, Faisalabad, 38040, Pakistan
2Institute of Physics, Bahauddin Zakariya University, Multan, 60800, Pakistan

*Email: k.kamran@uaf.edu.pk

ABSTRACT

This study investigates the effect of boundary conditions and treatment-time on the electrokinetic (EK) desalination of salt-affected soil. The effect of ion exchange membranes (IEM), calcium chloride ($CaCl_2$), and ethylenediaminetetraacetic acid (EDTA) on the removal of salt (i.e., Na^+, Cl^-, and Ca^{2+}) and metal (i.e., Co^{2+} and Fe^{2+}) ions from the soil by EK was studied. For this purpose, a DC electric field of 1 V cm^{-1} was applied across the soil specimen via steel mesh electrodes for 12, 24, 48, and 72 hours. The results show that an increase in treatment-time decreased the electroosmosis and ion removal rate, which might be attributed to the formation of acid-base fronts in soil, except in the IEM case. While applying IEM the electroosmotic flow (EOF) was not observed within the soil specimen, therefore, the removal of ions took place only by diffusion and electromigration. The results show that higher electroosmosis was observed by using $CaCl_2$ and EDTA; thus, the removal rate of Co^{2+}, Na^+ and Ca^{2+} ions was greater than Cl^- ions due to higher EOF. However, for relatively low EOF, the removal of Cl^- ions exceeded that of Co^{2+}, Na^+, and Ca^{2+} ions, possibly due to a lack of EOF. In addition, the adsorption of Fe^{2+} ions in soil increased by increasing treatment time due to the corrosion of anode during all HEK experiments except in the case of HEK-2, where AEM was introduced at the anode-soil interface.

Keywords: Electroosmosis, Electromigration, Ion exchange membranes, EDTA, pH

EXOGENOUS APPLICATION OF CADMIUM AND ZINC DIFFERENTLY AFFECTS THE RICE MORPHOLOGICAL TRAITS AND PADDY YIELD UNDER SIMULATED WASTEWATER

Sadia Talpur[1], Farooque Bughio[1], Javaria Afzal[2], Nizamuddin Depar[2], Bushra Danish Talpur[3]

[1]Institute of Plant Sciences, University of Sindh, Jamshoro, Pakistan
[2]Soil and Environmental Sciences Division, Nuclear Institute of Agriculture, Tandojam, Pakistan
[3]Dawood University of Engineering and Technology Karachi, Pakistan

*Email: sadia.mahmoodtalpur@gmail.com

ABSTRACT

Cadmium (Cd) pollution is increasing around the globe and its trace quantity can severely affect all living things, including plants. We conducted a pot experiment during summer 2023 following a replicated Completely Randomize Design to investigate the effects of simulated wastewater added with different Cd levels (5.0, 10 and 15 ppm as $CdCl_2$) and Zn (20 ppm Zn as $ZnSO_4$) on the growth, yield and physiological traits of rice (cv. Shua-92). Results showed that the application of simulated wastewater with Cd and Zn significantly affected the plant height, weight, panicle weight, biological and grain yield of rice crop. Moreover, Chlorophyll a and b, proline and relative water content were also significantly differed under all treatments. The non-significant effects of all treatments were observed on number of tillers, panicle count, 1000 grain weight on each panicle and straw yield of rice. The maximum increase for all parameters was observed under (5.0 ppm Cd) with simulated wastewater treatment except grain weight/panicle, straw yield, proline and relative water content were maximum at the level of (5.0 ppm Cd + 20 ppm Zn) with simulated water. The minimum growth rate was found under control while minimum values of 1000 grain weight on each panicle, biological yield, grain yield under (15 ppm Cd+ 20 ppm Zn). It can be concluded from the above findings that application of (5ppm Cd) with wastewater couldn't affect the growth & development of rice genotype Shua-92. Moreover, this genotype didn't respond to Zn in presence of Cd. It can be suggested that this genotype should be further explored at different combinations of Zn and Cd.

Keywords: Simulated wastewater, Rice, Cadmium, Zinc, Shua-92

ALONE AND COMBINE APPLICATION OF CuNPs AND nHAP IMPROVE THE GRWOTH AND PHYSIOLOGY OF WHEAT PLANT UNDER CADMIUM STRESS

Saleha Mushtaq*[1], Muhammad Zia-ur-Rehman[1], Muhammad Usman[1], Mujahid Ali[1], Sana Rana[1], Asia[1], Muhammad Rizwan[2]

[1]Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad 38000, Punjab Pakistan
[2]Department of Environmental Sciences, Government College University, Faisalabad, 38000, Punjab Pakistan

*Email: ziasindhu1399@gmail.com

ABSTRACT

The toxic effects of cadmium (Cd) on wheat plants include the accumulation of reactive oxygen species, disruption of antioxidant enzymes, interference with nutrient uptake, and reduction in growth and yield. These effects highlight the importance of mitigating Cd stress in agricultural systems to ensure the productivity and quality of wheat crops. Application of copper nanoparticles (CuNPs) and hydroxyapatite nanoparticles (nHAP) is known as the most economical strategy to reduce the adverse effects of Cd on plants. A pot experiment was conducted to remediate Cd-contaminated soil by using CuNPs and nHAP during the growth of wheat crops. The results of the current experiment revealed that the combined application of CuNPs and nHAP increased plant height (73%), root length (63%), spike length (44%), shoot dry weight (57%), root dry weight (63%), and grain yield (49%) compared to the Cd-contaminated control. Similarly, the physiological attributes of wheat crop leaves were improved by the combined application of CuNPs and nHAP, relative to the application of CuNPs and nHAP alone at different rates. The photosynthetic rate, transpiration rates, stomatal conductance, and sub-stomatal CO_2 intake increased in the combined application of CuNPs and nHAP by 45%, 63%, 49%, and 55%, respectively, compared to the control treatment. These findings highlight the potential of CuNPs and nHAP for mitigating the toxic effects of Cd on wheat plants and improving their growth and physiological performance in Cd-contaminated soil. The study provides valuable insights into the use of nanomaterials for remediation of heavy metal-contaminated agricultural soils and the enhancement of crop productivity under Cd stress.

Keywords: Cadmium, Hydroxyapatite, CuNPs, Grain yield, Stomatal conductance, Crop productivity.

HEAVY METAL ACCUMULATION IN SPINACH UNDER DIFFERENT IRRIGATION WATERS AND SOIL ZINC APPLICATION

Waleed Ramzan*, Ammara Basit, Shahid Hussain

Department of Soil Science, Faculty of Agricultural Sciences and Technology, Bahauddin Zakariya University, Multan 60800, Pakistan

*Email: waleedramzan2@gmail.com

ABSTRACT

The utilization of wastewater for irrigation can lead to the accumulation of heavy metals in soils and crops, ultimately resulting in the entry of these toxic metals into the human food chain. This research investigates the accumulation of heavy metals in spinach cultivated using irrigation waters ranging from good to marginal quality, with or without soil zinc (Zn) application. In this experiment, different types of irrigation water including distilled water (control), wastewater, canal upstream water, canal downstream water, and tubewell water were used. Since there were significant differences in heavy metal loads at different sites, a composite wastewater sample from 14 disposal stations across Multan city was collected for wastewater irrigation. Additionally, two rates of Zn (0 and 8 mg Zn kg^{-1}) were applied to the soil as zinc sulfate heptahydrate ($ZnSO_4.7H_2O$). Throughout the growth period, the pots were irrigated with the respective irrigation waters. Preliminary observations indicated that spinach irrigated with wastewater and canal downstream water, supplied with Zn, exhibited better yield compared to no soil Zn application and irrigation with tubewell or distilled water. This suggests a significant effect of heavy metal contamination through irrigation water and soil Zn application. In conclusion, wastewater irrigation coupled with Zn application is likely to reduce the uptake of heavy metals in crops. This not only ensures safer and sustainable agriculture production but also safeguards human health by minimizing potential exposure to heavy metals.

Keywords: Accumulation, Heavy metals, Irrigation, Spinach, Soil, Wastewater, Zinc

SORPTION OF CADMIUM, CHROMIUM, AND LEAD ON GREEN-WASTE AND POPULAR-TWIG BIOCHARS IN WASTEWATER AND WASTEWATER-IRRIGATED SOIL

Zeshan Aslam[1,2], Muhammad Aon[3]*, Shahid Hussain[3], Muhammad Amjad Bashir[4], Muhammad Farooq Qayyum[3], Waleed Ramzan[3]

[1]Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad, Pakistan
[2]Pesticide Residue Laboratory, Department of Agriculture, Government of Punjab, Pakistan
[3]Department of Soil Science, Faculty of Agricultural Sciences and Technology, Bahauddin Zakariya University, Multan, Pakistan
[4]Department of Agronomy, Engro Fertilizers Ltd. Lahore, Pakistan

*Email: dr.maon@bzu.edu.pk

ABSTRACT

Despite being cost-effective, wastewater irrigation carries environmental and health risks. This study compared the effectiveness of low-temperature (350ºC) pyrolyzed green-waste biochar (GWB) and popular-twig biochar (PTB) in removing Cd, Cr and Pb from wastewater and in heavy metal sorption in soil. The study also assessed treatment effects on irrigation water quality and soil fertility. In the first part, municipal wastewater was treated with GWB and PTB at 0, 1, 2, and 4 g L^{-1}. The highest rate of GWB had the highest capacity to remove heavy metals, ranging from 88% to 96%. The maximum metal sorption capacities, up to 1093 µg g^{-1}, were with 1 g GWB L^{-1}. Biochar also significantly increased the concentrations of nitrate-N, phosphate-P and total K in the wastewater. In the second part, an alkaline-calcareous was incubated for 90 days after amending with GWB and PTB at 0, 1 and 2% (w/w). During the incubation, the soil was irrigated with the municipal wastewater. Biochar additions significantly decreased plant-available concentrations of Pb, Cd and Cr, and increased microbial biomass C, microbial biomass P and alkaline phosphatase. In conclusion, treating wastewater with 4 g GWB L^{-1} was the most effective in removing Cd, Pb and Cr from wastewater, but the metal sorption capacities were maximum at 1 g GWB L^{-1}. Similarly, wastewater-irrigated soil amended with 2% GWB had the lowest concentrations of plant-available Cd, Pd, and Cr with a significant increase in nutrient availability. These findings contribute to the safe use of wastewater for irrigation.

Keywords: Alkaline-calcareous soil, Biochar, Heavy metal, Municipal wastewater.

Evaluating Cadmium (II) Removal Enhancement in Aqueous Solutions through Potassium Permanganate-Modified Eucalyptus Biochar: Adsorption Performance and Mechanistic Insights

Audil Rashid[1*], Anila Sikandar[2], Arslan Rafique[1] and Shamim Akhtar[3]

[1] Department of Botany, University of Gujrat, Pakistan
[2] Department of Environmental Science, Kunming University of Science and Technology, Kunming, China
[3] Department of Botany, Rawalpindi Women University, 6th Road, Satellite Town, Rawalpindi

*Email: a.rashid@uog.edu.pk

ABSTRACT

This study has explored the utilization of a cost-effective and efficient adsorbent for the removal of cadmium (Cd) from polluted water sources. The eucalyptus underwent pyrolysis and subsequent treatment with potassium permanganate to produce Potassium Permanganate-modified biochar (KBC), enhancing its ability to adsorb Cd. A variety of methodologies were utilized to comprehensively analyze and explore the physicochemical properties of KBC. In addition, a comprehensive evaluation was conducted to analyze the influence of various environmental factors on the capacity and rate of Cd (II) adsorption. These factors include temperature, adsorbent dosage, pH, adsorption duration, and starting concentration. The mechanism of Cd (II) removal by KBC has been studied in detail through adsorption kinetics, isotherms, and thermodynamics. It is worth noting that KBC exhibits a significantly higher sorption capacity for Cd (II) at 31.05 mg g^{-1}, in contrast to the 26.438 mg g g^{-1} observed for unmodified biochar (BC). The removal rate reached an impressive 99.36% under optimal conditions. These conditions included a pH of 5, a dosage of 80.0 mg, and contact duration of 6 hours, at temperature of 25°C, and an initial concentration of 50.0 mg L^{-1}. The adsorption mechanism aligns with the Langmuir isothermal adsorption model and the pseudo-second-order kinetic model, indicating monolayer adsorption on a uniform surface with spontaneous heat absorption due to combined chemical and physical factors. The Cd (II) adsorption mechanism is primarily driven by the oxygen- and manganese-containing groups of KBC, which utilize complexation, oxidation, and cation-π electron interaction. Based on the data analysis, it can be concluded that the application of potassium permanganate to modify eucalyptus biochar is an effective method for removing heavy metals, specifically cadmium.

Keywords: Heavy metals, sorption, biochar.

USING MICROBIAL INOCULANTS FOR ENHANCING DECOMPOSITION OF CITY WASTE AND BIOGAS PRODUCTION

Amna Nisar[1], *Tanveer Iqbal[1], Ghulam Jilani[1], Muhammad Umair[2]

[1]Institute of Soil and Environmental Sciences, PMAS-Arid Agriculture University Rawalpindi, Pakistan
[2]Department of Agricultural Engineering, PMAS-Arid Agriculture University Rawalpindi, Pakistan

*Email: tanveeriqbal@uaar.edu.pk

ABSTRACT

Municipal solid waste management is a serious problem all over the world. Anaerobic digestion of organic part of municipal waste to produce biogas to be used as a source of energy could be useful technique in developing countries to manage municipal solid waste. In this research study anaerobic digestion of municipal solid waste was carried out in different combinations with hydrogen and methane producing bacteria to see the possibility of biohythane production (methane+hydrogen). The study was carried out in biogas unit of PMAS-Arid Agriculture University Rawalpindi, Pakistan. The treatments included: City waste (CW), City waste (CW) + *Clostridium beijerinkii* (HPB), City waste (CW) + *Methanobacterium thermoautotrophicum (MPB)*. City waste (CW) + HPB+MPB. Plastic drums (250 L) with proper sealing and inlet, outlet valves were used for anaerobic condition purpose. Temperature and moisture were recorded regularly through a digital hygrometer installed in each plastic drum. Anaerobic digestion continued for 60 days. The results indicated that the highest value of CH_4 was 74.2 % in CW+MPB+HPB followed by 64 % in CW+MPB. The highest value of H_2 was 14.96 % in CW+MPB+HPB followed by 10.53% in CW+HPB. The highest value of H_2S was 63.3ppm in CW+MPB+HPB followed by 54.66ppm in CW+HPB. The highest value of CO was 850 ppm in CW+MPB followed by 680 ppm in CW+HPB. Chemical analysis of composts revealed that pH varied from 7.4 to 7.7 and overall, it was close to neutral. Electrical conductivity of composts varied from 1467.4 mg/L to 1667.5 mg/L. Total nitrogen, phosphorus and potassium content of these composts varied from 2.2% to 2.93, 0.25 to 0.89% and 3.2 to 3.8% respectively. The anaerobic composts produced in above experiment were used in greenhouse study to check the effect of application of various composts on soil and plants. Maize was sown as test crop in pots for 60 days. Treatments included application of four composts, i.e. CW, CW+MPB, CW+HPB, CW+MPB+HPB and then application of these composts along with half dose of recommended NPK for maize. It was noted that plant growth parameters, i.e. plant height, fresh biomass weight, along with macro and micronutrient content of soil and maize plants were higher with the application of CW+MPB+HPB+1/2NPK followed by CW+MPB+1/2NPK and CW+HPB+1/2NPK. Although H_2 emission was less than desired but if it can be improved close to 20% then this mixture can be used for biohythane production also.

Keywords: Biogas, City waste, Anaerobic digestion, Soil, Compost.

IMPACT OF INSECTICIDE CHOICE ON THIOPHENATE METHYL METABOLISM AND ASSESSING CARBENDAZIM RESIDUES IN VEGETABLES

Rehman Gul*, Abdullah Niaz, Muhmmad Sadiqque Shakir, Mehrana Ehsan, Arslan Nazarat, Umber Ghafoor, Sarfraz Hussain.

[1]Pesticide Residue Laboratory, Institute of Soil Chemistry and Environmental Sciences, Kala Shah Kaku

*Email: drr.gul2042@gmail.com

ABSTRACT

The aridity and intensive cropping pattern in Pakistan give rise to numerous insect and pests which warrants pesticide application in increasing quantity year by year. In a judicious way use of agriculture pesticides is, however, a great concern for both food safety as well as environmental protection. The sale and export especially under free trade agreements and the WTO scenario, the export of fruit, vegetables, and cereals, to the modern international market is strictly regulated, in terms of technical trade barriers, for pesticide residues concerning the established maximum residue limits (MRLs). Keeping in view, a trial was conducted at Pesticide Residue Laboratory, Kala Shah Kaku in 2022-23 to assess the presence of residues of commonly used pesticides on the vegetables; Imidaclopride (25% WP) and Lufenurone (5% EC) (insecticides), Thiophenate methyl (70%WP) (Fungicide) haloxy fop-P methyl (10.8%EC) (Herbicide) Okara, Brinjal and Chilli. Herbicide was applied to all plots @ 350 ml/acre at the time of sowing. Similarly, thiophene methyl was applied to all plots @ 100 g/acre at flowering, while two insecticides were applied in respective plots at flowering at 200 g/acre and 400 ml/acre. The aim of the study was to evaluate the metabolic conversion of the thophenate methyl to carbendazim and to study any possible effect of accompanying insecticide on this conversion in three selected vegetables. Results of the study showed that Imidaclopride, lufenuron, and haloxyfop-P methyl did not cause any residue in all 3 vegetables in detectable quantity. However, the use of thiophenate methyl produced carbendazim residues, which were subjected to change in the presence of two different insecticides in all three vegetables namely Brinjal, Chilli, and Okara. Factors and analysis have shown that in Okra the thiophenate methyl metabolism into carbendazim was more facilitated in the presence of Imidacloprid than lufenuron where 2.75 ppm of carbendazim was detected as compared to 1.31 ppm with imidaclopride and lufenuron respectively. The same was the case with the other two vegetables (Chilies and Brinjal), the same amount of thiophenate methyl (@100 g/acre) yielded 0.74 and 1.98 ppm carbendazim with imidaclopride while lufenuron insecticide 0.26 and 0.56 ppm with lufenuron. So, the choice of insecticide affects the conversion of thiophenate methyl into carbendazim which is currently a serious issue with Pakistan's exports to the international market. The message could be important for extension workers, industry, exporters, and the farming community at large.

Keywords: Thiophenate methyl, Carbendazim, Pesticide residues, Vegetables.

COMPARATIVE EFFECTIVENESS OF MICRON SIZED ORGANIC AND INORGANIC AMENDMENTS TO IMMOBILIZE Cd AND ITS PHYTOAVAILABILITY TO MAIZE GROWN ON CONTAMINATED SOILS

Mujahid Ali*[1], Muhammad Zia-ur-Rehman[1], Muhammad Rizwan[2], Sana Rana[1], Muhammad Ashar Ayub[1,3], Muhammad Usman[1], Ali Rizwan[1], Muhammad Saqib[1]

[1] Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad 38000, Punjab, Pakistan
[2] Department of Environmental Sciences, Government College University, Faisalabad, 38000, Punjab Pakistan
[3] Institute of Agro-Industry and Environment, The Islamia University of Bahawalpur, Bahawalpur 63100, Pakistan

*Email: ziasindhu1399@gmail.com

ABSTRACT

Cadmium (Cd) pollution is of concern in many countries, particularly where untreated wastewater is disposed of in agricultural soils. Previously experiments have been conducted using bulk particle-sized amendments, but there is a lack of research specifically by using micron-sized organic and inorganic amendments. The current pot experiment was conducted to investigate the efficiency of micron-sized (< 140 µm) gypsum (Gyp), single super phosphate (SSP), rock phosphate (RP), rice husk biochar (RHB), farmyard manure (FYM), compost (CMP) amendments on the growth, physiological characteristics, and antioxidant enzyme activities of maize crop in artificially (30 mg kg^{-1} and 60 mg kg^{-1}) Cd contaminated soils. The application of RHB having < 140 µm micron-size showed a maximum increase in plant length (50.01%, and 43.68%), shoot dry weight (122.80% and 95.87%), and grain/cob weight (103.96% and 90.67%) was measured in 30 and 60 mg kg^{-1} soil respectively as compared to control. Similarly, the maximum increase in chlorophyll contents 80.59% and 70.97%, photosynthetic rate 70.63% and 61.57%, stomatal conductance 98.64% and 88.91%, and transpiration rate 92.98% and 82.80% was measured for RHB in both 30 and 60 mg kg^{-1} Cd contaminated soils respectively. Maximum increase in antioxidant enzyme activity parameters like sodium dismutase (66.96% and 58.14%), peroxidase (73.77% and 67.62%), catalase (81.05% and 70.82%), and ascorbate peroxidase (85.37% and 74.55%) at various Cd contamination levels 30 and 60 mg kg^{-1} respectively, was measured in soil where RHB was applied. Overall, the above results showed that RHB having < 140 µm size was the most efficient source for increasing growth, yield, physiological characteristics, and enzyme activities of maize crop in Cd-contaminated soils.

Keywords**:** Cd Contaminated Soils, Food safety, Maize Growth, Micron-sized amendments.

CADMIUM AND ZINC INFLOWS THROUGH IRRIGATION WATER GOVERN THEIR BALANCES IN SOILS UNDER WHEAT-SORGHUM ROTATION

Ayta Umar[1], Muhammad Nadeem[2], Shahid Hussain[1*], Ammara Basit[1]

[1]Department of Soil Science, Faculty of Agricultural Sciences and Technology, Bahauddin Zakariya University, Multan 60800, Pakistan

[2]Department of Agronomy, Faculty of Agricultural Sciences and Technology, Bahauddin Zakariya University, Multan 60800, Pakistan

*Email: shahid.hussain@bzu.edu.pk

ABSTRACT

Wastewater irrigation may add toxic metals like Cd into soils, potentially contaminating edible plant parts and the human food chain. This research investigated inflows and outflows of Cd and Zn in soils during a two-year wheat-sorghum rotation, affected using irrigation water. This field study included two experimental sites (a control site and an exposed site) and two cropping seasons (2019–20 and 2020–21). At exposed site, both total and DTPA-extractable Cd and Zn concentrations in the soil were higher than those at control site. This difference was attributed to the use of contaminated irrigation water and wet atmospheric depositions at exposed site. At exposed site, Cd and Zn balances in wheat cropping seasons ranged from +66 to +71 g ha^{-1} for Cd and from +274 to +301 g ha^{-1} for Zn. In sorghum cropping seasons, these balances ranged from +80 to +86 g ha^{-1} for Cd and from +148 to +152 g ha^{-1} for Zn. At control site, Zn balance was negative that ranged from −67 to −77 g ha^{-1} and from −227 to −228 g ha^{-1} in wheat and sorghum cropping seasons, respectively. Conversely, the Cd balance was positive and ranged from +4 to +7 g Cd ha^{-1} in both years for the two crops. Crop removal was the major outflow pathway of Cd and Zn from the soils of both sites, with sorghum being the exhaustive crop. In general, concentrations of Cd and Zn in plant samples were higher at exposed than control site. Consequently, wheat at exposed site had grain Zn concentration (35–36 mg kg^{-1}) close to the desirable limit but the Cd concentration (0.30–0.33 mg kg^{-1}) exceeded the permissible limit. Therefore, it is advisable to remove metals from wastewater before discharging the water into drains. Moreover, for contaminated sites, the design of crop rotations should be based on the rates and sources of metal inflows as well as the types of crops being cultivated. Conversely, for sites with minimal heavy metal exposure, the application of Zn to low-Zn calcareous soils is imperative to achieve optimal crop yields.

Keywords: Cadmium, Inflows and Outflows, Wastewater irrigation, Wheat-sorghum rotation, Zinc.

URBAN TREE RESPONSE TO HEAVY METAL ENRICHMENT FROM DUST DEPOSITION IN METROPOLITAN AREA OF LAHORE

Usama Ahmad Khan*[1], Hamaad Raza Ahmad[1], Muhammad Hassan Bashir[1]

[1]Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad, 38040 Pakistan

*Email: usamaahmad1254@gmail.com

ABSTRACT

The re-suspension of urban road dust particles, containing high concentrations of hazardous metals, stands as a primary source of particulate matter impacting human health and air quality. To assess dust levels containing heavy metals, we targeted four sampling sites in Lahore: Punjab University's new campus, Canal Road, Services Hospital Lahore, and a commercial site near Jahangir Tomb. At each site, we evaluated five available Ulta Ashok trees (Polyalthia longifolia). From each tree, two old and two young leaves were collected. One leaf from both the old and young categories underwent washing, while the other remained unwashed. This process was replicated for all trees at all four sites. The study revealed higher concentrations of Cd (0.35 mg kg^{-1}), Pb (2.45 mg kg^{-1}), and Zn (6.12 mg kg^{-1}) in Ulta Ashok leaves from commercial sites, whereas Punjab University exhibited the lowest values of Cd (0.25 mg kg^{-1}), Pb (1.79 mg kg^{-1}), and Zn (5.43 mg kg^{-1}). Moreover, a strong positive correlation was observed between foliar toxic metal quantities and dust retention, particularly for smaller particles. This suggests that hazardous metals are absorbed through the leaf surface subsequent to dust deposition. The findings further indicated that trees situated in commercial areas and near busy highways were more prone to accumulating dust, including metals.

Keywords: Particulate matter, Dust, Heavy metals, Foliar transfer, Risk assessment, Human health.

REGRESSION MODELING AND PREDICTIVE ANALYSIS FOR DTPA INDUCED METAL SORPTION AND PHYTOACCUMULATION IN LETTUCE (LACTUCA SATIVA)

Faiza Naseem[1], Rabia Safeer[2], Zainab Zafar[3] and Hafiz Muhammad Touqeer[4]

[1]Department of Mathematics, University of Gujrat, Pakistan
[2]Department of Earth and Space Sciences, University of Science and Technology, Hefei, China
[3]Department of Botany, University of Gujrat, Pakistan
[4]Department of Environmental Science, University of Gujrat, Pakistan

ABSTRACT

The effect of the chelator Diethylene Triamine Pentaacetic Acid (DTPA) on the phytoaccumulation of lead (Pb) and cadmium (Cd) by lettuce (*Lactuca sativa*) has been systematically analyzed. In order to investigate metal sorption on agricultural soils from various regions, two separate experiments have been carried out. Three months of greenhouse trials show that adding metal chelators significantly increases lettuce growth. In the first phase of experiment the influence of chelator on phytoaccumulation of Pb and Cd by lettuce shows that Cd has a higher propensity for forming complexes with plant enzymes and translocate from roots to shoots more effectively than Pb. The competitive adsorption of particular metals on agricultural soils has been evaluated through batch studies in lab setting. The bioavailability of Cd has been improved with the rising concentration of DTPA while an opposite trend observed for Pb, highlighting a complex interaction between metals and chelators. Moreover, plant dry biomass decreases by more than 50% with an increase in chelator's concentration while three-month DTPA treatment results in a significant metal solubility in soil signifies increase in bioavailability followed by slight degradation. The regression models were trained and optimized to predict the adsorption capacity according to plant characteristics, metal sources, environmental conditions (e.g. temperature and pH), and the initial concentration of metals. Langmuir isotherm analysis supports effective metal adsorption on soil surfaces, emphasizing robust degrading capability. Notably, lettuce demonstrates superior phytoaccumulation and adsorption capacity for Cd compared to Pb. These findings underscore the complex dynamics of metal-chelator interactions, providing crucial insights for optimizing metal remediation strategies in agricultural contexts. This study contributes to practical approaches for enhancing soil health and plant productivity in metal-contaminated environments.

Keywords*:* soil sorption, predictive modeling, phytoaccumulation, soil health, DTPA.

MCPA SORPTION AND DESORPTION AS A FUNCTION OF BIOCHAR PROPERTIES AND PYROLYSIS TEMPERATURE

Abdullah Niaz[1,2], Kurt A. Spokas[3*], Bea Ga´miz[4], David Mulla[2], Khaliq R. Arshad[1], Sarfraz Hussain[1]

[1]Pesticide Residue Laboratory, Institute of Soil Chemistry & Environmental Sciences, Kala Shah Kaku, Punjab, Pakistan
[2]Department of Soil, Water and Climate, University of Minnesota, St. Paul, MN, United States of America
[3]United States Department of Agriculture, Agricultural Research Service, St. Paul, MN, United States of America
[4]Department of Inorganic Chemistry, Chemical Institute for Energy and the Environment (IQUEMA), University of Co´rdoba, Co´rdoba, Spain

*Email: kurt.spokas@usda.gov

ABSTRACT

The MCPA is highly mobile herbicide, being one of the widespread pesticides detected in potable water sources. Sorption on biochar's restricts unchecked pesticides movement avoiding harm to unidentified targets. Long-lasting sorption though could restrict herbicide bioefficacy, compromising usefulness as vital crop protection input. This research was planned to evaluate effect of pyrolysis temperatures (350, 500 and 800 °C) on easily available feedstocks; poultry manure (PM), rice hulls (RH) and wood pellets (WP) finding possibility in tailoring biochar with MCPA sorption but reversibly, not affecting purpose of application. The MCPA concentration levels included: 0.1, 0.9, 4.7, 9.4, 25 and 50 mg L^{-1}. Pyrolysis temperature brought more carbon, ash contents, C/N and C/H, while O/C decreased in biochars over temperature increments. Sorption increased with pyrolysis temperature from 350 °C to 800 °C. For % sorption, descending order was poultry manure (53.23%) > rice hulls (50.40%) > wood pellets (48.33%). Slope (1/n) values were <1, L-type isotherm, showing MCPA sorbed more at low herbicide concentration. Poultry manure and rice hulls pyrolyzed at 800 °C (PM800 and RH800) continued sorption during first desorption step in 24 h. PM800 continued sorbing MCPA even on increasing concentrations, taking almost all (> 99%) from solution. Sorption/desorption coefficients were corelated strongly (R^2 = .982; $p < .05$). Desorption decreased with the increase in pyrolysis temperature. For mean %desorption, order could be wood pellets (32.17%) > rice hulls (28.24%) > poultry manure (27.17%). Lower Hysteresis coefficient (H) values with increased pyrolysis temperature also showed variation in desorption pattern from that of sorption, sorbing more than desorbing. Sorption/desorption data fit to Langmuir, Freundlich, Dubinin–Radushkevich and Temkin isotherm models. Langmuir parameters were better corelated with MCPA sorption/desorption {R^2 = -0.850 (sorption) and R^2 = -0.831 (desorption); $p < 0.05$}. Poultry manure and rice hulls when pyrolyzed on higher temperatures (500 and 800 °C) could be referred to after spills, accidental leakages and other direct losses for soil and water contamination. While wood pellets and rice hulls pyrolyzed on 350 °C could sorb better quantities of MCPA to cover indirect losses including runoff and drift at first step nevertheless desorbing subsequently to let herbicide perform effectively for the intended use of application.

Keywords: MCPA, Sorption, Desorption, Biochar, Pyrolysis, Temperature

ANAEROBIC CO-DIGESTION OF COW MANURE WITH VEGETABLE RESIDUES USING BENTONITE AND BIOCHAR AS COMPOSITE ACCELERANT

Ayaz Mehmood[1*], Muhammad Hanzalah Amjad[1], Yasir Abbas[2], Shah Rukh[3], Mohsin Tariq[1], Mazhar Hussain[1], Sining Yun[2*]

[1]Department of Soil and Climate Sciences, The University of Haripur Pakistan
[2]Functional Materials Laboratory (FML), School of Materials Science and Engineering, Xi'an University of Architecture and Technology, Xi'an, Shaanxi, 710055 China.
[3]National Centre of Excellence in Geology, University of Peshawar-25130, Peshawar, Khyber Pakhtunkhwa, Pakistan.

Email: ayaz.gill@uoh.edu.pk

ABSTRACT

Accelerants can effectively enhance the performance of the anaerobic digestion (AD) system. It is hypothesized that methanogens present in the inoculum (Intestinal fluid) can enhance the process of biodegradation and biogas production due to which nutrients could mineralize and bentonite may further increase the biodegradation process due to Direct Interspecies Electron Transfer (DIET). The objective of this study was to optimize the best composition of accelerants (bentonite and biochar) for the optimization of biogas production and to assess the effect of sole as well as combined accelerants for optimizing digestate nutrients contents. To improve the biogas yield and digestate utilization of anaerobic digestion (AD), low-cost composited accelerants consisting of bentonite (BT) (0.5, 1.0, and 2.0 g/L) and biochar (BC) (0.12, 0.16, 0.20 g/L) and composite (0.25g/L BT+0.6g/L BC, 0.5g/L BT+ 0.8g/L BC and 1.0g/L BT+ 0.10g/L BC) were conducted in batch experiment with a constant temperature of (36 ± 1ºC). Total biogas yield (580 mLg^{-1} VS) was the highest for bentonite (2.0 g/L), followed by bentonite (1.0 g/L and 0.5 g/L) and was the lowest in the control group (441 mLg^{-1} VS). The total solid, volatile solid, and chemical oxygen demand removal rates (42%, 47%, and 48%) for anaerobic digestion with bentonite (2.0g/L) were much higher than the control group (31.4%, 36%, and 37.9%). The enhanced fertilizer nutrient content (4.04%) confirmed that the digestate with bentonite (2.0 g/L) could safely serve as a potential component of organic fertilizer. It is concluded that low-cost accelerants not only enhance the biogas yield but also increase the nutrient content of the digestate.

Keywords: Anaerobic digestion, Additives, Organic fertilizer, Digestate fertility, Intestinal waste.

THE COMPETITIVE ADSORPTION BEHAVIOR OF METALS (Cd, Fe, Ni, Pb, AND Zn) ON BIOCHARS PREPARED USING DIFFERENT FEEDSTOCK

Muhammad Ahmar Amin[1], Muhammad Farooq Qayyum[1*]

[1]Department of Soil Science, Faculty of Agricultural Sciences & Technology. Bahauddin Zakariya University Multan

*Email: m.ahmaramin@gmail.com

ABSTRACT

Heavy metals also termed as potentially toxic elements can enter the food chain through different anthropogenic activities. Sewage irrigation of crop plants is one of these unwanted activities. Use of several organic and inorganic amendments to immobilize or reduce the availability of metals to crop plants is recommended. Biochar is an organic amendment prepared through pyrolysis of organic wastes and has proved itself a promising soil amendment. An experiment was designed to check the biochars (BCs) capacities prepared from different type of feedstocks to adsorb HMs. The different concentrations 0.0, 0.5, 1.0, 2.0, 5.0, 10.0, 20.0, 40.0, 60.0 and 80.0 mg L^{-1} of single elements solutions were prepared and added in centrifuge tube containing 2 g of BC. The treatments were T_1 Control (Without Biochar), T_2 Cotton Stalks Biochar (CSBC), T_3 Rice straw Biochar (RSBC), T_4 Poultry Manure Biochar (PMBC), T_5 Lawn Grass Biochar (LGBC), T_6 Vegetables Peel Biochar (VPBC), T_7 Maize Straw Biochar (MSBC), T_8 Rice Husk Biochar (RHBC). The tubes filled with suspension of BC and metals solution were shaken on mechanical shaker, centrifuged for 10 min (2000 rpm) and finally clear filtrate was extracted. The equilibrated filtrates were analyzed for concentration of heavy metals (Cd, Pb, Fe, Pb, Ni). The concentrations of BC-sorbed metals were measured by calculating the difference of applied solution and remaining concentration in that applied solution. The sorption data was fitted for two nonlinear isotherm models (Freundlich and Langmuir) and adsorption parameters were investigated. The results showed that the rate of sorption was fast at initial solution concentrations due to maximum available empty spaces for metals. All the BCs were good sorbent for all HMs because, the presence of negatively charge functional groups surface of BCs in addition of different feedstocks make it best for sorption. The results indicated strong sorption affinity of all BCs for all metals except Fe in applied form of solutions. It was concluded that the Freundlich and Langmuir equations (linear) were best fit on adsorption data.

Keywords: Biochar, Heavy-metals, Sorption, Bio-remediation.

COMBINED USE OF (*Bacillus safensis*) AND COMPOST TO IMPROVE GROWTH AND PRODUCTIVITY OF SPINACH UNDER LEAD (Pb) STRESS

Asma Mukhtar[1]*, Farheen Nazli[1], Ghulam Hassan Abbasi[1], Qasim Ali[2], Asma Majeed[1] Muhammad Hamza[2], Kiran Javed[1]

[1]Institute of Agro-Industry and Environment, The Islamia University of Bahawalpur, Bahawalpur 63100, Pakistan
[2]Department of Soil Science, Faculty of Agriculture and Environment, The Islamia University of Bahawalpur, Bahawalpur 63100, Pakistan

Email: am3286616@gmail.com

***ABS*TRACT**

Heavy metal pollution has become a significant concern due to its toxic effects on humans, plants, animals, and the environment. The presence of heavy metals like lead (Pb) in agricultural soils needs to be remediated to fulfil the food needs of the world's enormous population. Different physical, chemical, and biological methods are used to remediate soil pollution with heavy metals. However, the combined application of metal-tolerant bacteria with chemical amendments is getting attention due to their cost-effectiveness and environment-friendly nature. Plant growth-promoting rhizobacteria (PGPR) are involved in growth promotion, yield improvement, and physiological processes of plants. Compost improves soil structure and provides the substrate to microbes. Therefore, in the present research, lead-resistant bacteria and compost as an organic amendment were used to enhance the growth of spinach and immobilize the lead. Lead nitrate was used to spike the soil with three levels (0, 500, and 800 ppm) of lead. It was observed that PGPR (*Bacillus safensis N-11)* and compost applications demonstrated good results in lessening the toxicity of Pb and improving the growth, physiology, and antioxidant status of spinach. However, the combined application of PGPR and compost significantly enhanced the plant height (28%), plant dry weight (31%), chlorophyll SPAD value (30%), relative water content (27%), and membrane stability index (28%) of spinach as compared to control under 800 ppm Pb concentration. Moreover, the combined application of PGPR and compost significantly reduced the proline content (21%), CAT (26%), POD (26%), POX (29%) SOD (23%) of spinach at 800 ppm Pb. Further, significant reductions in shoot and root lead content were also observed, which were 35% and 21% less than the respective control at 800 ppm Pb concentration, respectively. It is concluded that the combined use of *Bacillus safensis* and compost can enhance spinach growth and immobilize Pb under contaminated conditions.

Keywords: PGPR, Spinach, Lead, Heavy metal stress, *Bacillus safensis,* Compost.

ASSESSING THE INTEGRATED EFFECT OF CADMIUM AND COPPER CONCENTRATION IN MAIZE

Muhammad Asad Farooq*[1], Chanda Saleem[1], Hamaad Raza Ahmad[1], Zilyad-Ul-Hassan[1], Rehman Ali[1]

[1]Institure of soil and environmental sciences, University of Agriculture, Faisalabad

Email: asadfarooq591@gmail.com

ABSTRACT

Soil is a geochemical sink for all the waste of our planet. Heavy metals lead to the cause of contamination in agricultural soils. Heavy metals accumulate in agricultural soil adversely affect plant growth. Among Heavy metals Copper and Cadmium have serious adverse effects on plant growth and human health. To determine the impact of copper application on maize crop growth in cadmium contaminated (Clayey Loam) soil (pH 7.4, EC 1.32dS m^{-1}, SAR 7.4) a pot experiment was conducted using Cd Contaminated soil (30 mg kg^{-1} as $CdNO_3$), to investigate the effect various level of Copper applied in Cadmium contaminated soil in Maize crop. In cadmium contaminated soil copper was applied @ 15 and 30 mg kg^{-1} using $CuSO_4$ salt. Results indicated that copper application did not have positive effect on the growth of Maize crop. However, after control treatment (normal soil) the maize growth attributes were improved with the application of Cu@15 mg kg^{-1}. Our investigation suggests that copper application @15 ppm in cadmium contaminated soil can effectively ameliorate the cadmium stress.

Keywords: Contaminated Soil, Cadmium, Copper, Maize.

IMPACT ASSESSMENT OF INDUSTRIAL EFFLUENTS ON FOOD QUALITY OF *Brassica oleracea* SPECIES

Alisha*[1], Muhammad Anwar-ul-Haq[1], Muhammad Usama Mustafa[1], Aneela Riaz[1], Muhammad Usama Javed[1], Syed Muhammad Mizfar Gohar[1], Rehman Ali[1]

[1]Saline Agriculture Research Centre, Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad 38000, Pakistan

*Email: alishanaz748@gmail.com

ABSTRACT

The heavy metals like Nickle (Ni), Copper (Cu), Cadmium (Cd) and Lead (Pb) have ability to alter the structure of soil. These metals are unnecessary and have bad impacts on the life of flora, fauna and microorganisms. The study objectives were assessing the substantial metals and nitrogen accumulation in cabbage and cauliflower at maturation stage by the application of industrial effluents. The study was conducted in wire house at SARC, University of Agriculture Faisalabad. The samples of water were collected from four different sites like masood textile mill (MTM), ibrahim fibers, sitara chemical and canal water. Then the following treatments were used for irrigation: T1 = tap water, T2 = 25% MTM+ 25% (sitara +ibrahim) + 50% tap water), T3 = Masood Textile Mill (MTM), T4 = Sitara Chemical + Ibrahim fiber, T5 = (50% MTM+ 50% (Sitara +Ibrahim). The physio-chemical and biological analysis of water, Soil and Plant like EC, pH, RSC, SAR, TDS, TSS, Soil particles distribution analyses, turbidity, BOD, COD, growth parameters of plants, and instrumental analyses were performed. The data obtained from these parameters was analyzed statistically. The results showed that the maximum chlorophyll contents (77.40), membrane stability index (80.8%), relative water contents (93.04%), shoot fresh weight (216.2), root fresh weight (13.2 g), flower fresh weight (95.4 g), shoot dry weight (41.08 g), root dry weight (5.31 g), flower dry weight (25.5 g), root length (14.1 cm), flower circumference (73.8 mm) and total nitrogen in root (0.39%), shoot (0.37%) and flower (0.31%) were recorded in TI (canal water) and minimum in T6 (50% MTM+ 50% (Sitara +Ibrahim) in cabbage relatively cauliflower. While the maximum concentration Pb in shoot (2.72 ppm) and root (2.87 ppm) and Cu in shoot (3.28 ppm) and root (3.34 ppm) in the T6 (50% MTM+ 50% (Sitara +Ibrahim) and minimum in T2 (tap water) in cabbage as compared to cauliflower respectively.

Keywords: **Brassica,** Heavy metals, Industrial effluents, SARC, Food quality.

BIOSURFACTANT-ASSISTED BIOTREATMENT OF TANNERY EFFLUENTS CONTAMINATED WITH DYE AND CHROMIUM

Hira Saleem*[1], Azeem Khalid[1]

[1]Institute of Soil and Environmental Sciences, PMAS-AAUR

*Email: hiraraoenv@gmail.com

ABSTRACT

Biosurfactants are amphiphilic compounds produced extracellularly by microorganisms on cell surfaces, or excreted extracellularly. They contain hydrophilic and hydrophobic moieties that reduce surface and interfacial tension between molecules at the surface and interface respectively. Focus of the present study was on the isolation of bio surfactant producing bacteria from (tannery wastewater) and assessing the potential of these isolates for biosurfactant production. Oil displacement, hemolytic activity, CTAB assay and emulsification index methods were used to screen the capability of isolates for producing biosurfactant. Additionally, simultaneously biodegradation potential of selected isolate for azo dyes and chromium (VI) was investigated. For Emulsification index among all the isolates strain K-3, K-1 K-17, S-13, and S-5 showed up to 40% emulsification after 24 hours. Best oil displacement activity was observed in strain K-6. This strain could displace 2 nm diameter to 8 mm. Best hollo zone formation on CTAB media plates observed by strain S-5 and K-3. For blood hemolysis test, best result was observed for K-3 and S-5 bacteria strains. Best results for chromium at 2 mgL^{-1} were shown by strain S-13 as compared to control Up to 90 % degradation was observed after 48 hours of incubation of bacterial strains. Two best strains (K-3, S-13) were selected from study based on their degradation potential and their degrading capability. Maximum decolonization for Azodye Reactive-5 black was shown by strain S-13 on all concertation (15 mgL^{1},100 mgL^{-1}150 mgL^{-1}) and bacterial strain K-3 was found with best simultaneous degradation potential for azodye and reduction potential for chromium.

***Keywords*:** Biosurfactant, Biotreatment, Tannery, Effluent, Dye, Chromium

CAN PHOSPHORUS AND FARMYARD MANURE CHANGE ARSENIC BEHAVIOR IN SOIL AND ITS TOXICITY TO PLANTS?

Muhammad Ashraf[1*], Muhammad Awais Pairach[1], Sajid Masood[2], Sher Muhammad Shahzad[1], Naeem Akhtar[3]

[1]Department of Soil & environmental Sciences, College of Agriculture, University of Sargodha, Sargodha, Pakistan
2Department of Soil Science, Faculty of Agricultural Sciences & Technology, Bahauddin Zakariya University, Multan, Pakistan
[2]Department of Plant Breeding and Genetics, College of Agriculture, University of Sargodha, Sargodha, Pakistan

Email: ashraf.muhammad@uos.edu.pk

ABSTRACT

Arsenic (As) immobilization through adsorption and precipitation by inorganic and organic supplements might be an important strategy for improving the productivity of contaminated soils. In two independent experiments, four P levels (0, 5, 10 and 20 g kg^{-1} phosphate rock) and four FYM levels (0, 20, 35 and 50 g kg^{-1}) at two As contamination levels (60 and 120 mg kg^{-1} soil) were tested in three different textured soils (sandy, loamy and clayey) to evaluate the effect of P and FYM on As dynamics in soil and toxicity to sunflower (*Helianthus annuus* L.). Increasing P supplementation increased labile (L-As), calcium-As (Ca-As), organic matter-As (OM-As) and residual As (R-As) while decreased iron-As (Fe-As) and aluminum-As (Al-As) in all the three textural types. P restricted As movement to plants, and mitigated the As-induced oxidative stress which was evident by a significant ($P \leq 0.05$) reduction in hydrogen peroxide (H_2O_2), malondialdehyde (MDA) while increase in glutathione (GSH), and consequently improved the achene yield. FYM was also found to decrease water soluble As (WS-As), L-As, Al-As, Ca-As but increased R-As, OM-As and Fe-As. FYM mediated immobilization was increased with increasing its rate of application, and highest effect was noticed in clayey textured soil. As speciation in soil also significantly ($P \leq 0.05$) varied with FYM, reduction in arsenate while increase in arsenite, mono-methyl arsenate and di-methyl arsenate with increasing the rate of FYM supplementation. Bioaccumulation factor declined with FYM, and maximum decline of 38.65% and 42.13% in sandy, 34.24% and 36.26% in loamy while 29.16% and 35.10% in clayey soils at As-60 and As-120, respectively by 50 g kg^{-1} FYM as compared to respective As level without FYM. As mobility in soil and uptake plant was significantly ($P \leq 0.05$) declined by P and FYM with the subsequent improvement in sunflower growth and yield.

***Keywords*:** Bioaccumulation, Farmyard manure, Fractionation, Phosphorus, Speciation, Soil texture, Sunflower.

USE OF RICE STRAW AS BIO-SORBENT FOR REMOVAL OF CHROMIUM FROM CONTAMINATED WATER

Muhammad Ahmed Akram[1]*, Muhammad Atif Riaz[1], Wajid Ishaque[1], Muhammad Akhtar[1]

[1]Soil & Environmental Sciences Division, Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad

*Email: mianahmedakram@gmail.com

ABSTRACT

Fresh water is scarce in Pakistan and may become distinct entity in future. Thus, it is becoming imperative for the farmers, particularly in close vicinities of industrial areas, to use polluted wastewater for irrigation. Therefore, we investigated the removal of chromium (Cr) from artificially contaminated water using rice straw as a bio-sorbent, which represents a viable, ecofriendly, and cost-effective solution to the problem. Fine milled rice straw was treated with acid (HNO_3) and alkali (NaOH) solutions to expose its exchange sites and functional groups. Firstly, the optimum adsorbent dose, water temperature and pH rendering maximum adsorption were determined using various levels of each variable in batch experiments. In each case, 50 mL of contaminated water containing 3 *mM* Cr (III) was treated with the adsorbent. Later, adsorption isotherms (Langmuir and Freundlich) were studied to determine the adsorption capacity of rice straw at the optimized adsorbent dose, temperature and pH values using series of Cr contaminated waters. The maximum adsorption was found at 6 pH and 45 ˚C temperature under the controlled environment. Chromium adsorption to the bio-sorbent was best described by Langmuir adsorption model (R^2 = 0.98), and the bio-sorbent was found to adsorb substantial amount of metal from solution leaving water safer for agricultural use. The results suggest that agricultural waste like rice straw may be used as bio-sorbent to remove pollutants from wastewater discharged by industry for irrigation without affecting soil health.

Keywords: Water pollution, Food safety, Soil health, Environment.

RESPONSE OF *Acacia ampliceps* UNDER WATER AND CHROMIUM STRESSED SOILS

Muhammad Nauman Sattar[1], Muhammad Saad Bin Zafar[*1], Qandil Shafiq[1], M. Saqib[1], Nain Tara Mushtaq[1], Noman Zahid[1], Amina Abdul Rahim[1], Laraib Noor[1], Ayesha Abid[1], Samra Sattar[1]

[1]Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad-38000, Pakistan

Email: ibnezafar28@gmail.com

ABSTRACT

Due to textile and leather industrialization, heavy metal contamination is an evolving issue for arable lands and in some areas these contaminations have increased up to alarming levels. Hexavalent Chromium is one of the most toxic heavy metal that is released in soil due to these anthropogenic activities. It has severe effects on plant health and soil microbiota. Drought or water deficit is a severe abiotic stress that adversely affects the growth and yield of crops. Yield losses up to 50% have been observed for various crops due to water deficiency. Drought affects plants in many ways and at various levels of their growth and development. The objective of the study was to evaluate the capacity of *Acacia ampliceps* to take up this heavy metal into roots, shoots, leaves and to evaluate the growth parameters and physiological response of this plant. Moreover, the survival response and effect on nutrient content under chromium toxicity was also assessed. All treatments were kept under the same environmental conditions having control (normal irrigation), drought (half to normal), waterlogging (double to normal) and chromium level at 50 mg kg^{-1} respectively. There were three replications for each treatment respectively. Two factor CRD was used for statistical analysis. Different physiological parameters were recorded, and experimental observations were done for four weeks. The results show tolerance of *Acacia ampliceps* to drought but moderate sensitivity to Chromium stress.

***Keywords*:** Acacia ampliceps, Water stress, Chromium, Soil

ASSESSMENT OF HEAVY METAL CONTAMINATION IN LEAFY VEGETABLES: IMPLICATIONS FOR PUBLIC HEALTH AND REGULATORY MEASURES

Nasir Rahim1, Aimen Noor1, Aqsa Kanwal1, Majid Mahmood Tahir1, Abid Yaqub1

[1]Department of Soil and Environmental Sciences, University of Poonch, Rawalakot

*Email: nasirrahim@upr.edu.pk

ABSTRACT

Heavy metal contamination in leafy vegetables poses significant health risks, emphasizing the urgent need for stringent monitoring and intervention measures to ensure food safety and mitigate potential adverse effects on public health. This study investigates the levels of heavy metals, including Cd, Cr, Ni, Pb, Zn, and Cu, in locally grown and commercially available leafy vegetables, comparing them to the safety limits established by WHO/FAO. The results revealed that Cd, Cr, Ni, and Pb levels in vegetables exceeded WHO/FAO limits, while Zn and Cu remained within permissible bounds. Marketed vegetables had higher metal concentrations than nearby farms. For Cu (0.114-0.289 mg kg^{-1}) and Zn (0.005-0.574 mg kg^{-1}), DIM was below DI and UL. Cd's DIM (0.031–0.062 mg kg^{-1}) stayed below UL but exceeded DI. Marketed kale and mint surpassed both DI and UL limits for Ni, while local produce only exceeded DI. All vegetables had DIM below DI, except mint and kale. For Pb, every vegetable exceeded DI limits, with market samples contributing significantly. Cr DIM ranged from 0.028 to 1.335 mg kg^{-1}, lacking a set maximum daily intake. HRI values for Zn, Cd, Cu, Ni, and Pb suggested potential health risks associated with leafy greens, while Cr HRI was below 1. The study underscores the need for stringent monitoring and intervention measures to mitigate health risks posed by heavy metal contamination in leafy vegetables. This suggested that eating these leafy greens might put consumers of Cd, Cu, Ni, Pb, and Zn at considerable risk for health problems.

Keywords: *Heavy metal, Leafy vegetables, Public health*

EFFECT OF VARIOUS SOWING METHODS AND ZINC APPLICATION ON GROWTH AND QUALITY TRAITS OF MAIZE

Aziz Laghari [1], Mahmooda Buriro[1], Ghulam Mustafa Laghari[1], Khalid Husain Talpur[1]

[1]Sindh Agriculture University Tando Jam

***Email:** mburiro@sau.edu.pk

ABSTRACT

Plant nutrient management and sowing methods play a crucial role for maize production. However, in Pakistan, many maize growers still rely on improper fertilizers and outdated sowing methods. To address this issue, a field trial was conducted at the Student's Experimental Farm Department of Agronomy, Sindh Agriculture University Tando Jam during 2017. The trial aimed to investigate the effect of sowing methods and zinc application on growth, yield and quality traits of maize using randomized complete block design with three replicates having net plot size 3 m x 5= (15 m^{-2}). The maize variety used in the trial was Akbar, and it was subjected to six different treatments: F1 = 0Zn + Broadcasting, F2 = 0Zn + Drilling, F3 = 0Zn + Ridge, F4 = Recommended Zn @ 20 kg ha-1 + Broadcasting, F5 = Recommended Zn @ 20 kg ha-1 + Drilling, and F6 = Recommended Zn @ 20 kg ha^{-1} + Ridge. The results of the trial showed that the application of zinc with the ridge sowing method significantly improved various agronomic, phenological, and physiological traits of maize. Parameters such as plant height, number of leaves per plant, stem girth(cm), number of cobs $plant^{-1}$, cob girth(cm), cob length(cm), grain weight per cob(g), seed index (1000 grains weight), biological yield(kg ha^{-1}), grain yield (kg ha^{-1}), 50% days to tasseling, 50% days to silking, leaf area index, crop growth rate(gm^{-2} $days^{-1}$), net assimilation rate (g m^2 day^{-1}), and zinc uptake (kg ha^{-1}) were all observed to be highest in the treatment involving the recommended Zn @ 20 kg ha^{-1} + ridge sowing method. On the other hand, the lowest values for these traits were found in the treatment with 0Zn + broadcasting. Whereas, the quality traits of the maize crop, such as protein content, starch, and total sugars, were not significantly affected by zinc application with different sowing methods. The treatment with recommended Zn @ 20 kg ha^{-1} and the ridge sowing method resulted in the highest protein content, starch, and total sugars The findings of this study indicate that the application of Zn at a rate of 20 kg ha-1 during ridge sowing resulted in improved growth, yield, and quality characteristics of maize crops when compared to zinc application through broadcasting and drilling sowing methods.

***Keywords*:** Maize, Sowing, zinc, growth, yield and quality.

IN-SITU STABILIZATION OF HEAVY METALS AND YIELD OF SPINACH THROUGH VARIOUS ORGANIC AMENDMENTS IRRIGATED WITH WASTEWATER

Maria Mussarat[1], Muhammad Zohaib Ikram[1], Muhammad Rashid[2], Dost Muhammad[1]

[1]Department of Soil and Environmental Sciences, Faculty of Crop Production Sciences, The University of Agriculture, Peshawar-Pakistan
[2]Soil and Plant Nutrients Division, Agricultural Research Institute, Tarnab, Peshawar

Email: drmaria@aup.edu.pk

ABSTRACT

Agriculture lands irrigated through industrial wastewater have detrimental effect on agriculture crop production as well as on human health. The current study was conducted at the Agriculture Research Institute Tarnab, to determine effect of green soil bio-fertilizer (GSB) applied at 1.73 kg ha^{-1}, Humic acid (HA) at 30 kg ha^{-1}, Single super phosphate (SSP) at 2500 kg ha^{-1} and Biochar (BC) applied at 20 t ha^{-1}. Treatments were arranged in RCB design, and all plots were irrigated with wastewater received from irrigation channels and sewage water from houses. Results showed that total spinach yield from three cuts was higher in SSP treated plots (22666 kg ha^{-1}) followed by similar value of 22428 kg ha^{-1} in biochar treated plots that were statistically higher than humic acid (20809 kg ha^{-1}), green biochar (18189 kg ha^{-1}) and control (14857 kg ha^{-1}). The NPK concentrations as average of three cuts and as well as in postharvest soils were higher in treated plots as compared to control but the differences among treatments were either statistically similar or inconsistent in case of plant but in soil it followed the pattern as BC>SSP>HA>GS except AB-DTPA ext. P that was higher in SSP treated plots than others. Postharvest AB-DTPA ext. micronutrients (Cu, Zn, Fe and Mn) and heavy metals (Ni, Cd, Pb, and Cr) concentrations as well as their concentration in plants were higher in control than treated plots suggesting heavy metal stabilization under wastewater irrigation. The stabilization in both soils and plants generally followed the pattern as BC>SSP>HA>Green Soil. It was concluded that amendments like biochar, SSP and humic acid should be used to stabilize heavy metals and enhance yield of leafy vegetables under the given wastewater irrigation.

Keywords: Heavy metals stabilization, Biochar, Wastewater irrigation, Contaminated soil.

APPLICATION OF RELEASE NITROGEN FERTILIZERS AND BIOCHAR FOR SUNFLOWER (*Helianthus anus L.*) PRODUCTIVITY AND TO ALLEVIATE THE DROUGHT STRESS

Shabir Hussain*, Mehrab Khan, Muhammad Nadeem Shah*, Bushra Hussain

[1]Institute of Agronomy, Faculty of Agricultural Sciences and Technology,
[2]Bahauddin Zakariya University, Multan, Pakistan
[3]Department of Agriculture, Government College University, Lahore, Pakistan,
[4]North Florida Research and education Centre (NFREC), University of Florida, 155 Research Road, Quincy, Florida, USA;

*Email: shabirhussain@bzu.edu.pk

ABSTRACT

Sunflower is an oilseed crop growing successfully in Pakistan. Pakistan produces only 13 percent oil of its total consumption. The yield of sunflower is low in Pakistan as compare to other growing countries. Abiotic stress like drought stress and proper nutrition are the reasons behind the low yield of sunflower. For this a two year field experiment was conducted at the Agronomic Research Area, Department of Agronomy, Bahauddin Zakariya University, Multan. Treatments included the biochar application (Control and Biochar), slow release nitrogenous fertilizer (simple urea, zinc coated urea and sulphur coated urea) and drought stress (normal irrigation (100% field capacity) and drought stress (60% field capacity)). The experiment was laid out in randomized complete block design (RCBD) with split-split plot arrangement and was repeated three time. Field capacity was adjusted in the main-plot, biochar application was adjusted in the sub-plot while nitrogenous fertilizers were adjusted in the sub-sub plot. Results regarding the yield and quality attributed were studied with their antioxidant activity. Results showed that Application of biochar with the application of zinc coated urea increased the sunflower achene yield (2484 and 2494 kg ha^{-1}) with increasing the yield attributes like achene head diameter (13.7 and 15.29 cm) and number of achene per head (1457 and 1463) under normal irrigation during the year-I and year-II. Maximum leaf transpiration rate (9.26 and 9.16 m $mols^{-1}$), photosynthetic rate (18.10 and 18.19 µmol $m^{-2}s^{-1}$), stomatal conductance (852.0 and 856.2 $molm^{-2}s^{-1}$) and chlorophyll contents (19.5 and 19.6) were also measure with the application of biochar and zinc coated urea during the year-I and year-II. Application of biochar also increased the antioxidant activity under drought stress. Maximum mineral uptake was also determined in the application of biochar and zinc coated urea in normal irrigation. It was concluded that maximum crop productivity can be obtained with the application of biochar and zinc coated urea and adverse effect of drought can be alleviate with the application of biochar.

Keywords: Biochar, slow release nitrogen fertilizers, chlorophyll contents, quality and drought stress

EFFECT OF PHYTOSYNTHESIZED IRON NANOPARTICLES ON GROWTH AND LEAD UPTAKE IN MAIZE (*Zea mays* L.) PLANTS

Haseeba Maryam[1], Muhammad Rizwan[1]*

[1]Department of Environmental Sciences, Government College University Faisalabad, Faisalabad 38000, Pakistan

***Email:** mrazi1532@yhaoo.com

ABSTRACT

Excess lead (Pb) level in arable soils is a serious concern in recent times which needs timely and proper attention for safer food production on such soils. The current study investigated the effects of green-synthesized iron nanoparticles (FeNPs) on growth and Pb uptake by two maize (*Zea mays* L.) hybrids. The results depicted that plant growth linearly decreased with increasing Pb levels in soil. Pb alone enhanced the leaf electrolyte leakage, hydrogen peroxide, and activities of selected enzymes. Combined use of FeNPs and Pb increased the growth and reduced the oxidative stress in plants than Pb treatments alone. Pb alone increased the Pb concentrations in maize tissues while FeNPs decreased the Pb concentrations in maize tissues. The findings depicted that foliar-applied FeNPs may have potential in minimization of the toxic effects of Pb in maize hybrids through minimizing Pb concentrations in tissues thereby enhancing biomass of the plants. Thus, FeNPs may facilitate safer cereal production in soils having excess Pb.

Keywords: Heavy metals, Nanoparticles, Cereals, Iron, Lead.

NANO-PARTICLES: A NOVEL TOOL FOR SUSTAINABLE CROP PRODUCTION AND PROTECTION

Muhammad Hamza Khalil[1*], Munazza Rafique[2], Muhammad Naveed[1], Ahmed Hassan[1], Muhammad Farhan Qadir[3] Hina[1]

[1]Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad, Pakistan
[2]Soil Bacteriology Section, Ayub Agricultural Research Institute, Faisalabad, Pakistan
[3]College of Resources and Environment, Xinjiang Agricultural University, 311 Nongda East Road, Urumqi, 830052, Xinjiang, China

*Email: m.hamzakhalil2125@gmail.com

ABSTRACT

The agriculture sector, vital for global food production, faces environmental challenges stemming from the use of chemical fertilizers, such as nutrient leaching and methane emissions. This review explores the potential of nanotechnology in promoting sustainable crop production, aiming to enhance growth and productivity while mitigating environmental impact. Nanotechnology presents a promising solution by introducing controlled release fertilizers that can enhance nutrient absorption rates, utilization, and reduce nutrient losses. Nanoparticles, fabricated through physical, chemical, and biological methods, offer diverse options for agricultural applications. Examples include Nano-fertilizers, Nano-herbicides, Nano-fungicides, and Nano-pesticides, all designed to optimize crop production. Utilizing nanotechnology in agriculture offers several advantages. By releasing nutrients at rates matching plant demand, nanotechnology minimizes losses and optimizes nutrient utilization. Additionally, nanoscale products enhance pest and weed control efficiency, reducing reliance on excessive chemical applications. This not only decreases input requirements but also minimizes waste, fostering sustainable agricultural practices. Furthermore, nanoparticles produced through biosynthesis hold promise for environmentally friendly and economically viable approaches to long-term agricultural development. Despite these benefits, challenges must be addressed. Effective regulations and risk management protocols are essential to ensure the safe and responsible use of nanoscale products in agriculture. Continued research and development are imperative to comprehend fully the potential impacts of nanotechnology on crop ecosystems and the environment. Collaboration among scientists, policymakers, and stakeholders is crucial to establish guidelines and standards for the widespread adoption of nanotechnology in agriculture. In conclusion, while nanotechnology offers immense potential for sustainable agriculture, responsible implementation necessitates adequate regulations, risk management, and ongoing research. With these measures, nanotechnology can revolutionize crop production, contributing significantly to a more sustainable and resilient food system.

Keywords: Climate change, Controlled release fertilizers, Environmental issues, Green revolution, Nanotechnology, Sustainable agriculture

IRON APPLICATION IN Cd-CONTAMINATED SOIL CAN ENHANCE THE PHYTOREMEDIATION POTENTIAL OF CASTOR BEAN

Zarish Maqsood[1], Muhammad Shaukat[2], Sher Muhammad[2*], Sofia Khalid[1], Ellen D.v.L. Maas[3],

[1*]Department of Biology and Environmental Science, Faculty of Sciences, Allama Iqbal Open University, Islamabad–4400, Pakistan.
[2]Department of Agricultural Sciences, Faculty of Sciences, Allama Iqbal Open University, Islamabad–4400, Pakistan.
[3]Rothamsted Research, UK.

E-mail: sher.muhammad@aiou.edu.pk

ABSTRACT

Phytoremediation, the use of plants to clean environmental contamination, is known to be an effective strategy for removing heavy metals from soils in an environment-friendly way. Iron (Fe) is a necessary nutrient that might help in the mitigation of heavy metal stress. Cadmium (Cd) contamination is an emerging global problem that has several adverse effects on the growth and development of organisms. In the current study, a pot experiment was conducted to evaluate the Fe-assisted Cd tolerance potential of castor bean (*Ricinus communis*) at the botanical garden of Allama Iqbal Open University, Islamabad-Pakistan. A total of eight treatment combinations of Fe ($FeCl_2.4H_2O$) and Cd ($Cd (NH_3)_2$) were replicated thrice. Plant biomass, leaf gas exchange parameters, chlorophyll score, relative water content, membrane permeability, antioxidant enzymes, proline, and accumulation of Cd were measured. Results showed that only the Fe_{30} treatment enhanced shoot and root biomass by 18.78%, and 24.49%, respectively, as compared to the control treatment. Furthermore, Cd with Fe treatments improved the photosynthetic rate, stomatal conductance, superoxidase (SOD), catalase (CAT), and glutathione (GSH) by 15.80%, 46.33%, 27.57%, 51.69%, and 8.52%, respectively, relative to Cd without Fe treatments. Additionally, Fe addition resulted in the reduced bioavailability of Cd, leading to less accumulation of Cd in plant parts relative to Cd without Fe treatments. In conclusion, the Fe supplement could assist in the tolerance of Cd stress to castor beans by modulating the defense system, physiology, and allometry of plants.

Keyword: *Phytoremediation; castor bean; allometry; Pakistan; antioxidants; accumulation*

"Soil Health: A Key to Food Security"

20th INTERNATIONAL CONGRESS OF SOIL SCIENCE

20-22 February 2024, Rawalpindi, Pakistan

SOIL MICROBIOLOGY & BIOCHEMISTRY

COMBINED APPLICATION OF PGPR AND BIO-STIMULANTS FOR GROWTH PROMOTION OF RICE (*ORYZA SATIVA L.*)

Fatiha khan[1], Hafiz Naeem Asghar*[1], Zahir Ahmad Zahir[1], Tehreem Fatima[1], Zara Ali[1]

[1]Institute of soil and environmental sciences, University of Agriculture Faisalabad

*Email: naeemasghar@yahoo.com

ABSTRACT

Since rice is grown worldwide, its production is severely affected by biotic and abiotic stresses and various other factors such as agricultural inputs, lack of canal water, expert consultancy to the farmers, and finance. To increase rice production, there are several chemical and physical methods in practice, which in turn deteriorate the environment and affect soil health. Whereas biological amendments are more reliable and eco-friendlier than any other chemical amendments. As, recent studies showed that biological amendments have long-lasting effects on soil health but have not been widely used, because of their slower effects. It is also an alternative approach to minimize the usage of chemical fertilizers and their environmental impact. The biological amendments used now a days are PGPR, microbial biostimulant, biochar and compost etc. The PGPR can enhance nutrient availability and uptake, while the bio-stimulants can improve nutrient assimilation and utilization. The combined application of PGPR and bio-stimulants can have synergistic effects on plant growth and stress tolerance. To check the effectiveness of these biological amendments 'PGPR and biostimulants on the rice yield, a pot experiment was conducted using a completely randomized design (CRD) in the wire house of ISES, UAF. The treatment plan comprised of control (no amendment), PGPR (RPF_1+RPF_2), biostimulant (Dip and Grow), biostimulant + PGPR (RPF_1+RPF_2) along with three replications. All agronomical practices were carried out. The agronomical data collected from pot trial showed that the bacterial strains with biostimulant performed well (55%) as compared to the control (32%) without any amendment. The combined application of (RPF_1 and RFP_2) with bio-stimulant increased the fresh shoot weight, fresh root weight, 100grain weight, and grain yield of rice by 77, 73, 47, and 26%. The fertile spikes increased by 27% when biostimulant was applied, while the sterile spikes rate decreased in control treatment. Based on the result, it was concluded that individual use of PGPR strain and bio-stimulant positively affected the plant yield in almost all treatments but the effects of combination (RPF_1+RPF_2) with bio-stimulant 65% were excellent. The findings of the study provide supporting evidence that rhizobacteria and biostimulants effectively contributed to increasing rice yield.

***Keywords*: Rice yield, Plant growth promoting rhizobacteria (PGPR), Biostimulants (Dip and Grow)

ISOLATING, SCREENING, AND INTEGRATED IMPACT OF CONSORTIUM OF RHIZOBIUM AND RHIZOBACTERIA ON YIELD OF MASH BEAN UNDER IN VITRO CONDITIONS

Kashiuf Asif*[1], Waqas Mahmood[1], Hafiz Naeem Asghar[1], Zahir Ahmad Zahir[1]

[1]Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad.

*Email: kashafasif3595@gmail.com

ABSTRACT

Excessive use of synthetic fertilizers is a major bottleneck towards adopting microbial techniques on a large scale and poses a great challenge to food security by disrupting soil properties and increasing production costs. Current research must focus on developing suitable alternatives for optimizing crop production along with reduced agricultural cost. We compared the efficacy of different rhizobial and rhizobacterial isolates for promoting growth of *Vigna mungo* in a growth room trial. Several PGPR and rhizobacteria strains are isolated and checked for growth promoting characters. Results revealed that isolates, '*Stenotrophomonas rhizophila* PKA-18' significantly enhanced shoot length (1.58-fold), root length (95%), root fresh weight (1.45-fold), shoot dry weight (6.3-fold) and SPAD value (1.35-fold) as compared to control. While inoculation of '*Rhizobium* sp. RKA-47' significantly increased shoot length (2.07-fold), root length (77%), shoot fresh weight (2.95-fold) and shoot dry weight (1.55-fold). Principal component analysis (PCA) indicated that among rhizobacteria, '*Bacillus subtilis* PKA-25' and '*Stenotrophomonas rhizophila* PKA-18' whereas, among rhizobia, '*Rhizobium* sp. RKA-47' and '*Bradyrhizobium japonicum* RKA-46' were the most efficient strains. Similarly, root parameters (root diameter, number of tips and root length) with root scanner were noted. Based on growth promotion, 3, 3 isolates from growth room trial were selected and further tested for consortium development. A combination of rhizobial and PGPR strains with multiple traits could be more useful under diverse conditions compared to a strain containing single trait. Compatibility of these isolates were checked. These combinations were further checked for mash bean growth promotion under axenic conditions. Hence, co-inoculation of rhizobacteria and rhizobia proved to be an ideal option for improving mash bean growth under axenic conditions.

Keywords: PGR's, Microbiome, co-inoculation, biofertilizer, nodule, symbionts, biological nitrogen fixation

ACIDIFIED MANURE AND NITROGEN-ENRICHED BIOCHAR SHOWED SHORT-TERM AGRONOMIC BENEFITS ON COTTON-WHEAT CROPPING SYSTEMS UNDER ALKALINE ARID FIELD CONDITIONS

Suleman Haider Shah[1], Muhammad Baqir Hussain[1*], Ghulam Haider[2], Tanveer Ul Haq[1], Zahir Ahmad Zahir[3], and Claudia Kammann[4]

[1]Department of Soil and Environmental Sciences, Muhammad Nawaz Shareef University of Agriculture, Multan, Pakistan
[2]Department of Plant Biotechnology, Atta-ur-Rahman School of Applied Biosciences (ASAB), National University of Sciences and Technology (NUST), Islamabad, Pakistan
[3]Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad, Pakistan
[4]Climate Change Research for Special Crops, Department of Applied Ecology, Hochschule Geisenheim University, Von-Lade Str. 1, D-65366 Geisenheim, Germany

*Email: baqir.hussain@mnsuam.edu.pk

ABSTRACT

Application of organic residues such as farm manure and biochar in various agricultural environments has shown positive effects on soil carbon sequestration. However, there is a lack of consensus regarding the agronomical benefits of a single and small dose of biochar and farm manure in arid alkaline soils. Therefore, a field experiment with the given treatments (i) control (no amendment), ii) acidified manure (AM) at 300 kg ha^{-1}, iii) nitrogen (N)-enriched biochar (NeB) at 3 Mg ha^{-1}, and iv) an equal combination of AM + NeB (150 kg ha^{-1} AM + 1.5 Mg ha^{-1} NeB)) was conducted in a typical cotton-wheat cropping system. A parallel laboratory incubation study with the same amendments was carried out to account for soil carbon dioxide emissions (CO_2). The N enrichment of biochar and its co-application with acidified manure increased soil mineral N (NO_3^- and NH_4^+) in the topsoil (0-15 cm) and increased total N uptake (25.92% to 69.91%) in cotton over control, thus reducing N losses and increasing uptake over control. Compared to the control, co-application of AM + NeB significantly improved soil N and P bioavailability, leading to increased plant biomass N, P, and K (32%, 40%, 6%, respectively) uptake over control. The plant's physiological and growth improvements [chlorophyll (+28.2%), height (+47%), leaf area (+17%), number of bolls (+7%), and average boll weight (+8%)] increased the agronomic yield in the first season crop cotton by 25%. However, no positive response was observed in the second-season wheat crop. This field study improved our understanding that co-application of acidified manure and N-enriched biochar in small doses can be a strategy to achieve short-term agronomic benefits and carbon sequestration in the long run.

Keywords**:** organic amendment, soil respiration, nitrate leaching, cotton-wheat yield

ISOLATION AND SCREENING OF RHIZOBIUM AND PGPR FOR IMPROVEMENT IN GROWTH AND NODULATION OF SOYBEAN.

Nabiha Asghar*[1], Hafiz Naeem Asghar[1], Zahir Ahmad Zahir[1]

[1]Institute of Soil and Environmental Sciences, University of Agriculture.

*Email: nabihaasghar103@gmail.com

ABSTRACT

Soybean holds significant importance in sustainable agriculture in Pakistan due to its high protein content, oil production, and nitrogen-fixing abilities. However, challenges such as inadequate nodule formation, soil degradation, and phosphorus deficiency affects soybean production. Biofertilizers can effectively address these issues by containing microbes that aid in nitrogen fixation, nutrient solubilization, and growth promotion. Use of biofertilizer is the need of hour to gain sustainable soybean production. This study aims to accomplish several objectives, such as isolating plant growth-promoting rhizobacteria (PGPR) from rhizospheric soil and rhizobium from soybean nodules, evaluating their individual and combined effects, assessing their influence on soybean growth promotion and nodulation patterns, and by developing an inoculated rock phosphate-enriched compost (biofertilizer).The isolation of PGPR from rhizospheric soil and rhizobium from soybean nodules was collected from soybean growing areas of Punjab. The PGPR isolates were screened for growth-promoting factors such as phosphorus solubilization, exopolysaccharide production (EPS), oxidase activity, and catalase activity. Three isolates exhibited positive results in all screening tests. The purified rhizobium isolates grown in YEM agar media with Congo red underwent confirmatory testing for identification, including the glucose peptone agar test, keto-lactose test, and a 45-days growth chamber trial to assess its ability to produce nodules and its impact on crop growth patterns. Various physiological and agronomic parameters were recorded, with two isolates demonstrating superior performance in plant growth and nodulation compared to all other tested strains in the growth chamber trial. Selected isolates of PGPR and rhizobium were then combined with rock phosphate-enriched compost and incubated for 7-14 days to stimulate microbial proliferation. These combinations will be further evaluated in a pot experiment to identify the most effective combination for maximizing growth and nodulation. Ultimately, the findings indicate that both PGPR and rhizobium have the potential to improve soybean production by enhancing nodulation and growth.

Keywords: sustainable agriculture, biofertilizer, soybean, PGPR, rhizobium

EXPLORING THE POTENTIAL OF ENDOPHYTIC BACTERIA TO MANAGE THE DROUGHT STRESS IN CHICKPEA BY PROMOTING RHIZOBIA-CHICKPEA SYMBIOSES

Muhammad Usman Jamshaid*[1], Muhammad Baqir Hussain[1], Zahir Ahmad Zahir [2], Mehreen Gul[3] and Muhammad Khubaib Ayyaz4

[1]Department of Soil and Environmental Sciences, Muhammad Nawaz Shareef University of Agriculture Multan
[2]Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad[3]Department of Soil Science, Bahauddin Zakariya University, Multan
[4] School of Biological Sciences, University of East Anglia Norwich, UK

*Email: usman.jamshaid@mnsuam.edu.pk

ABSTRACT

Pulses production is an integral part of arid land agriculture. However, the sustainable production of the pulses on marginal land of arid region is challenging due to abiotic stresses particularly drought and salinity. Chickpea is the important pulse crop grown in rain fed regions of Pakistan. Different strategies are in practice for promoting the growth of chickpea particularly under water-limited conditions. The present research is an attempt to explore the role of endophytic bacteria to promote chickpea production under water limited conditions. For this purpose, endophytic bacteria were isolated from roots, stems, leaves and pod tissues and rhizobia were isolated from the nodules of chickpea plants grown under arid/semi-arid regions of Punjab, Pakistan. Based on colony morphology and prolific growth, isolates were selected for *in vitro* screening of their drought tolerance capability at different water potentials i.e. -0.65, -1.57, -2.17 and -2.23 MPa developed by using polyethylene glycol (PEG 6000). Out of 40 endophytic bacteria and 20 rhizobia, 10 endophytic bacteria and 8 rhizobia were found efficient for better survival and growth at low water potential. These efficient bacteria were tested to improve chickpea seedling growth and nodulation (in the case of rhizobia) under water limited gnotobiotic conditions. Based on plant growth promotion (for endophytic bacteria) and nodulation (for rhizobia) experiment, 08 endophytic bacteria and 03 rhizobia, which were found efficient for ameliorating the drought stress and improving chickpea growth and nodulation, respectively, were selected for evaluation of their compatibility with each other. Compatibility evaluation was carried out at different water potential levels and increase/decrease in total cell count was monitored. Out of 24 combinations 09 were found compatible with each other. The 09 compatible combinations were evaluated to improve growth and nodulation of chickpea under water limited axenic conditions from which 04 combinations were selected. Bacteria (02 endophytic bacteria and 02 rhizobia) making up these four combinations were characterized for different characters and identified as *Ochrobactrum* (Cr4), *Stenotrophomonas* (Cp3) and *Mesorhizobium* (Mr4 and Rs8). Endophytic bacteria i.e. *Ochrobactrum* (Cr4) and *Stenotrophomonas* (Cp3) were evaluated for their potential in the presence of Mesorhizobia (Mr4 and Rs8) to promote their symbioses with chickpea under water limited pot and field conditions.

Results suggested that endophytic bacteria promoted symbioses between Mesorhizobia and chickpea by improving the nodulation attributes and nodule physiology under water limited natural conditions.

Keywords: Endophytic Bacteria, Rhizobia, Chickpea, Drought

SIDEROPHORE-MEDIATED IRON UPTAKE: A KEY TO IMPROVED GROUNDNUT (*ARACHIS HYPOGAEA* L.) PRODUCTIVITY AND NUTRITIONAL QUALITY

Sair Sarwar[1]*, Abdul Khaliq[2], Munazza Yousra[1], Tariq Sultan[1], Tauseef Tabassam[1], Muhmmad Zameer Khan[1], Muhammad Manzoor[1]

[1]Land Resources Research Institute, NARC
[2]University of Poonch, Rawalakot

*Email: sardarsair@parc.gov.pk

ABSTRACT

Iron is a vital element for plant and microbial growth, yet the major portion of iron in soil is in the form of (oxi-) hydroxides with limited bioavailability, resulting in decreased yield and quality of crops. To evaluate the effectiveness of siderophore-producing bacterial strains (SPBs), alone and in combination with Fe (soil or foliar applied), on the yield and nutritional quality of groundnut, a two-year field experiment was conducted at Chakwal (Potohar region) and NARC (Islamabad) sites. The results showed that the consortia of three SPBs (MGS-91, MGS-14, and MGS-11) was found to be superior to the individual SPB strains during both years. The maximum pod yield of groundnut was obtained from SPBs consortia+Fe-SA and was at par to the yield obtained from MGS-11+Fe-SA at both sites. The maximum N, P, K and Zn contents of groundnut (kernel) were recorded in the treatments where consortia of SPBs was combined with soil applied iron (Fe-SA) and was at par with SPBs+Fe-FA. Similarly, the Fe content and its uptake in kernel of groundnut was found highest in SPBs consortia+Fe-SA. The kernel protein and oil contents recorded for the SPBs+Fe combined treatments were found higher over the SPBs alone and their consortia. Regarding the effect of treatments on fatty acid composition of groundnut, the results indicated that the oleic and linoleic acids were accounted for the predominant fraction with mean values of 54.0 and 28.4% (for Chakwal) and 53.9 and 27.0% (for NARC) sites. Hence, it is concluded that the integrated use of SPBs and Fe (soil or foliar sprayed) represented an effective and sustainable approach to reduce the burden of micronutrient deficiencies, especially Fe via improving the iron biofortification of the food crops.

Keywords: Iron, Groundnut, Biofortification, PGPRs, Siderophores

EXPLORING ENTEROCOCCUS DURANS S2C: PRODUCTION OF ANTIFUNGAL GELATINASE AND ITS POTENTIAL ROLE IN BIOLOGICAL CONTROL

Zafar Hayat[1], Irum Mukhtar[1], Faluk Shair[1], Kifayat Ullah[1], Ahmed Hafeez[1], Fauzia Yusuf Hafeez[1] and Anwar Ullah[1]

[1]Department of Biosciences, COMSATS University Islamabad

*Email: zafar.hayat83@gmail.com

ABSTRACT

Probiotic bacteria are potential sources of antimicrobial agents which are part of the normal microbiota in the gastrointestinal tract of both animals and humans. Among these, Enterococci are widely distributed in nature and utilized as probiotics in the food industry. In this current study, the isolation of *Enterococcus durans* S2C strain from raw cow's milk was done by using a culture-dependent method and assessed as an antifungal agent. The strain S2C was scanned for extracellular proteolytic activity and the extracellular peptide was the main source of antifungal property. Furthermore, the *E. durans* S2C strain demonstrated a low incidence of antibiotic resistance and non-hemolytic activity. In the evaluation of antifungal activity, *E. durans* S2C showed strong inhibitory effects against two predominant plant pathogenic fungi, *Fusarium oxysporum* and *Rhizoctonia solani*. The antifungal impact showed that *R. solani* revealing greater susceptibility as compared to *F. oxysporum*. Additionally, the purification of the gelatinase enzyme from the *E. durans* S2C isolate further highlighted its role in antifungal activity. This study underlines the potential application of the environmentally derived *E. durans* S2C strain for technological purposes to control pathogenic fungi and to protect the economic value of crops.

Keywords: Raw Milk, Enterococcus durans, Gelatinase, Antifungal Activity, Antibiotic Resistance Pattern

ANTAGONISTIC POTENTIAL OF DIFFERENT RHIZOBACTERIA ISOLATED FROM SORGHUM AGAINST DIFFERENT FUNGAL PATHOGENS

Tauseef Tabassam[1*], Maryuem Humayun[1], Tariq Sultan[1], Sair Sarwar[1], Munazza Yousra[1], Sonia Samreen[1]

[1]Land Resources Research Institute, National Agricultural Research Centre, Islamabad

*E-mail: tauseefrwp@gmail.com

ABSTRACT

Soil-borne diseases are responsible for major crop losses worldwide. Alternatives to the use of synthetic chemicals for disease control are increasingly being sought. Plant growth-promoting rhizobacterium (PGPR) has been increasingly proposed as an eco-friendly alternative in agriculture. These PGPRs can stimulate plant development and restrict the growth of plant diseases, either directly or indirectly. Biocontrol mechanisms in pathogen suppression include substrate competition for iron, nutrients, and space, antibiotic production, lytic enzymes production, hydrogen cyanide, volatile compounds, and induced systemic resistance in the host. The objective of this work was to evaluate the antagonistic activities of some bacterial strains isolated from sorghum rhizosphere against four phytopathogenic fungal strains (*Fusarium oxysporum, Macrophomina phaseolina, Aspergillus flavus* and *Pencillium*). A total of 58 bacterial isolates were collected from the sorghum rhizosphere and characterized morphologically and biochemically. These bacteria were tested for their inhibitory activity against selected fungal pathogens in dual-culture bioassays. Fifteen isolated rhizobacteria showed positive biocontrol activity against *Fusarium oxysporum* (stalk rot) where strains SG1A7 presented 216 percent inhibition. Twenty-eight strains were antagonistic against *Macrophomina phaseolina* (charcoal rot) and percentage inhibition of 525 was observed by MRS15, Biocontrol of *Aspergillus flavus* (Grain storage mold) was presented by 5 strains with 77.7% inhibition by SG1B2 while only SG1e isolate was found biocontrol positive against *Pencillium* (Grain storage mold) with 44.2% inhibition. The results revealed that single PGPR strain typically does not exhibit biological control against multiple pathogens. The formulation of mixtures of PGPRs could be one strategy to address multiple modes of action and the biocontrol of multiple pathogens.

Keywords: Biocontrol, PGPR, Fungal Pathogen, Sorghum

SYNERGIZING THE EFFECT OF PHOSPHATE SOLUBILIZING BACTERIA, COMPOST AND BIOCHAR WITH DI-AMMONIUM PHOSPHATE AND NITRO-PHOS

Muhammad Yasir[1], Muhammad Baqir Hussain[1*], Wazir Ahmad[1], Shahid Iqbal[2], Muhammad Usman Jamshaid[1], and Sajid Hussain[3]

[1]Department of Soil and Environmental Sciences, MNS University of Agriculture Multan
[2]Department of Agronomy, MNS University of Agriculture Multan
[3]Soil and Water Testing Laboratory (Lab-292), Pak Arab/Fatima Group, PFL-Plant, Multan

*Email: baqir.hussain@mnsuam.edu.pk

ABSTRACT

The application of mineral fertilizers as di-ammonium phosphate (DAP) and nitro-phos (NP) are common phosphorus supplements for modern agriculture. However, the stagnation of crop yields and very low efficiency of these fertilizers has triggered the attention of scientists to add bio-organic amendments like phosphate solubilizing bacteria (PSB), biochar or compost to improve crop growth and nutrient use efficiency. The present research was planned to study the interaction of DAP and NP with PSB, biochar or compost for improving growth and nutrition of maize fodder. The treatments were arranged as recommended P using DAP or NP, and their combinations with PSB seed inoculation or biochar @ 0.5% or compost @ 300 kg ha^{-1}, respectively. The treatments were maintained in pots containing 7 kg soil and arranged following completely randomized design with three replications. The plants were grown till 45 days after sowing. The results obtained showed significant improvement in leaf transpiration rate (E), leaf water use efficiency (WUE), shoot / root dry / fresh weight, nitrogen / phosphorus contents in plant / soil, and soil organic matter contents due to DAP as compared to NP. Whereas, PSB inoculation significantly improved the leaf transpiration, leaf WUE, shoot / root fresh weight and root dry weight as compared to no amendment, biochar or compost. However, PSB inoculation showed significant improvement in plant nitrogen and phosphorus contents but at par with biochar and no amendment, respectively. The interaction of DAP with PSB also proved beneficial to maize as a significant increase in shoot fresh / dry weight, soil / plant phosphorus, and plant nitrogen was observed over all other interactions of mineral fertilizers with biochar or compost. These results would be due to the compatibility of DAP to our sandy clay loam soil where the seed inoculation with PSB supplemented the crop nutrition and growth thought various plant growth promoting traits. Therefore, the combined application of DAP and PSB can be suggested due to their synergism.

Keywords: Corn, Bio fertilizer, Organic amendments, Fertilizers, Phosphorus.

BIODEGRADATION OF AZO DYE THROUGH MICROALGAE AND SIMULTAEOUS BIOLIPID PRODUCTION

Aqsa Riaz*[1], Shahid Mahmood[1], Azeem Khalid[1], Muzammil Anjum[1]

[1]Institute of Soil and Environmental Sciences, PMAS-Arid Agriculture University, Rawalpinid, Pakistan

*Email: aqsariaz211@gmail.com

ABSTRACT

Azo dye-contaminated wastewater is one of major environmental pollution sources in developing countries like Pakistan. Due to their carcinogenicity and recalcitrant nature, they possess severe environmental implications and need to be treated beforebeing released into the natural environment. Similarly, fossil fuel burning is also causing serious environmental issues. Therefore, in this study we use dyes contaminated wastewater to grow algae to observe the potential of strain for dye degradation and subsequent lipid accumulation. Parameters like pH, carbon sources, carbon concentration, inoculum concentration, substrate concentration was optimized to enhanced degradation of simulated wastewater and simultaneous lipid accumulation. Almost 90 % degradation of Congo red dye was showed by algal strain SW at 50ppm concentration. The work suggests that algae can degrade dye more efficiently at concentration below 100ppm and with pH value 7 at room temperature. The most suitable carbon source is glucose, carbon concentration is $1gl^{-1}$, and inoculum rate is 10ml for efficient dye degradation. It is also concluded from our research work that there is no significant impact of pH on simultaneous lipid potential and the best carbon source is glucose, inoculum rate is 15ml and dye concentration is 50ppm for maximum lipid accumulation. FTIR analysis was done for functional group identification and GC-MS analysis was performed to obtained lipid profile. The results showed that algal strain SW has potential to accumulate different fatty acid compounds. The most recurring lipid compounds include octadecanoic acid, hexadecanoic acid, oleic acid and linoelaidic acid. The study would be useful to tackle two growing environmental concerns i.e., water pollution and fossil fuel burning.

Keywords**:** Algae, Lipid Accumulation, Degradation, Azo Dye

EFFICACY OF BIO-ACTIVATED IRON COATED UREA FOR IRON BIOFORTIFICATION OF MAIZE UNDER POT TRIAL

Sammia Ghazanfar[1], Azhar Hussain[1], Maqshoof Ahmad [1], Abubakar Dar[1]

[1]Department of Soil and Environmental Sciences, Institute of Soil and Water Resource, The Islamia University of Bahawalpur, Pakistan,63100

*Email: samiaghazanfar389@gmail.com

ABSTRACT

Agriculture is a key to meeting the challenge of supplying food to the ever-emergent population with the development of green revolution. Unfortunately, agricultural policies mainly focus on the profitability of farmers and industries and have never been delimited with major target to promote the health of human beings. In this regard application of bioactivated iron coated urea not only increase the availability of N by reducing N loses but also increase iron biofortification in maize crop by increasing its solubility. Efficacy of bio- activated iron coated urea for iron biofortification of maize was evaluated for increasing Fe availability in maize grain and yield under pot trial. Data of growth, physiological attributes and yield parameters was recorded and analyzed by using standard statistical protocols. From pot trial results it was analyzed Bacteria + OM + Iron oxide coated urea showed more significant results as compared to others followed by Bacteria + OM + Fe ash coated urea while control where no fertilizer was applied not improve plant growth efficiently. Maximum increase in shoot dry weight (36.4%), shoot fresh weight (39%), relative water content (38.01%) was observed by Bacteria +OM +Iron ash coated urea. Root length (37.34%), shoot length (38.87%), root fresh weight (36.79%), root dry weight (38.09%), SPAD value (36.28%), membrane stability index (37,81%) and N (37.33%), P (36.06%), K (38.06), Zn (36.98%), Fe (37.81%) in grain was maximum by Bacteria + OM + FeO coated urea. Similarly maximum increase in N, P, K, Zn and Fe was observed in maize straws.

Keywords: Biofortification, Iron Coated Urea, Maize

ISOLATION AND CHARACTERIZATION OF BACTERIA FROM LENTIL TO IMPROVE ITS YIELD

Sabiha Kanwal [1], Arshad Nawaz Chaudhry [1]*, Rimsha Sadaf [1], Tajwar Alam [2], Muhammad Noman Rafiq[1], Muhammad Ikram[1]

[1] Institute of Soil and Environmental Science, PMAS Arid Agriculture University. Rawalpindi 46000, Pakistan
[2] Institute of Hydroponic Agriculture, PMAS Arid Agriculture University, Rawalpindi 46000, Pakistan

*Email: arshadnawaz@uaar.edu.pk

ABSTRACT

Lentil is among the leading pulse crops containing around 30 percent protein in its seed. Plant-microbe interaction in rhizosphere is determinant of soil fertility, while the presence of beneficial bacteria in vicinity of roots stimulates plant growth. Objectives of the current study was to isolate, characterize and identify potential bacterial strains among the lentil nodulating microflora and to assess rhizobacterial impact on nodulation, N_2-fixation and yield under greenhouse and field conditions. On the bases of 16SrRNA gene sequencing, purified isolate (bacterial strains) was identified as, *Rhizobium tropici* LE-15*, and Rhizobium esperanzae* LE-4 holding optimum plant growth stimulating attributes such as Phosphorous solubilization, Auxin, Indole Acetic Acid, and Siderophore production at various ranges. Various parameters, viz., nodulation, biomass, N2-fixation, and grain yield of lentil was recorded while testing these bacteria isolates efficacy under greenhouse and field condition on lentil crop. In both conditions, treatment with bacterial strains inoculation showed better results as compared to control (uninoculated) treatments. Inoculants (strains LE-15 and LE-4) when applied in soil improved crop growth attributes and N_2 fixation. An increase in crop growth attributes depicts the potential of these strains in crop production. Therefore, it is recommended to use LE-15 and LE-4 bacterial strains to enhance lentil production.

Keywords: Lentil; *Rhizobium*; nodulation; bacterial strains; soil fertility; yield

COMPARATIVE EFFECTS OF BIO-PRIMING AND OSMO-PRIMING TO MODULATE DROUGHT STRESS IN WHEAT (*TRITICUM AESTIVUM L.*)

Sanaullah Yasin[1]*, Sonia Ihsan[1], Ghulam Abbas Narejo[2], Muhammad Asif Shehzad[3], Nosheen Mirza[1], Abid Mahmood[4] and Muhammad Qasim[5]

[1]Department of Soil and Environmental Sciences Ghazi University, Dera Ghazi Khan 32200, Pakistan
[2]Government Degree College, Therhi, Khaipur Mirus 66160, Sindh Pakistan
[3]Department of Agronomy, Muhammad Nawaz Shareef University of Agriculture, Multan, Pakistan
[4]Department of Environmental Sciences and Engineering, Government College University Faisalabad, 38000, Pakistan

*Email: syasin@gudgk.edu.pk

ABSTRACT

Drought is a major environmental problem that causes plants to have reduced germination, lowered development, and decreased yields. The objective of the current study is to determine where the application of different priming media concentrations and durations can increase wheat's (*Triticum aestivum* L.) ability to survive under drought stress. The key objective of priming was to trigger a rapid germination process, which ameliorates the drought and improves uniform germination. Two separate experiments were conducted; one was a screening experiment under gnotobiotic conditions to evaluate germination parameters by treating seed with priming media, while the second was in the field to measure growth and yield parameters. The results of all lab parameters (imbibition capacity, germination percentage, germination index, mean germination time, and Final germination time) showed significant results in T_7 (24-hour priming duration). The pot experiment demonstrated that Relative water content, Chlorophyll a, Chlorophyll b, and hydrogen peroxide significantly increased in T_4 (microbial strain (*Bacillus subtilis)* with a combination of potassium chloride). The results of the experiments demonstrated that all parameters in the pot and laboratory experiment showed a positive response. The results of this study concluded that priming of wheat genotypes with a combination of microbial strains (*Bacillus subtilis*) is recommended for synchronized germination, growth, and yield under drought conditions. However, Osmo priming potassium chloride with a microbial strain also significantly improved all parameters.

Keywords**:** Drought, Bio-Priming, Wheat, Germination, Yield

MODIFIED SMECTITE AS ADSORBENT OF AFLATOXIN B1

Ahmad Khan[1,2*], Mohammad Saleem Akhtar[1], Khalid Saifullah Khan[1], Saba Akbar[1,2], Youjun Deng[2]

[1] Institute of Soil and Environmental Sciences, PMAS-Arid Agriculture University, Rawalpindi, Pakistan
[2] Department of Soil and Crop Sciences, Texas A&M University, College Station, Texas, USA

*Email: ahmadk78@gmail.com

ABSTRACT

Aflatoxins are toxic metabolites of Aspergillus that occur as contaminant in animal feed and human food. Natural smectites are effective binders for aflatoxin in aqueous solutions but have limitations in the in-situ gut environment due to interference and competition of biomolecules. The main objective of the present study was to modify well-characterized indigenous bentonite structure by pillaring and cation exchange to enhance aflatoxin B1 adsorption capacity and selectivity. Smectite was pillared with Al and Al-Fe polycations or saturated with Ca, Mg, Zn, or Li. Structural changes in smectites with or without heat treatment were determined using X-ray diffraction and Fourier-transform infrared spectroscopy. Equilibrium aflatoxin B1 adsorption to the smectites was measured in aqueous solution and in simulated gastric fluid. Pillaring with the polycations expanded smectites in the *z*-direction to 18.6 Å and the expansion was stable after heating at 500°C. Changes in the Al–OH–Al infrared bands in the stretching region supported the formation of pillared clays. The unheated Al- and AlFe-pillared smectites adsorbed significantly more aflatoxin B1 from an aqueous suspension than did unpillared clay. In both water and simulated gastric fluid, heat treatment decreased aflatoxin B1 adsorption to pillared smectites. Ca-saturated smectite showed the greatest aflatoxin B1 adsorption, 114 g kg^{-1}, from aqueous suspension after 400°C heat treatment. The Zn-, Mg-, and Li-saturated smectites showed maximum aflatoxin adsorption of 107, 93, and 90 g kg^{-1}, respectively, after 200°C heat treatment. Pillared smectites effectively adsorbed aflatoxin B1 from aqueous suspension, but Ca- and Zn-saturated smectites after heat treatment might improve the selectivity of smectites for aflatoxin B1 over pepsin and enhance the efficacy of smectite as a feed additive.

Keywords: Aflatoxin B1, Pillaring, Bentonite, Adsorption, Clay Minerals

HEAT INDUCED STRUCTURAL CHANGES IN PALYGORSKITE, SEPIOLITE AND SMECTITE FOR AFLATOXIN B1 ADSORPTION

Saba Akbar[1,2*], Mohammad Saleem Akhtar[1], Ahmad Khan[1,2], Youjun Deng[2]

[1] Institute of Soil and Environmental Sciences, PMAS-Arid Agriculture University, Rawalpindi, Pakistan
[2] Department of Soil and Crop Sciences, Texas A&M University, College Station, Texas, USA

*Email: syedasaba101@gmail.com

ABSTRACT

Smectites are effective binder for aflatoxin in aqueous suspensions but are suspected to adsorb essential nutrients, vitamins, and proteins in the gut non-selectively. Palygorskite and sepiolite act as molecular sieve and may serve as alternatives or complements to smectites. The specific objective was to determine heat treatments effect on structural characteristics of palygorskite (Pal_PK, Pal_CN), sepiolite (Sep) and smectite (Sm-37GR) and consequent effect on aflatoxin B1 adsorption and selectivity. The selected clay minerals were heat treated at 200, 400, 500 and 600°C and characterized for any phase and structural changes by X-ray diffraction and IR. Comparative aflatoxin B1 adsorption was determined in aqueous and simulated gastric fluid as the equilibrium solutions. The clay structures irreversibly collapsed in all the clays with heating at 400°C and above with zeolitic and coordinated water disappearing progressively in the fibrous clays. The smectite had the greatest maximum aflatoxin B1 adsorption of all the clays. The estimated adsorption capacity of the clays for aflatoxin B1 followed the trend: Sm-37GR > Pal_PK > Sep > Pal_CN. Sepiolite had greater binding strength for aflatoxin B1 than all the other clays. With intact clay structure heating induced negligible effect on aflatoxin B1 adsorption by the fibrous clays while in the smectite Sm-37GR adsorption increased with heating at up to 250°C. Heat induced folding and structural collapse that had occurred at 400°C caused an abrupt decline in aflatoxin B1 adsorption irrespective of the clay type. In the simulated gastric fluid, the decline in aflatoxin B1 adsorption due to pepsin competition was 25-30% in the sepiolite, 52-60% in the smectite while it remained unaffected in the palygorskites. Palygorskite and sepiolite though have had lower maximum adsorption capacity for aflatoxin B1 than the smectite but also have had lower adsorption for pepsin, therefore, may both prove effective as feed additives.

Keywords: Adsorption, Aflatoxin B1, Fibrous Clays, Heat Treatments, Heat Activation

UTILIZING *STREPTOMYCES SP*. AS AN ECO-FRIENDLY CATALYST FOR SLUDGE BIOCONVERSION: AN INNOVATIVE APPROACH IN WASTE BIO-REFINERY

Sana Akbar[1], Azeem Khalid[2], Muzammil Anjum[1]*

[1]Environmental Sciences, Institute of Soil and Environmental Sciences, PMAS-Arid Agriculture University, Rawalpindi, Pakistan

*Email: sana.akbar712@gmail.com, muzammilanjum@uaar.edu.pk

ABSTRACT

Developing bio-lipids from waste has increased interest in finding a different sustainable energy source to fulfill future energy demands. Due to the significant organic content in sludge which might be converted into valuable goods, the industrial sludge collected from wastewater treatment plants showed considerable potential as a feedstock for biofuel generation. *Streptomyces sp.* was used as a potential oleaginous bacterium for lipid production, leading to biofuel via transesterification. The pre-isolated oleaginous *Streptomyces sp*. from the National Regional Research Laboratory was used which can store bio-lipids by utilizing sludge as a substrate under diverse reactor conditions. To obtain the necessary sludge sample for experimentation, the sample was collected from the CDA sewage treatment plant in I-9 Islamabad. The initial physicochemical characterization of various sludge-related parameters was then carried out. The optimization phase focused on several reactor conditions, such as incubation time (24 to 96 h), inoculation rate (5 to 15%), pH levels (4 to 9), temperature (25 to 40°C), agitation (0 to 250 RPM), nitrogen sources (using yeast, urea, ammonium chloride, and ammonium nitrate) and carbon sources (using glucose, sucrose, starch, and dextrose). Cell dry weight was calculated using oven dry method and the chloroform-methanol extraction method was used to extract lipids. The experiments were carried out in a continuous shaking single batch aerobic bioreactor using sludge to assess lipid accumulation within the cells of the pre-isolated oleaginous strain after determining the optimal conditions which illustrated 40 % of lipid accumulation further, Fourier-transform infrared spectroscopy analysis was done for functional group identification and then Gas chromatography-mass spectrometry for fatty acid identification in *Streptomyces sp.* additionally, the collected lipids were transformed into biodiesel by the transesterification process. The results of this study will provide insight into *Streptomyces sp.* ability to produce biofuels using sludge as a substrate. They will also contribute to the reduction of sludge waste, yielding additional environmental benefits.

***Keywords*: *Streptomyces sp.;* Bio-lipids; Sludge; Degradation; Transesterification**

SYNERGISTIC EFFICACY OF ASCORBIC ACID AND RHIZOBACTERIA: A FLOURISHING ALLIANCE FOR ENHANCING SPINACH GROWTH IN SALINE SOILS

Arbab Shehzadi[1], Muhammad Zafar-ul-Hye[1*], Sajid Masood[1], Muhammad Mueen Akram[1], Zainab Tahir Shah[1], Shiza Manzoor and Sheraz Khadim[1]

[1]Soil Microbiology and Plant Nutrition Research Group, Department of Soil Science, Faculty of Agricultural Sciences and Technology, Bahauddin Zakariya University Multan, Pakistan

*Email: zafarulhyegondal@yahoo.com

ABSTRACT

This study delves into the escalating challenge of salinity, a prominent abiotic stressor exerting a substantial adverse impact on global agricultural landscapes. It is estimated that, by the year 2050, a staggering 50% of the world's arable land will succumb to the deleterious effects of salinity. The mechanisms through which salinity exerts its influence on plant growth are multifaceted, disrupting soil osmotic potential, water permeability, and inducing specific-ion toxicities and nutrient imbalances. Of particular significance is the realization that the salinity threshold for most crops hovers around $\leq$2.5 dS m^{-1}, a threshold that, when surpassed, leads to diminished productivity, and hindered growth of essential vegetable and cereal crops. This research specifically homes in on the consequences of salinity, set at 5 dS m^{-1}, on spinach plants. It investigates the potential ameliorative effects of exogenously applied ascorbic acid (AsA) at two distinct concentrations, 150mg/L and 300mg/L paired with two beneficial bacterial strains, namely *Bacillus cereus* and *Lysinibacillus fusiformis*. The outcomes of this comprehensive study shed light on a myriad of plant parameters crucial for assessing growth and resilience under saline conditions, including plant height, yield, root and shoot fresh weights, chlorophyll content, electrolyte leakage, and concentrations of essential nutrients such as phosphorous, potassium, and nitrogen. Intriguingly, the results spotlight the significant efficacy of AsA, particularly at the higher concentration of 300 mg/L, in bolstering various facets of plant growth. The treatment combination of *Bacillus cereus* + AsA 300mg/L emerges as particularly promising, demonstrating a remarkable 40% increase in yield under saline stress. This surpasses the performance of other combinations, including *Bacillus cereus* + AsA 150mg/L and Ascorbic acid 300 mg/L alone, which exhibit commendable increases of 30% and 25%, respectively, compared to the control. Additionally, positive trends are observed in plant height as well as shoot fresh and dry weights. These findings underscore the potential of strategic interventions, such as the application of AsA and beneficial bacteria, in fortifying plants against the debilitating impacts of salinity stress. They provide valuable insights into the development of sustainable agricultural practices aimed at ensuring food security in the face of escalating environmental challenges.

Keywords: *Salinity, environment, soil health*

ADVANCING MICROALGAE BASED BIO-REFINERY AND BIOPROCESS EVALUATION

Sumera Arshad[1], Tajwar Alam[2]*, Beenish Afsheen[1], Summaia Arshad[3]

[1]Department of Plant Sciences, Quaid -i-Azam University Islamabad Pakistan, 45320
[2]Institute of Hydroponic Agriculture, PMAS- Arid Agriculture University Rawalpindi, Pakistan
[3]Department of Chemistry, Rawalpindi Women University, Pakistan

*Email: tajwaralam@uaar.edu.pk

ABSTRACT

Microalgae is a broad group of single-celled photosynthetic microorganisms became highly promising and environmentally friendly alternative for producing various bio-products such as biofuels, specialized chemicals, and bio-fertilizers. The pressing need to shift towards more environmentally friendly and renewable energy sources has emerged in recent times because of the growing risks associated with effects of climate change and the depletion of fossil resources. Conventional energy sources, which are mostly reliant on fossil fuels, have limited resources in addition to increasing greenhouse gas emissions. Microalgae offers a technique to produce sustainable energy that may significantly reduce the energy sector's carbon footprint because of their capacity to trap carbon dioxide (CO_2). Microalgae are the focus of extensive scientific research due to their adaptability and capacity to generate a diverse range of products. These bio-products, which include high-value chemicals, biodiesel, biogas, and bioethanol have the potential to simultaneously address several global concerns. Moreover, conducting a thorough life cycle analysis (LCA) is crucial in evaluating the sustainability of bio-refineries that rely on microalgae. This include assessing their environmental impact, carbon emissions, water consumption, and land needs. These assessments are essential for comprehending the overall viability and ensuring that microalgae-based bio-refineries can fulfill the criteria for environmental sustainability. Bio-refineries that utilize microalgae have promise in tackling urgent contemporary issues, including energy security, ecological sustainability, and insufficient resources.

Keywords: Microalgae, Bio-refineries, Biofuels, Microalgae, Sustainable Energy

DEVELOPMENT OF LOW-COST MICROBIAL INOCULANTS FOR SUSTAINABLE AGRICULTURE WITH INCREASED SHELF LIFE

Humera Aslam Awan [1,2,3*], Muhammad Irfan ul Haq [2] and Kauser Abdulla Malik[3]

[1]Dehqan Biosciences SMS Ltd. Lahore, Pakistan.
[2]Centre of Excellence in Agriculture and Biotechnology, Auriga Group of Companies, Multan Road, Lahore, Pakistan.
[3]Kauser Abdulla Malik School of Life Sciences, Forman Christian College (A Chartered University), Lahore, Pakistan.

*Email: awanhumera@gmail.com

ABSTRACT

The progressively increasing demand for organically grown food has resulted in the surge of organic farms. This has led to the augmented use of plant-beneficial microbial inoculants as eco-friendly strategy alternatives to chemical agro-inputs, but the constraint is cost and shelf-life of formulations. Optimization for low-cost formulations (liquid, solid wet, and dry formulations) with increased shelf life of bacteria can be opted as a feasible alternative. Utilization of soil and plant associated microorganisms to develop various inoculants ranging biofertilizers, biostimulants, biofungisides and bioinsecticides has been done. In this regard, Liquid inoculants with several industrial-grade polymeric additives, surfactants, and adjuvants were tested for shelf-life stability. Formulations with 0.1% carboxymethylcellulose, 1% polyvinylpyrrolidone (PVP) and XMPA (surfactant) supported survival of bacteria stored at 30±2°C. Solid wet formulations were tried using two approaches, Alginate beads are excellent to sustain the microbes but were not effective in releasing trapped microbes and this method is relatively costly. On the other hand, the use of agricultural waste for fermentation and formulation is a sustainable and eco-friendly approach. Rice husk and press mud (sugar industry waste) were used for the development of biofilm-based solid wet formulations, but it was challenging for field application. The powder-based dry formulations (wet-able) are excellent to retain microbial count for extended periods and at high temperatures. Spray drying with the addition of whey powder was found effective, but it requires specific equipment and is costly, while air drying is a low-cost and effective method. Wet-able powder (WP) air dried bio fungicide formulation was tested to preserve bacterial count even after 3 years. Hence WP is the most viable formulation due to cost, survival of microbes, and easy field application. Since this method is being successfully used for microbial inoculants (biofertilizer, biofungicide, bioinsecticide and biostimulant) at industrial level.

Keywords: formulation; alginate beads; wet-able powder; sustainable agriculture; adjuvents

CHARACTERIZATION AND COATING OF ZN SOLUBILIZING ISOLATES ON UREA TO IMPROVE THE EFFICIENCY OF ZINC

Muhammad Fasih Ullah[1]*, Azhar Hussain[1], Maqshoof Ahmad[1], Asad Bashir[1]

[1]Department of Soil Science, Faculty of Agriculture and Environment, The Islamia University of Bahawalpur, 63100 Bahawalpur

*Email: fasihmalik2018@gmail.com

ABSTRACT

Zinc (Zn) is an important micronutrient for the proper growth and development of all organisms. About 70% of soil in Pakistan is Zn deficient due to less organic matter, high pH, Ca, Mg, Na carbonates, waterlogged and saline soils thus we need to add Zn containing fertilizers in soil. $ZnSO_4$ is most common and expensive Zn source used in Pakistan containing 33% of Zn thus farmers are reluctant to use it, while ZnO being cheaper source contains 80% of Zn contents but in insoluble form. Zn solubilizing rhizobacteria plays an important role in increase of the bioavailability of Zn in soil. Coating of ZnSB on urea is a new cost effective, eco-friendly, and feasible approach, hypothesized as a possible solution to enhance growth, physiology, yield and quality of crop because they can release Zn from its insoluble compounds (ZnO, $ZnCO_3$ and $Zn_3(PO_4)_2$). Keeping in view of the above discussion, pot experiment under CRD design was conducted to evaluate the Zn release in soil by isolating and charactering bacterial isolates for their Zn solubilization potential. Out of 24 strains, four show the best promising results. ZnSB and zinc ash were coated on urea and compared with the recommended Zn (ZnSO4) and control (no Zn) using 8 treatments. Different treatments showed different responses with respect to Zn release in soil. After 15 days, chemical parameters of soil were carried out to check the zinc release in soil. Significant results were shown by bacterial strain IUB-38 coated urea that significantly improved the soil zinc concentration (9%), soil nitrate nitrogen (11%) than the treatment with recommended ZnSO4 dose (2%) and control. Same analysis of soil at 30th day were performed and showed the soil zinc concentration (26%), soil nitrate nitrogen (25%) than the treatment with recommended ZnSO4 (8%) and control with no Zn source. Similarly, inoculation with bacterial strains IUB-96 and IUB-93 significantly improved the soil zinc concentration, soil nitrate nitrogen content by 6%, 7% and 8%, 9% respectively compared to control. The maximum increase in Zn bioavailability observed at 45th day by IUB-38 that showed the soil zinc concentration (38%), soil nitrate nitrogen (32%) than the treatment with recommended ZnSO4 (15%) and control (no Zn). This study concluded that the use of effective ZnSB as bio-fertilizer increase the Zn solubilization in soil, improve plant nutrition. Thus, this approach is less laborious, less costly and ecofriendly as compared to the application of Zn and urea separately.

***Keywords*:** Zn solubilizing bacteria, Zn coated urea, Zn uptake, Zn solubility

BROAD SPECTRUM PLANT GROWTH PROMOTION POTENTIAL EXHIBITED BY *ENTEROBACTER* SP. AF-31 NATIVE TO CHAMMANKOT, DISTRICT DHIRKIOT, AJK

Afshan Majeed*[1, 2], M. Kaleem Abbasi[1, 3], Sohail Hameed[2], Fathia Mubeen[2], Asma Imran[2], Majid Mahmood Tahir[1]

a Department of Soil and Environmental Sciences, University of the Poonch, Rawalakot, Azad Jammu and Kashmir, Pakistan
b National Institute for Biotechnology and Genetic Engineering (NIBGE), P.O. Box 577, Faisalabad, Pakistan
cUniversity of Azad Jammu and Kashmir

*Email: afshanmajeed@upr.edu.pk

ABSTRACT

As the excessive use of chemical fertilizers resulted in a remarkable increase in crop yield but drastically reduced soil fertility; increased the production cost, food prices, and carbon footprints; and depleted the fossil reserves and soil health with huge penalties to the environment and ecological sustainability. Hence the replacement of chemical fertilizers with biological fertilizers has attracted widespread attention as an environmental protection strategy. This study was envisaged for (a) the isolation, characterization and identification of a potent plant root associated beneficial bacteria from the soil samples collected from different sites of sub-division Dhirkot, AJK using biochemical and molecular techniques, (b) analysis of bacterial diversity using polyphasic techniques, (c) documenting exo and endo-rhizospheric bacterial interaction in sunflower using different microscopy techniques *i.e*., Transmission Electron microscopy and Confocal Laser scanning Microscopy and (d) sunflower plant inoculation and evaluation of potential plant growth promoting rhizobacteria under controlled conditions and field environment to select the candidate bacteria for inoculum production of sunflower. A potential *Enterobacter* sp. AF-31 was isolated from Chammankot, Mountain region of Dhirkot (subdivision), Azad Jammu and Kashmir. The bacterium produced 24.67µgmL^{-1} indole-3-acetic acid, showed 137.84nmoles mg^{-1} protein h^{-}1 nitrogenase activity and solubilized 40.11µgmL^{-1} insoluble phosphorus and showing significant decrease in pH (from 7 to 4.74) due to the production of oxalic acid, malic acid and gluconic acid. The *Enterobacter* sp. AF-31 was metabolically diverse (utilized 68 out of 96carbon sources), resistant to many antibiotics, and showed antagonistic activity against *Fusarium oxysporum.* Inoculation with this bacterium to sunflower grown in soil-free (hydroponic) medium, sterilized soil and under natural field conditions at two locations *i.e*., Rawalakot, Azad Jammu and Kashmir, and Faisalabad, Pakistan showed a significant increase in sunflower growth, yield and oil contents and achene NP uptake compared with non-inoculated control treatments. *Enterobacter* sp. AF-31 was able to colonize on sunflower roots forming a biofilm like structure; documented through *yfp*-labelling by confocal laser scanning microscopy as well as through immunogold labeling coupled with transmission electron microscope.

This study concludes that the *Enterobacter* sp. AF-31 containing multiple plant growth promoting traits can be a potential candidate for production of biofertilizer for sunflower crop to enhance yield with reduced application of chemical (NP) fertilizers hence reducing the chemical fertilizer pollution crises.

Keywords: PGPR, Colonization potential, Sunflower

EFFECT OF PLANT GROWTH PROMOTING RHIZOBACTERIA (PGPR) AND BIOSTIMULANT (L-TRYPTOPHAN) ON THE GROWTH AND YIELD OF ONION *(ALLIUM CEPA)*

Iqra Akram[1]*, Fatima Aamir[1], Husna Ijaz[1] and Rehman Ali[2]

[1] Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad 38000, Pakistan
[2] Saline Agriculture Research Center, Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad 38000, Pakistan

*Email: iqraakram33g@gmail.com

ABSTRACT

In Pakistan, onion production decreases due to inadequate soil management, low soil quality, drought, agricultural inputs, climate change and lack of canal water. To increase onion production, there are several chemical and physical methods in practice which effect the soil health as well as environment. The biological amendments are more reliable and eco-friendly than chemical amendments. Use of plant growth promoting rhizobacteria (PGPR) and L-Tryptophan considered as an important potential approach to enhance the growth of onion. Biological amendments have long-lasting effects on soil health but have not been widely used, because of their slow-releasing effect. It is also an alternative approach to minimizing the usage of chemical fertilizers and their harmful environmental impacts. A pot experiment was conduct at the greenhouse of University of Agriculture, Faisalabad to check the effectiveness of biological amendments 'PGPR and Biostimulant (L-tryptophan) on the onion yield under a complete randomized design (CRD). Following treatments Control (no amendment), PGPR (IAR_1+IAR_2), Biostimulant, Biostimulant + PGPR (IAR_1+IAR_2) were applied along with four replications. The outcomes of this experiment Reveled that impact on various agronomic parameters, including fresh weight, dry weight, bulb diameter, and plant height. Specifically, the treatment incorporating both PGPR and the biostimulant (L-tryptophan) exhibited significantly higher values compared to other treatments. This suggests a synergistic effect between PGPR and L-tryptophan in enhancing the growth-related characteristics of onion plants. In addition to agronomic parameters, the physiological parameters, such as chlorophyll contents (a, b & c) also demonstrated significant variations among treatments. The treatment containing PGPR showed notably higher levels in chlorophyll contents compared to alternative treatments. In conclusion, the incorporation of PGPR, either alone or in combination with L-tryptophan, emerges as a beneficial strategy for optimizing the growth and yield of onion crops. the potential of PGPR as a valuable tool in reducing reliance on chemical fertilizers.

Keywords: PGPR, L-tryptophan, Onion, Agronomic Parameters, Physiological Parameters, Chemical Parameters, Sustainable Agriculture, Alternative Fertilization.

ISOLATION AND CHARACTERIZATION OF ZINC SOLUBILIZING BACTERIA FROM ONION FOR DEVELOPMENT OF NEXT GENERATION BIOFERTILIZER

Durshana Khan Khanzada[1,2*] Ghulam Murtaza Jamro[1], Inayatullah Rajpar[1], Sair Sarwar[2]

[1]Department of Soil Science, Sindh Agriculture University Tandojam, Pakistan
[2]Directorate of Agriculture Extension, Tando Allahyar, Government of Sindh, Pakistan
[3]Land Resources Research Institute, National Agricultural Research Center

*Email: durshanakhan@gmail.com

ABSTRACT

Zinc (Zn) is an indispensable micronutrient for both plants and animals. Zn deficiency is a serious problem worldwide which results in poor nutritional quality and crop yield. Microorganisms convert insolubilized forms of nutrients like N, P, K and Zn to plant available forms. Application of Zinc Solubilizing Bacteria (ZSB) is a potential strategy to convert insoluble soil Zn into soluble Zn. This study assessed potential of plant growth promoting rhizobacteria (PGPR) found in 20 soil samples collected from major onion growing District Tandoallahyar, Sindh. Out of 60 rhizobacterial isolates, 15 rhizobacterial isolates exhibited multiple PGP (plant growth promoting) traits. Out of the 15 isolates, seven isolates exhibiting the most promising PGP traits were found. The D2(2) isolate showed maximum solubilization of phosphate up to 2900 mg L^{-1}. Maximum zinc solubilizing efficiency (ZSE) and IAA production was observed in isolate D4 (3) including 1030 and 50.4 mg L^{-1} respectively. Out of nine isolates, five isolates D4(3), D8 (3), D11 (2), D11 (3) and D14 (1) showed promising and positive in exopolysaccharides EPS, nitrogen fixing, NH_3 production and catalase activity. Maximum cellulase activity (508 mg L^{-1}) was observed in D8 (3) and pectinase (3500 mg L^{-1}) and amylase (1918 mg L^{-1}) activities were observed in isolate D4 (3) respectively. It was concluded that these isolates could be helpful to develop next generation biofertilizer for onion production.

Keywords: Zinc, biofertilizer, Zinc solubilizing bacteria, onion.

ALLEVIATE DROUGHT EFFECTS IN FIELD CROPS OF POTHWAR BY INOCULATION OF *RHIZOBIUM* AND PGPRS; IN FUTURE-PROSPECTS

Azhar Mahmood Aulakh[a], Mohammad Yunus[a], Saefraz Ahmad[a], Obaid ur Rehman[a], Ghulam Qadir[b], Tariq Sultan[c], Motsim Billah[d]

[a] Soil and Water Conservation Research Institute, SAWCRI, Chakwal, Pakistan
[b] Department of Agronomy, PMAS Arid Agriculture University, Rawalpindi, Pakistan
[c] Land Resource Research Institute, NARC, Islamabad, Pakistan
[d] Office of Research, Innovation and Commercialization, Rawalpindi Women University, Rawalpindi, Pakistan.

*Email: azuaulakh@gmail.com

ABSTRACT

Prolong and severity drought spell during growing season of field crops especially under rain fed conditions of Pothwar affects growth and productivity due to impact of ongoing climate change and is likely to enhance day by day directing to worldwide food insecurity. Drought stress exhibits worse effects on crop plants such as oxidation due to exorbitant accumulation of reactive oxygen species (ROS) under lower CO_2 concentration, which decreases photosynthetic rate. A few mandatory assimilation and alleviation approaches are needed to manage against drought stress. Promising bacterial strains could play pivotal role to mitigate abiotic stress is considered most effective approach. The capability of field crop plants to cope drought stress needs to associate bacterial strains for enhancement of net return and exhibit drought stress resistance. Bacterial strains capable to colonize with crop roots in rhizosplane and rhizospheric soil and secrete several growth promoting phytohormonal enzymes, exoploysaccharides (EPS) and 1-aminocyclopropane-1-carboxylat (ACC) deaminase liberation, volatiles composite induction, osmolytes and antioxidant compounds accumulation as well as remodeling of root architecture and growth dynamics to alleviate different stresses such as biotic and biotic. The present review concerns about results of most relevant conducted experiments at research farm of Soil and Water Conservation Research Institute as well as globalized studies to mitigate drought stress through many physiological and chemical changes occurred by most efficient isolated bacterial strains of PGPRs and Rhizobium in single and in consortium to field crops plants.

***Keywords*:** Drought stress, Field crops, Pothwar, Rhizobium, PGPRs

ENHANCING AEROBIC BIOREACTOR FOR OPTIMAL WASTE TO BIOLIPID CONVERSION WITH OLEAGINOUS BACTERIA

Rida Abbasi[1], Shahid Mahmood[2], Azeem Khalid[*]

[1]Institute of Soil and Environmental Sciences, PMAS-Arid Agriculture University, Rawalpinid, Pakistan

*Email: ridaabbasi322@gmail.com

ABSTRACT

In current scenario where energy sector is mostly dependent upon fossil fuels, adoption of alternative renewable energy resources is very essential to minimize GHGs emissions and dependence on those exhaustible sources. Lipid based biofuel production is one of the best alternatives where microorganisms can be used as lipid factories, but high-cost substrates are barrier in industrialization of biofuel. This study was designed to estimate the potential of oleaginous bacteria to produce Biolipids utilizing food processing waste as substrate. Pre-isolated OB strain B104, isolated from de-oiled olive waste of BARI was tested for lipid accumulation potential using citrus peels (citrus limetta) as a substrate. After initial characterization, strain was subjected for optimization experiments on substrate and series of optimization treatments like inoculation rate, substrate concentration, pH, temperature, revolution per time, carbon and nitrogen sources were applied. Most suitable combination for strain was: 5ml inoculation rate using 1g substrate, at temperature 30 oC under normal shaking condition of 150r/min, sucrose as carbon and yeast as nitrogen source and pH 6. Overall, in different treatments, strain B104 indicated lipid accumulation potential more than 70% at 96 hour of incubation time. The aerobic bioreactor was designed under optimized conditions to estimate LAP% and waste degradation in B104. The lipid production of 77.9% and decrease in pollution load was also observed in terms of COD% and VS% removal more than 50%. Further, FTIR analysis was performed for functional groups identification and then GC-MS analysis which confirmed the presence of various fatty acids, adipic acid as most recurrent one than oleic acid, plamitic acid and vaccenic acid in its cell using citrus limetta as substrate. Results of study indicated the dual benefit of lipid accumulation for biofuel production to meet energy needs along with waste degradation.

***Keywords*: Oleaginous bacteria; FPW; citrus peels; bio-lipids; biofuel.

ENHANCING MAIZE PRODUCTIVITY IN SALINE CONDITIONS THROUGH THE USE OF HALOTOLERANT PGPR IN CONJUNCTION WITH COMPOST

Hafiz Tanvir Ahmad[1,6*], Muhammad Iqbal[2], Usman Aziz[3], Azhar Hussain[4], Muhammad Abubakar Dar[5], Tanveer ul Haq[6], Noor ul Ain[7] and Fariha Amin[8]

[1,3]National Cotton Breeding Institute, the Islamia University of Bahawalpur
[4,5]Department of Soil Science, the Islamia University of Bahawalpur
[6]Department of Soil Science and Environmental Sciences, MNS-UAM.
[7,8]Department of Soil Science, University of Haripur KPK, Pakistan

Email: hafiz.tanvir@yahoo.com

ABSTRACT

In Pakistan, the pervasive issue of salinity poses a significant challenge to agriculture, particularly in the Southern Punjab region where adverse environmental conditions exacerbate the problem. Addressing this concern, the application of halotolerant plant growth-promoting rhizobacteria (PGPR) emerges as a potential solution to improve the soil health and crop yield in saline environments. This study aimed to assess the efficacy of halotolerant PGPR, both individually and in combination with compost, as a cost-effective and efficient strategy for mitigating the impact of salinity on maize cultivation. A pot experiment was conducted with four distinct treatments: a control group, compost application at a rate of 400 kg per hectare, PGPR inoculum, and a combined treatment of PGPR with compost. The experimental layout adhered to a randomized complete block design. Comprehensive data, encompassing parameters related to growth, physiology, and yield, were systematically recorded throughout the experiment. Statistical analysis using statistix 8.1 was applied to interpret the findings. The results unveiled the positive impact of both PGPR and compost when applied individually, demonstrating enhanced growth and yield in maize under saline conditions. Notably, the combined application of PGPR with compost exhibited even more promising outcomes, indicating a synergistic effect on mitigating the constraints posed by salinity. This suggests that the integration of halotolerant PGPR with compost holds great potential as a holistic and effective approach to ameliorate the challenges associated with salinity in agricultural soils. Further exploration and optimization of this combined strategy could pave the way for sustainable and resilient crop production in saline-prone regions.

Keywords: *Salinity, Halotolerant PGPR, Maize, Soil health, Synergistic effect*

IDENTIFICATION OF ANTIFUNGAL ACTIVITY AND GC-MS DETECTION OF *AMARANTHUS VIRIDS* AGAINST PHYTOPATHOGENIC FUNGI

Iram Naz Sherazi*[1], Muhammd Akbar[1], Komal Shoukat[2], Noshia Arshad[1], Sair Sarwar[3], Zarrin Fatima Rizvi[2], Tariq Sultan[3], Muhammad Iftikhar[3]

[1]Department of Botany, University of Gujrat, Pakistan
[2]Department of Botany, GC Women University Sialkot, Pakistan
[3]Land Resources Research Institute, National Agricultural Research Center

*Email: iramsherazi6@gmail.com

ABSTRACT

In the present study, antifungal, antibacterial and antioxidant (DPPH free radical scavenging activity) activity of a weed, *Amaranthus viridis* was investigated. Organic solvent extracts of different parts of plant were prepared using *n*-hexane, chloroform and ethyl acetate. Antifungal activity was investigated by utilizing 5, 10, 15, 20 and 25 mg mL^{-1} extract concentration, while antibacterial activity was measured by using 100 mg mL^{-1}. In antioxidants assays 10, 20 and 30 µg mL^{-1} extract was used keeping DPPH as control. In these bioassays, ethyl acetate fraction of leaf exhibited pronounced results in antifungal and antioxidants assays. Ethyl acetate leaf fraction showed 48 % reduction in fungal biomass of *Fusarium oxysporum*, while in other treatments the effect was less pronounced. Ethyl acetate leaf fraction also resulted in creation of maximum inhibition zone where it caused 21 mm inhibition zone against *Pseudomonas syringae.* On the other hand root n-hexane fraction exhibited highest antioxidant potential (24 %). Gas Chromatography Mass Spectrometry (GCMS) analysis was performed on ethyl acetate extract depicting the presence of 09 compounds. Of these, 9 compounds, one compound identified as 1, 2- Benzenedicarboxylic acid, mono (2-ethylhexyl) ester, exhibited maximum peak area as 58.521 %. It was concluded that the biological activities observed during the present investigation were due to this compound that can be harnessed as natural antifungal, antibacterial compound.

***Keywords*:** Amaranthus viridis, Antifungal, GC-MS, Plant pathogenic, Slender amaranth

SIMULTANEOUS DEGRADATION OF CITRUS AND OLIVE WASTE AND LIPID ACCUMULATION BY OLEAGINOUS BACTERIA

Javeeria Iqbal*[1], Azeem Khalid[2]

[1]Institute of Soil and Environmental Science, PMAS Arid Agriculture University, Rawalpindi, Pakistan

*Email: javeeriabba@gmail.com

ABSTRACT

Increasing population and industrialization have led to high energy demand, and this is primarily met through non-renewable energy sources such as fossil fuels. However, considering recent climate changes, fuel security and economics, there is dire need to find alternatives. The present study is aiming at biolipid production from waste through degradation by oleaginous bacteria while simultaneously reducing the load of waste in the environment. This research is intended to overcome this issue and to produce biofuel which may provide a huge economic and environmental benefit. For this study food processing waste was collected from canteen, cafe, outdoor food stalls, National Agricultural Research Center (NARCP) and Barani Agricultural Research Institute (BARI) and pre-isolated strain that are initially isolated from De-oiled olive waste was used in this study. Initial physiochemical characterization was performed of food processing waste by adding 5g of waste in 95ml of distilled water and optimized conditions was maintained of bioreactor. The lipid accumulation potential of pre-isolated bacterial strain was analyzed by doing the bacterial characterization gram staining and catalase activity test which shows bacterial strain NR1 positive in both cases. To increase the lipid production and degradation efficiency different parameters were optimized which increases the lipid rate from 5-10%. Citrus limetta work in less acidic conditions ranges from 6-6.5 while olive pomace work in acidic condition ranges from 4-4.5pH. Optimum results were obtained after 96hrs giving 35.809% lipid from NR1. 2% of the inoculum was used 250ml of slurry. The characterization of parameters including total solids, volatile solids, and fixed solids was examined at 550 °C for 2 h in muffle furnace and chemical oxygen demand was carried out to assess the degradation of waste. COD and VS removal was 59.77% and 51.502% in citrus limetta inoculated with bacterial strain NR1. This study would help to develop environmentally friendly biofuel from food processing waste and also minimizes waste disposal issues in future.

Keywords: *Biolipids; biorefinery; biotreatment; citrus peel; fegradation; olive waste*

IMPROVING PHYTOREMEDIATION POTENTIAL OF WATER HYACINTH USING CHROMATE RESISTANT BACTERIA

Rabia Afzal[1]*, Muhammad Fasih Ullah[1], Wajeeha Attiq[1], Qasim Ali[1], Muhammad Ameen[1], Maqshoof Ahmad[1]

[1]Department of Soil Science, Faculty of Agriculture and Environment, the Islamia University of Bahawalpur, 63100 Bahawalpur

*Email: rabiaafzal13579@gmail.com

ABSTRACT

Human activities have had a significant impact on the world's water resources in recent years due to urbanization and industrialization. Numerous pollutants from various industries are discharged into neighboring ponds. Among these pollutants, heavy metals are persistent, toxic, and non-biodegradable pollutants that negatively impact every type of life's ecological niche. An estimated 1.6 million children succumb to illnesses transmitted through contaminated water annually. Traditional methods of pollutant removal from wastewater are expensive, time-intensive, and detrimental to the environment. Phytoremediation is an emerging green technology that is economically viable. Water hyacinth (Eichhornia crassipes), along with certain other aquatic plants, is a notable hyperaccumulator of metals that aids in the remediation of heavy metal contamination in water. Keeping in view the above discussion, a study was designed to investigate the effectiveness of water hyacinth (*Eichhornia crassipes*) along with heavy Cr(VI) resistant PGPR strains for the remediation of Cr(VI) polluted water. There were four levels of Cr(VI) i.e., 0, 5, 15 and 30 ppm and three treatments. Pots were arranged using the completely randomized design (CRD) under factorial settings. After harvesting analysis of the water and plant for physicochemical and chemical parameters were carried out. The results indicated that Cr(VI) contamination negatively affected the growth and chlorophyll content of water hyacinth and effect was more strong by increasing the concentration of Cr(VI). Bacterial inoculation (M1 and M2) positively affected all the recorder parameters. However, more pronounced results were observed in the case of bacteria strain M1 that significantly improved the shoot length (39%), root length (31%), shoot fresh weight (34%) and root fresh weight (50%) than control at 30 ppm Cr(VI) concentration. Similarly, inoculation with bacterial strains M1 and M2 significantly improved the SPAD chlorophyll value, chlorophyll a, b and carotenoids content by 25%, 31%, 30%, 47% and 20%, 18%, 25%, 48%, respectively compared to respective control at 30 ppm Cr(VI) concentration. Moreover, inoculation with bacterial strain resulted in significant reduction in Cr(VI) concentration of water by 33, and 23%, respectively when compared to control. M1 caused better results compared to M2 strain. With regard to the prospective dimensions of phytoremediation, the application of invasive plant species in phytotechnologies designed to mitigate pollution can undeniably contribute to their sustainable administration in the treatment of wastewater.

Keywords**:** Water hyacinth, Cr resistant Bacteria, water treatment, phytoremediation, Heavy metal

BIOREMEDIATION OF CONTAMINATED SOIL THROUGH CHROMIUM RESISTANT BACTERIA

Natasha Malik*[1], Maqshoof Ahmed[1], Zaffar Malik[1], Azhar Hussain[1], Iftikhar Ahmed[1], Zartasha Malik[1], Muhammad Usama[2]

[1]Department of Soil Science, Faculty of Agriculture and Environment, The Islamia University of Bahawalpur
[2]Chemical and Biological Science, The Islamia University of Bahawalpur

*Email: maliknatasha17@gmail.com

ABSTRACT

The environment and human health are being impacted by the rising toxicity of heavy metals, especially chromium, due to intensified industrial operations. The potential of chromium-resistant bacteria is the focus of this work, which isolates seven effective strains for bioremediation. NM8, NM14, NM28, and NM32 were chosen to undergo metal tolerance testing out of all of these. The chromium minimum inhibitory concentrations (MIC) of NM8 (1400 µg mL^{-1}), NM14 (900 µg mL^{-1}), NM32 (1500 µg mL^{-1}), and NM28 (1100 µg mL^{-1}) were ascertained. Growth, IAA production (19.24 µg mL^{-1}), EPS generation (110.39 µg mL^{-1}), and lactic acid secretion (1.033 µg mL^{-1}) were all more stable in NM28 under increasing chromium stress. These strains mitigated the chromium stress-induced inhibitory effects on tomato and chili plants in jar trials with chromium-contaminated soil. In both plants, chromium stress had a detrimental effect on Growth. physiological and antioxidant attributes. In tomatoes and chilies, NM28 and NM8 dramatically enhanced root architecture when subjected to chromium stress (50 and 150 Cr mg kg^{-1}). Tomato and chili seedlings that were inoculated with bacteria resistant to chromium experienced a decrease in chromium content and an increase in antioxidant enzyme activity. Potential biofertilizers Bacillus subtilis NM8 and Bacillus cereus NM28 were found by visual and biochemical examination. Significant quantities of malic acid (926.12 µg mL^{-2} for *Bacillus cereus* L. and 992.25 µg mL^{-2} for *Bacillus subtilis* L.) were found by HPLC. The organisms were identified as Bacillus subtilis NM8 and Bacillus cereus NM28 by 16S rRNA sequencing. On a Novelty basis, strain NM28 shows promise as a phyto-stabilizing biofertilizer for soils contaminated with heavy metals. By lowering the concentrations of heavy metals in plant consumables, *Bacillus cereus* L. NM28 may be more beneficial than Bacillus subtilis NM8, providing a revolutionary strategy for safer and sustainable agriculture.

***Keywords*: Bioremediation, Chromium resistant bacteria, Organic acid, vegetablescontaminated soil.

ROLE OF BACTERIAL CELL WALL IN THE REDUCTION OF HEXAVALENT CHROMIUM IN AQUEOUS MEDIUM

Muhammad Waseem[1]*, Saima Muzammil[2], Alia Anayat[3], Muhammad Rizwan[1]

[1]Department of Environmental Science, Government College University Faisalabad Pakistan.
[2]Department of Microbiology, Government College University Faisalabad Pakistan.
[3]Soil & Water Testing Lab. For Research, AARI, Faisalabad Pakistan.

*Email: muhammad.waseem@gcuf.edu.pk

ABSTRACT

Industrial revolution has resulted into soil contamination with various toxic metals. Among these, chromium (Cr^{+6} or Cr^{+3}) is being released abundantly in wastewater due to its uses in different industrial processes. It becomes highly mutagenic and carcinogenic once it enters the cell through sulfate uptake pathways. However, bioremediation can be used an efficient and environmentally benign approach to reduce hexavalent chromium. For this bacterial strain K1 was characterized and utilized for this purpose. It was observed that strain K1 belonged to *Staphylococcus aureus* on the basis of 16S rDNA gene sequencing. It was able to withstand 22mM Cr^{6+} and can reduce >99% of Cr^{6+} in 24 hours at 35°C as estimated by DPC (diphenylcarbazide) method. The carboxyl, amino and phosphate groups of cell wall were involved in complexation with chromium as confirmed through FTIR analysis. SEM analysis proved that *Staphylococcus aureus* strain K1 has bioaccumulated Cr^{6+}. The results suggested that this bacterium (K1) could be a good candidate for its uses in bioremediation of chromium contaminated sites due to its intrinsic features of metal processing.

Keywords: *Pollution, chromium, environment, staphylococcus, antioxidant.*

IMPROVING PHOSPHOROUS UPTAKE IN WHEAT (*TRITICUM AESTIVUM* L.) BY THE APPLICATION OF PHOSPHATE SOLUBILIZING BACTERIA AND BANANA PEEL UNDER CLIMATE CHANGE CONDITIONS

Tayyaba Samreen*[1], Sidra Tahir[1], Faraz Anjum[1], Samia Arshad[1], Muhammad Zulqernain Nazir[1], Muhammad Ahmad[1]

[1]Institute of Soil and Environmental Sciences University of Agriculture Faisalabad, Pakistan.

*Email: tybasamreen@gmail.com

ABSTRACT

Wheat (*Triticum aestivum* L.) is the most consumed cereal grain crop. However, due to high pH and calcareousness, phosphorus (P) becomes immobile in the form of calcium-phosphate (Ca-P) bonds in arid and semiarid areas that resultantly makes it unavailable to plants. The current experiment was conducted to check the phosphate solubilizing potential of ten bacterial strains on Pikovskaya's agar medium in a lab experiment through qualitative test. The maximum phosphate solubilizing index (PSI) of 3.14 and 4.86 was observed by PSB6 and PSB10, respectively. These two isolates were used in a pot experiment to check the effectiveness of the co-application of PSB6 and PSB10 with rock phosphate (RP) and banana peel (BP) for the improvement of wheat growth. In different treatments, alone and combined application of PSB6 and PSB10 was applied with RP and BP as compared to control (NK). The data indicated a significant increase in plant height of 89.4 cm (44% increased over control), plant dry weight of 21.1 g (66% increased over control), root dry weight of 6.89 (80% increased over control) and 100-grain yield of 6.15 g (61% increased over control) in wheat crop by the co-application of PSB6 and PSB10 with RP and BP. The maximum available P was (61%) significantly increased by the inoculation of PSB10 with BP and RP. Thus, PSB plus P application as an organic source is an eco-friendly option to improve crop growth and P nutrition in calcareous soil under changing climatic conditions.

Keywords: *Phosphate solubilizing bacteria; Banana Peel; wheat; phosphorus*

VERMICOMPOST; INEVITABLE CARRIER FOR NEXT GENERATION BIOFERTILIZER BIOTECHNOLOGY

Aftab Tabasum*[1], Mian Inayat Muhammad Muzamil[1], Muhammad Akmal[1], Mukhtar Ahmed[2], Rifat Hayat[1], Misbah-Ud-Din Ahmad[1]

[1]Institute of Soil & Environmental Sciences, PMAS-AAUR
[2]Department of Agronomy, PMAS-AAUR

*Email: aftabtabasum1999@gmail.com

ABSTRACT

Vermicomposting is a biological process used to convert complex organic wastes into stabilized nutrient-rich peat-like materials called vermicompost (VC). Earthworms and microbes in their guts degrade organic wastes to form a product containing plant growth-promoting hormones and nutrients in plant-available form. The VC is an efficient carrier and promoter of bacteria and may be an eco-friendly alternative to conventional carrier materials like peat and charcoal etc. We reared a nursery of worms *Eisenia fetida* and VC was produced from these worms grown in cow manure for 3 months at the animal research station (ARS) of PMAS-Arid Agriculture University Rawalpindi, Pakistan. We also collected vermi wash (vermi tea) to be used as a disease and pest control agent. The admissibility (heavy metals and pathogenic content) and classification (Physical, chemical, and biological) characterization are the most essential criteria to determine VC quality in utilization as an organic amendment. The variables and conditions defining maturity and stability include the C: N ratio of the final product, water-soluble carbon (WSC), cation exchange capacity (CEC), carbon dioxide evolution (CO_2), and measure of phytotoxicity (germination index; GI). Other parameters like moisture content, total organic carbon content (TOC), humus-like substances content (C_{HS}, C_{HA}, C_{FA}), total nitrogen content (TN), phosphorus (P) and potassium (K) content, heavy metals, salinity, water holding capacity, bulk density, and pathogens are among the important determinant. Instrumental analysis of VC produced from dung is required to confirm its maturity before being used as an organic amendment for sustainable crop production. The surface morphology of VC can be analyzed through SEM and the initial SEM micrograph reflects robust and contiguous structures whereas the final VC reveals disaggregation. The decomposition of polypeptides, polysaccharides, aliphatic, aromatic, carboxylic, phenolic groups, and lignin can be confirmed using the FT-IR spectroscopy technique during vermicomposting. The progressive reduction in mass loss of VC indicates net mineralization and degradation and the TG method is used to characterize organic waste mineralization. Another technique, UV-vis spectroscopy is used to assess the degree of humification. The sharp fall in the humification index during the vermicomposting process indicates an elevated level of organic material humification. Changes in physicochemical (pH, electrical conductivity, organic carbon content, C: N ratio, nitrogen, phosphorus, potassium, sodium, calcium) and biological parameters (germination index) are also indicative parameters for organic waste mineralization as well as VC stability and maturity. We also refreshed our potential bacterial (*Rhizobium tropic* and *Rhizobium esperanzae*) cultures and populations of fresh inoculant were adjusted to about 4×10^9 cfu mL^{-1}, based on dilution factor, and then 25 mL of each inoculant was applied per kg of VC (wet base).

The quality control parameters of the Rhizobium-based biofertilizer, such as pH, total count, variable count, contamination level, moisture content, and expiry date provide essential information about the product's performance, shelf life, etc. were evaluated. The variable count was found to be 10^{-7} CFU ml^{-1}, indicating a high abundance of targeted bacteria. The application of VC biofertilizers into the soil inevitably transmits potential bacteria, antimicrobial-resistant microbes, and associated antimicrobial-resistance genes into the soil environment help to sustain soil health.

***Keywords*:** Vermicompost, instrumental analysis, biofertilizer carrier, soil health

Exploration of Symbiotic Association and Identification of Soil Fungal Species from Roots of Wheat in District Bhimber, Azad Kashmir

Tanveer Hussain[*1], Saleha Batool Munir[1], Aroosa Azeem[1]

[1]Department of Botany, Azad Jammu and Kashmir University of Bhimber -10040 (AJK), Pakistan.

Email: tanveer.botany@must.edu.pk

ABSTRACT

This study was determined the frequency of symbiotic interactions between Triticum aestivum and fungi. The root volume, dry biomass and fertility of wheat as well as the fungus growth rate were measured in order to assess the interactions between the wheat crop and the fungi. A greater understanding of the extent to which these interactions affect population and community dynamics needs the assessment of the role played by the ecological context (biotic/abiotic) under which the interactions developed. Mortierella, Penicillium sp, Arbuscular mychorrhizal fungi. Paraglomus, Piriformospora indica, Lachnum, Serendipita fungi were isolated from the soil and roots of the wheat crop from the fields of Barnala. Except Sistoterma, all fungi were isolated from Samahni. Recent years have seen a shift in the emphasis of conceptual models of biological interactions from competition and predation to symbiotic interactions. Mortierella, Penicillium sp, Arbuscular mychorrhizal fungi, Paraglomus, Piriformospora indica, Lachnum, Sistotrema, Podospora, Serendipita fungi were among the isolated species from wheat fields of the study area. Mortierella had the highest frequency and appearance percentages, at 21.6 and 20.4%, respectively. Penicillium sp came in second with a frequency and appearance percentage of 16.11 % and 14.10 %, respectively. The relative abundance and isolation frequency in different seasons also showed the diversity of symbiotic fungi in different seasons and locations.

Keywords: Symbiotic Interactions, Wheat Crop, Frequency, District Bhimber, Azad Kashmir

"Soil Health: A Key to Food Security"

20th INTERNATIONAL CONGRESS OF SOIL SCIENCE

20-22 February 2024, Rawalpindi, Pakistan

SOIL & ENVIRONMENTAL PHYSICS, SOIL CONSERVATION

ASSESSING THE INFLUENCE OF PLANT RESIDUES ON RUNOFF AND SOIL LOSSES IN WHEAT-COMMON BEAN CROPPING SYSTEMS IN THE MOUNTAINOUS REGION OF RAWALAKOT, AZAD JAMMU AND KASHMIR

Aqila Shaheen*[1], Sania Latif[1] and Nadia Afsar[1]

[1]Departmen of Soil and Environmental Sciences, University of Poonch, Rawalakot, AJK-Pakistan

*Email: aqeela.shaheen@gmail.com

ABSTRACT

Soil erosion stands as a significant global disaster due to its direct and severe impact on land productivity. Crop residues retention is a sustainable strategy to prevent soil losses. The field experiments were carried out at the research fields of the University of Poonch Rawalakot. Two organic amendments were used: pine needles and wheat husk/straw. The crops, i.e., common bean and wheat were grown in rotation. The treatments applied were: T1: control, T2: NPK (recommended rate of NPK fertilizers, i.e., 50:60:20 kg ha^{-1}), T3: PN (pine needles at 4 Mg ha^{-1}), and T4: WS (wheat husk/straw at 6 Mg ha^{-1}). The treatments were randomly allocated to each runoff plot, and each treatment was replicated three times. The order of losses persisted consistently, with the highest in the control group, followed by NPK, pine needles (PN), and wheat husk (WH). Maximum sediment losses of 213 g/plot and runoff losses of 7516.7 L/plot were observed in the control during the common bean season. In the wheat growing season, NPK treatment recorded maximum sediment losses of 376 g/plot and runoff of 7516 L/plot. Significantly higher runoff occurred in the control treatment, while the lowest runoff losses were noted in the wheat husk (WH) treatment. The experiments on both crops indicate the potential of organic amendments like wheat husk and pine needles in mitigating soil losses and reducing runoff.

Keywords: Common bean, wheat, sediment losses, runoff losses

A SOIL HEALTH INITIATIVE FOR AGRICULTURAL AND ENVIRONMENTAL SUSTAINABILITY IN PAKISTAN

Muhammad Iqbal*[1], Atif Javed[1]

[1]Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad

*Email: iqbal@uaf.edu.pk

ABSTRACT

To allow widespread soil health monitoring and assessment, the development of a standardized, integrative soil health test that assesses soil constraints is essential. For this purpose, soil samples were collected from farmer fields of the whole Punjab, Pakistan. Sampling was done when the fields were approximately at field capacity. A core sampler (0.08 × 0.05 m^2) was used for collecting samples for bulk density. From the same sites, sampling was done with shovel/spade for other tests from 0-15 cm and 15-30 cm depths. Soil samples were analyzed for eight potential soil health indicators. To aid interpretation of soil health measurements scoring functions are developed for the individual indicators. The composite soil health index (CSHI) is calculated as the average of the eight individual indicator scores obtained from the scoring functions for two soil textures i.e., fine (≥15% clay) and coarse (<15% clay). Values of the CSHI were qualitatively interpreted to indicate very low soil quality at CSHI < 40, low at 44 < CSHI < 55, medium at 55 < CSHI < 70, high at 70 < CSHI < 85 and very high at CSHI > 85. Results indicated that bulk density and potassium were in high range of CSHI which showed that management practices should be geared towards maintaining this condition, as it currently indicates proper functioning. Aggregate stability, organic matter, NO_3-N, phosphorus, active carbon and available water capacity were in medium range. Overall, in Punjab, Pakistan the average soils are rated medium for both fine and coarse classes for soil health suggesting that management practices should be geared towards improving this condition, as it currently indicates sub-optimal functioning. In conclusion, the CSHI was shown to be useful for monitoring, assessment, and in guiding on-farm management decisions for improved crop productivity in smallholder systems in Punjab Pakistan, and potentially elsewhere, since scoring functions are easily modified for local conditions.

Keywords: Soil health, composite Soil health index, sustainability, punjab

EFFECTS OF DIFFERENT LAND USE PRACTICES ON SOIL FERTILITY AND PHYSICOCHEMICAL PROPERTIES IN SEMI-ARID DRYLAND REGION

Kashif Ali Kubar[*1], Abdul Wahab[1], Shahmir Ali Kalhoro[1], Punhoon Khan Korai[1], Muneer Ahmed, Qamar Sarfaraz[1], Ghulam Murtaza Jamro[2], Imran Ameer[1], Mukhtiar Ahmed[1]

[1] Department of Soil Science, Lasbela University of Agriculture, Water and Marine Sciences, Balochistan-Pakistan
[2] Department of Soil Science, Sindh Agriculture University, Tandojam

*Email: Kashifkubar@yahoo.com

ABSTRACT

Maintaining the soil quality in the arid dry system is vital for restoring the fertility of deserted rangeland soil in dry environments. The current research was conducted to evaluate the impact of different land use practices on the soil fertility status of dry semi-arid region, Uthal, Pakistan. Treatments were comprised of five land use practices (forestland, agro-horticulture land, wheat crop land, grassland, and barren land) and three soil depths i.e., 0-15, 15-30 and 30-45 cm with three replications. The results showed that forest land had the highest soil organic matter (1.20%), total organic carbon (12.02 mg/kg), boron (8.20 mg/kg), sodium (27.58 meq/L), calcium (67.91 meq/L), magnesium (36.54 meq/L), available nitrogen (0.95 g/kg), available phosphorus (21.7 mg/kg) and available potassium (185 mg/kg), while the lowest in barren land at the depth of 0-15 cm, with a similar trend at the depth of 15-30 cm and 30-45 cm. However, the highest pH (7.99), bulk density (1.58 g/cm^3) were found in wheat cropland and the maximum electrical conductivity (1.08 d*S*/m) was found in barren land under the depth of 0-15 cm. The macroaggregates (97.16%) were found in grassland and lowest were reported in barren land (79.71%) at 0-15 cm depth. Microaggregates (26.44%) were found in barren land and lowest in grassland (2.87%) at the depth of 30-45 cm. In general, the larger size aggregates were found in grass land (56.75%) and the smallest aggregates were recorded on agro-horticulture land (9.30%). Macro-aggregate had positive correlations with soil organic matter and other soil fertility characteristics. This study demonstrated that diverse land use practices strongly affected the soil fertility status and soil quality characteristics in forestland followed by grassland as compared to barren land in semi-arid region of Lasebela district. Hence, cultivation practices could be implemented on barren land in order to preserve soil fertility status of semi-arid areas.

***Keywords**:* Soil Fertility Status, Land Use Practices, Organic Matter, Macro and Micronutrients, Total Organic Carbon, Soil Aggregates.

POTENTIAL OF MODIFIED REDUCED TILLAGE WITH COVER/GREEN MANURE CROP FOR CLIMATE CHANGE MITIGATION IN SMALLHOLDER RAINFED FARMING SYSTEM

Shahzada Sohail Ijaz*[1], Nabeeha Javed[1], Qaiser Hussain[1], Muhammad Ansar[2]

[1] Institute of Soil & Environmental Sciences, PMAS-AAUR, Pakistan
[2] Department of Agronomy, PMAS-AAUR, Pakistan

*Email: shahzadasohail@uaar.edu.pk

ABSTRACT

Soil possesses the capacity to function as both a reservoir and a source of greenhouse gases (GHGs), contingent on its management. Earlier investigations conducted in the dryland Pothwar plateau of Pakistan have unequivocally demonstrated that adopting reduced tillage practices significantly enhances soil health. This study aims to assess the potential of a modified reduced tillage approach, involving the use of cover or green manure crops, as a substitute for crop residues in order to mitigate GHGs emissions from soil within smallholder rainfed farming systems. Over a two-year period, a field experiment was carried out following a split-plot design. The main plots were allocated to different tillage techniques: moldboard plough (MB), tine cultivator (TC), and modified reduced tillage (MRT). Concurrently, the sub-plots were designated for two crop rotation sequences: a) summer fallow followed by wheat (F-W), and b) cover/green manure crop followed by wheat (GM-W). Comparatively, the MRT tillage plots exhibited higher soil moisture content than both the MB and TC plots, regardless of whether the rotation involved F-W or GM-W. Throughout both experimental years, the MRT tillage coupled with GM-W rotation displayed the lowest average CO_2 emissions, while the MB tillage combined with F-W rotation registered the highest average emissions. Although, tillage methods had an inconsequential impact on N_2O emissions, variations were notable in N_2O emissions due to differing crop rotations. Regarding global warming potential (GWP), no noteworthy variations were detected among the tillage methods; however, the greenhouse gas intensity (GHGI) was notably lower in the MRT tillage compared to the MB tillage. Our research concluded that adopting a modified reduced tillage technique along with the incorporation of green manure offers a viable strategy for curtailing GHGs emissions from soil, in the context of smallholder rainfed farming systems.

Keywords: Greenhouse Gases, Smallholder Rainfed Farming, Dryland, Reduced Tillage, Global Warming Potential, Greenhouse Gas Intensity.

IMPACT OF IN-SITU MOISTURE CONSERVATION TECHNIQUES ON WATER CONSERVATION AND YIELD IN A POMEGRANATE ORCHARD

Riffat Bibi*[1], Safia Naureen Malik[1], Waqas Naseem[1] and Obaid-ur- Rehman[1]

[1]Soil and Water Conservation Research Institute, Chakwal

*Email: riffat_ises@yahoo.com

ABSTRACT

In-situ soil moisture conservation by capturing rain and retaining it in soil for plant utilization can result in better growth, leading to enhanced biomass yield. Soil and Water Conservation Research Institute in Chakwal conducted this research over five years (2016-2021) with a focus on evaluating the effectiveness of in-situ moisture conservation techniques in a pomegranate orchard. The experiment was aimed at assessing the impact of various treatments on soil moisture content and fruit yield, using a Randomized Complete Block Design. The study revealed significant improvements in mean soil moisture content, with the maximum increase observed in the treatment involving the application of black sheet combined with gypsum (55% higher than the control). Additionally, the use of grass mulch with gypsum application showed a notable increase of 43% over the control. Fruit yield, a crucial parameter in orchard productivity, showed highest values in the treatment utilizing black sheet with gypsum application, resulting in a remarkable 50% increase compared to the control. Similarly, the control recorded the lowest fruit yield at 16 fruits per plant. The in-situ soil moisture conservation technologies were considered suitable for barani area conditions. The experimental findings revealed the potential of in-situ moisture conservation techniques in optimizing soil moisture levels and enhancing pomegranate fruit yield. The study provides valuable insights into sustainable agricultural practices, demonstrating the practical benefits of incorporating moisture conservation strategies for improved orchard management, economics and productivity. The in-situ soil moisture technologies have potential to increase orchards crop productivity and are viable for greater farmer adoption. It is recommended that these technologies be verified further by scientists and farmers through participatory approaches for wider promotion and adoption.

Keywords: In-Situ, Soil Moisture Conservation, Rainfed, Gypsum.

COMPARATIVE ROLE OF MELATONIN IN MITIGATING ABIOTIC AND BIOTIC STRESSES IN GROUNDNUT UNDER CLIMATE CHANGE SCENARIO

Ghulam Muhammad*[1], Waqas Naseem[1], Azhar Mehmood Aulakh[1], Sultan Ahmad Rizvi[1] and Obad ur Rehman[1]

[1]Soil and water Conservation Research Instituter, Chakwal

*Email: gmawan1031@gmail.com

ABSTRACT

Plant growth and productivity is sternly restricted due to biotic and abiotic stresses, which have become more detrimental due to recent climate change. Moisture stress is a major threat to agriculture globally, and lead to a series of morphological, physiological, biochemical, and molecular changes that adversely affect plant growth and productivity. Plants' stress tolerance response can be modified by treating plants with chemical before the occurrence of stress events. Chemical priming has emerged as an alternative approach that prepares plants to better tolerate abiotic and biotic stresses. Chemical priming imparts significant impact on plant growth, physiology, biochemistry, and molecular mechanism. Groundnut (Arachis hypogea L.) is an important cash crop in the tropical and subtropical regions of the world, including Pakistan. Plants pre-treated with melatonin showed significant improvement in kernel quality, yield attributes, and mediated antioxidant system that improved yield. In order to investigate the effect of melatonin, field experiment was carried out at Soil and water Conservation Research Instituter, Chakwal (SAWCRI) during Kharif 2021-23, in a randomized complete block design with four replicates. The treatments included are pre-soaked solution of melatonin @ 30, 50, 75 & 100 ppm in comparison to the control one. Results of the experiment illustrated that melatonin application significantly increased pods plant^{-1}, 100-pods weight and the pods yield of groundnut by 435 kg ha^{-1}, in comparison to the control. The results of the study emphasizes the potential role of melatonin in mitigating the most important yield constraints (moisture & heat stress) in rainfed conditions of Pothwar.

Keywords: Melatonin, Biotic, Abiotic Stress, Groundnut, Climate Change.

IMPACT OF ORGANIC AND INORGANIC MULCHES ON SOIL PROPERTIES AND GROWTH PARAMETERS OF GARLIC

Safia Naureen Malik[*1,] Waqas Naseem[1], Majid Rahim[1] and Obaid-ur- Rehman[1]

[1]Soil and Water Conservation Research Institute, Chakwal

*Email: safiamalik6@gmail.com

ABSTRACT

This research conducted at the Soil and Water Conservation Research Institute in Chakwal from 2016 to 2020, investigates the effects of different organic and inorganic mulches on soil properties, as well as the growth and yield of garlic. The study contains five treatments, black polythene mulch, superabsorbent polymer, leaf mulch, grass mulch, and farmer practice. The experimental design employed was Randomized Complete Block Design (RCBD) with four replications. Results indicated that black polythene mulch significantly increased soil moisture content compared to other mulches, with the highest recorded moisture content during the growth period. Growth parameters such as the number of leaves, plant height, bulb width, plant weight, number of cloves, and bulb weight were notably influenced by the diverse mulching treatments in comparison to the farmer practice. Throughout the growth period, the plot treated with black polythene mulch exhibited the highest soil moisture content at 13.64%, contrasting with the control plot without any mulch which recorded 12.67%. Furthermore, garlic yield demonstrated a substantial increase over the control, with the maximum yield observed in the black polythene mulch plot at 19.4 t ha^{-1} and the minimum yield recorded in the control plot at 13.6 t ha^{-1}. The order of yield was as follows: black plastic mulch > hydrogel > leaf mulch > grass mulch > control plots. These findings underscore the significant impact of mulching techniques on garlic growth and yield, providing valuable insights for sustainable agricultural practices and resource-efficient garlic cultivation. The study highlights the efficacy of black polythene mulch, showcasing its potential to enhance soil moisture retention and ultimately improve garlic productivity.

Keywords: Garlic, Rainfed, Organic Mulches, Inorganic Mulches.

CARBON MANAGEMENT FOR IMPROVING SOIL HEALTH AND CROP PRODUCTION

Sara*[1], Dost Muhammad[1] and Maria Mussarat[1]

[1]Department of Soil and Environmental Sciences, Faculty of Crop Production Sciences, The University of Agriculture, Peshawar-Pakistan

*Email: sarakhanses@gmail.com

ABSTRACT

Building up soil organic carbon through residue management or their addition to the soil along with other restorative cultural practices could improve soil health. However, various organic sources behave differently in different soils, environment and crop conditions. For this purpose, a study was conducted to assess the effect of various organic sources including poultry manure (PM), farmyard manure (FYM), compost manure (CM) and biochar (BC) with varying levels of mineral fertilizers on soil biochemical properties, nutrient availability and crop yield. The above organic amendments were applied based on 0.25, 0.5 and 1.0% C of soil (w/w at upper 10 cm depth) in combination with 75, 50 and 25% of recommended doses of NPK (120:90:60 kg N, P_2O_5 and K_2O ha^{-1}), respectively, once in each year only to maize season before sowing and its residual effect was checked on wheat in both years. The results showed that maize and wheat as well as soil nutrients and their uptake significantly improved with an increase in applied C levels irrespective of its source. However, in the first year of maize, the CM and PM owing to larger available fractions of nutrients superseded FYM and BC in enhancing their yield and other growth traits but in residual wheat. Similarly in maize and wheat during the 2^{nd} year, the differences among applied C sources were non-significant. Moreover, the performance of maize and wheat was comparatively better in the second year than first year, which could be associated to build-up of organic C and improvement in soil properties. It was concluded that application of amendments based on 0.5% C with 50% NPK or 0.25% C with 75% NPK is a better option for current crops and higher levels of 1% C along with 25% NPK for residual and long-lasting effect of organic amendments.

Keywords: Biochar, Poultry Manure, Farmyard Manure, Compost, SOC, Soil Properties.

EFFECT OF COWPEA (*VIGNA UNGUICULATE*) AS MULCH ON WHEAT UNDER RAINFED CONDITIONS

Sarfaz Ahmed*[1], Riffat Bibi[1], Safia Naureen Malik[1] and Obaid- ur- Rehman[1]

[1]Soil and Water Conservation Research Institute, Chakwal, Pakistan

*Email: sarfrazjm@gmail.com

ABSTRACT

A four-year (2017-2020) field experiment was executed at the research farm of Soil and Water Conservation Research Institute, Chakwal, to study the effect of cowpea (*Vigna unguiculata*) as a mulch with no till and its incorporation in soil on wheat (*Triticum aestivum*) under rainfed conditions. The field soil was sandy loam having pH: 7.8; and ECe: 0.48 dSm^{-1}, with low soil nutrients (OM: 0.53 %, available P: 4.8 mg kg^{-1} and extractable K: 88 mg kg^{-1}). Cowpea was sown as green manure and mulch in last week of June. It was incorporated as green manure and used as mulch during the last week of August. The biomass of green manure crop was 19.14, 15.20, 18.75 and 25.69 t ha^{-1} in the treatment where cowpea was incorporated into the soil and it was 18.49, 13.72, 17.15 and 24.29 t ha^{-1} in the mulching treatment during 2017, 2018, 2019 and 2020 respectively. Biomass of green manure crop was 7 % more in the incorporation treatment compared with mulching treatment. Average of three year results depicted that wheat grain yield was 3314 kg ha^{-1} in control, 3660 kg ha^{-1} in the incorporation and 2934 kg ha^{-1} in mulching treatment. The incorporation of green manure crop increased 10.4 percent wheat grain yield, 9.6 percent wheat straw and 3.2 percent productive tillers per m^{-2} compared with control. Mulching decreased 11.5 percent wheat grain yield, 11.0 percent wheat straw and 12.4 percent productive tillers per m^{-2} as compared to control. Maximum soil moisture contents (0-15 cm and15-30 cm) were observed in the incorporation treatment at sowing, 02 months after sowing, 04 months after sowing and at harvesting. Further research is being continued for conclusion and recommendation under rainfed areas of Pothwar.

Keywords: Cowpea, Green Manure, Mulching, Rainfed and Wheat.

TECHNOLOGICAL APPROACH: IMPLEMENTING ROOT ZONE TRENCHES FOR THE MANAGEMENT OF DIEBACK DISEASE IN MANGO TREES

Fatima Bibi*[1], Abdul Ghaffar Grewal[1], Khurram Shahzad[2], Sidra Kiran[3], Javed Iqbal[3], Beenish Butt[4]

[1]Mango Research Institute Multan, Pakistan
[2]Department of Soil Science, Lasbela University of Agriculture, Water and Marine Sciences, Uthal, Pakistan
[3]Mango Research Station Shujabad Multan, Pakistan
[4]Soil and Water Testing Laboratory, Multan, Pakistan

*Email: fatima.bibi71@gmail.com

ABSTRACT

In arid and semi-arid regions, inadequate drainage of irrigation water introduces salts into the soil, rendering approximately 80 percent of tubewell water in Punjab unsuitable for agricultural irrigation. This issue is particularly pronounced in mango orchards, where continuous irrigation leading to salt accumulation, soil pore blockage and caused dieback disease in mango cultivars specially Sammar Bahisht, Chaunsa, and Sidhri. Recognizing the pressing need for effective solutions, trench development has emerged as a promising strategy for rehabilitating trees and improving soil drainage. The current three-year study examined the impact of trench age on both plant health and soil conditions within mango orchard. We selected trenches aged one to three years that were developed around dieback-affected plants having approximately 20 years age. The results showed significant changes in key soil parameters, including electrical conductivity, pH, sodium adsorption ratio (SAR), soil bulk density, soil porosity, gravimetric and volumetric water content, and volumetric air content, specifically in three-year-old trenches. The changes were recorded in soil bulk density (1.44-1.37 g/cm3), soil porosity (45.77-48.50%), gravimetric water content (0.11-0.07 g/g), volumetric water content (0.15-0.09 cm/cm), and volumetric air content (45.62-48.41 cm/cm) for trenches with a longer age, particularly those aged three years. An encouraging outcome is the nearly 3% reduction in salt concentration detected in the upper 6 inches of the root zone within these trenches. In conclusion, the study affirms that trench development plays a pivotal role in positively influencing both plant and soil health by augmenting drainage capabilities. This not only holds significant practical implications for heightened mango orchard productivity but also underscores resource efficiency and reinforces long-term soil sustainability in mango cultivation, particularly in the challenging climatic conditions of arid and semi-arid regions.

Keywords: Mango, Soil Health, Bulk Density, Drainage.

ASSESSMENT OF SOIL EROSION USING RUSLE MODELING UNDER CONVENTIONAL AND CONSERVATION AGRICULTURE

Mah-Noor Azad*[1], Shahzada Sohail Ijaz[1], Khalid Saifullah Khan[1], Muhammad Ansar[2]

[1]Institute of Soil and Environmental Sciences, PMAS-AAUR
[2]Department of Agronomy, PMAS-AAUR

*Email: mahnoorazad35@gmail.com

ABSTRACT

Soil erosion is universally recognized as a serious threat to land resources. The soil resource once lost is lost forever. Worldwide, up to 75 billion tons of top soils are eroded every year by wind and water and 85% of world's agricultural soils are affected by erosion. This study aimed at quantifying potential of CA practices for erosion control in rainfed agricultural lands of Pakistan. We hypothesize that replacement of moldboard plow with less intensive chisel plow, and providing soil cover in summer season can help to control erosion. The specific objective is, quantification of soil erosion under conservation and conventional practices with RUSLE model. A two-year field experiment was laid out in split-plot design having three replications with a net plot size of 5m × 7m at Arid Agriculture University Research Farm. Main plot treatments were tillage systems *viz.* 1) Moldboard plow (MB), 2) Tine cultivator (TC), 3) Reduced tillage (RT), and 4) Minimum tillage (MT) with subplot treatments a) summer fallowing (SF), and b) green manuring (GM) followed by wheat. By using our field experiment results, we calculated a Conservation Practices factor of 0.75 when we apply chisel plough as compared to the conventional Moldboard or tine cultivator ploughing system. In the similar way, by using our field experiment results, a Cover Factor of 0.33 was calculated when crop cover is established during the summer as compared to the conventional fallowing of land during summer. The adoption of both cover cropping and chisel ploughing have a great impact on the annual soil loss from the agricultural areas. We found that the annual soil loss from the agriculture areas will reduce to 38 tons/ha per annum from 123 tons/ha per annum. Reduced tillage is identified as the effective technique to reduce the maximum loss of the top soil.

Keywords: Soil Erosion, Conservation Agriculture, RUSLE Modeling.

EXPLORING IMPACT OF HYDROGEL APPLICATION ON GROWTH AND YIELD OF WHEAT UNDER RAINFED SCENARIO

Majid Rahim[1*], Adnan Umair[2], Sarfraz Ahmed[1], Muhammad Yunas[1] and Obaid-ur-Rehman[1]

[1]Soil and Water Conservation Research Institute, Chakwal, Pakistan
[2]Soil and Water Testing Laboratory, Sialkot, Pakistan

*Email: majidrahim1974@gmail.com

ABSTRACT

Farmers in the Pothwar region lack any source of irrigation, hence, practice rainfed agriculture. Water scarcity is a major hurdle in effective and efficient crop production in this area. The problem accentuates further in the Rabi season when shortage of winter rains may lead to complete crop failure. The present study was conducted for four consecutive years during 2019-20 to 2022-23 at the farmer field in Sohawa, district Jhelum, Pakistan. The objective of the study was to evaluate the effect of hydrogel application on productivity of wheat crop. Hydrogel is a hydrophilic polymer exhibiting high water retention capacity and can provide water to crops during moisture stress. The treatments were control (no hydrogel), hydrogel @ 5 kg ha^{-1}, 7.5 kg ha^{-1} and 10 kg ha^{-1} in three replicates under Randomized Complete Block Design. The observations relating to various plant growth and yield attributes were recorded. The soil moisture increment was 13%, 10% and 5% by treatment of hydrogel @10 kg ha^{-1}, 7.5 kg ha^{-1} and 5 kg ha^{-1} respectively against control. The results indicated that the plant height, spike length and number of tillers were significantly enhanced due to hydrogel application. The plant population increased by 12% in treatment with hydrogel @ 10 kg ha^{-1} as compared to control. The biological yield as well as grain yield increased significantly (12% and 18% respectively) with hydrogel application. It was evident after four years trial that hydrogel application resulted in significantly enhanced wheat productivity. Conclusively, it can be ascertained that this technology could be promising in combating the moisture stress and enhancing productivity of rainfed crops in agriculture.

Keywords: Hydrogel, Wheat, Rainfed, Moisture Conservation.

ENHANCING PEACH PRODUCTION IN RAINFED AREAS OF PUNJAB THROUGH MULCHING TECHNIQUES

Muhammad Yunas[*1], Riffat Bibi[1], Waqas Naseem[1], Safia Naureen Malik[1], Sarfraz Ahmed[1], Obaid-ur-Rehman[1]

[1]Soil and Water Conservation Research Institute, Chakwal, Pakistan

*Email: soilscientist2002@gmail.com

ABSTRACT

Mulching, the practice of covering the soil surface around plants with materials like plastic sheets, organic matter or crop residues has been widely recognized for its ability to improve soil moisture retention, regulate soil temperature, and suppress weed growth. This study was conducted at the Soil and Water Conservation Research Institute, Chakwal, with the aim to investigate the potential of mulching techniques to enhance peach cultivation in rainfed areas of Punjab. It was a three years study on two years old peach plants during 2020-2022, laid out in Randomized Complete Block Design (RCBD). The treatments were polypropylene sheet, black plastic polyethene sheet, grass mulch, gypsum amendment and control. The results indicated a substantial improvement in mean soil moisture content, with the maximum enhancement observed in the treatment utilizing black sheet mulch (10.8%) followed closely by polypropylene sheet mulch (9.95%). Fruit yield, a critical parameter for assessing orchard productivity, exhibited the highest values in the treatment with black sheet mulch, recording an impressive fruit yield of 27.2 kg per plant. Conversely, the control group showed the lowest fruit yield at 18.5 kg per plant. These findings emphasize the significant potential of mulching techniques in optimizing soil moisture levels and augmenting peach fruit yield in rainfed areas. The study contributes valuable insights into sustainable agricultural practices, illustrating the practical benefits of employing mulching strategies to improve water retention and overall orchard productivity in regions characterized by limited rainfall. By analyzing the results of this study, policymakers, farmers, and researchers can gain insights into the adaptability of peach cultivation in rainfed areas of Punjab.

Keywords: Peach, Mulching, Rainfed, Moisture, Conservation.

IMPACT OF FARMYARD MANURE ON SOIL PHYSICAL PROPERTIES AND MAIZE GROWTH

Mussawar Abbas*[1], Muhammad Iqbal[1], Laiba Tahir[1], Tooba Mumtaz[1], Hifza Jabbar[1]

[1]Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad

*Email: mussawar747@gmail.com

ABSTRACT

Farmyard manure, a valuable organic amendment, has the prospective to enhance soil fertility, improves soil structure, and water retention, thereby affecting crop productivity. The current research aims to contribute to the extensive goal of achieving food security, while confirming the long-term health and productivity of agricultural ecosystem. A field experiment was laid out at experimental field in order to investigate the impact of farmyard manure (FYM) on soil properties and its consequent influence on maize growth, with a randomized complete block design and three replications. Amendment T_1 (control), T_2 (DM 3t/ha), T_3 (DM 6t/ha), T_4 (PM 3t/ha) T_5 (PM 5t/ha) and NPK were used according to recommended rate (200,150,105). Soil samples were collected at different depth to calculate changes in soil properties such as nutrient content, organic matter and soil bulk density. Maize growth parameters, including plant height, leaf area index and yield was observed. Result showed that application of dairy manure T_3(DM) decrease soil pH, bulk density (1.45 Mg m^{-3}) whereas increased soil organic matter (1.050%). Furthermore, the application of poultry manure increased infiltration rate and field saturated hydraulic conductivity (25.8-55.9%, 4.570 + 10^{-4} cm s^{-1}). Increase in root length (28.5cm) resulted in enhanced nutrient uptake by the plant through the application of dairy manure. The maximum available nitrogen, phosphorus and potash were found in T_3 (DM) by 4.0-4.8, 9.5-11.6, and 8.5-30.8, respectively. The maximum plant height, cob length, number of grains per cob, grain yield (1.50-1.85 t/ha), harvesting index (30.5%) and NPK in plant tissue where T_3 application of dairy manure applied. Leaf area index shoot length (45.9cm) and chlorophyll content (75.8%) of maize was found higher for PM_6. Overall, the findings of this research are projected to contribute valuable insights into the dynamics between farmyard manure application, soil health, and maize growth.

Keywords: Farmyard Manure, Soil Physical Properties, Maize Growth, Yield.

ENHANCING SOIL MOISTURE AND CROP YIELD IN RAINFED AREAS THROUGH SUPER ABSORBENT POLYMERS

Waqas Naseem*[1], Muhammad Yunas[1], Sultan Ahmad Rizvi[1], Ghulam Muhammad[1] and Obaid-ur-Rehman[1]

[1]Soil & Water Conservation Research Institute, Chakwal

*Email: waqasnaseem313@gmail.com

ABSTRACT

Super absorbent polymer (SAP) is widely recognized as a promising technology for enhancing both crop yield and soil moisture. However, the impact of SAP on crop yield and soil moisture exhibits inconsistency, with variations observed based on environmental factors and application conditions. This study investigated the impact of super absorbent polymers (SAP) on soil moisture retention and crop yield in rainfed regions. The study was carried out during 2018-2022 in the sandy loam soil at the Soil & Water Conservation Research Institute in Chakwal under Randomized Complete Block Design with treatments including Control, SAP at 5 kg ha^{-1}, 7.5 kg ha^{-1}, and 10 kg ha^{-1}, each replicated thrice. The results of the research showed that SAP increased the soil moisture retention and crop yield. The highest grain yield was recorded under SAP @ 10 kg ha^{-1} (4657 kg ha^{-1}) followed by 7.5 kg ha^{-1} (4343 kg ha^{-1}) and 5 kg ha^{-1} (4172 kg ha^{-1}) which was 34%, 25% and 20% higher as compared to control. Moreover, mean monthly soil moisture during the crop growth period increased by 36%, 25%, and 9% for SAP treatments at 10 kg ha^{-1}, 7.5 kg ha^{-1}, and 5 kg ha^{-1}, respectively, compared to the control. Additionally, productive tillers and plant height exhibited a gradual increase with increasing SAP application. Economic analysis revealed net benefit of Rs. 75,139 ha^{-1}, Rs. 54,681 ha^{-1}, and Rs. 48,100 ha^{-1} for the respective SAP treatments. This study highlights the potential of super absorbent polymers in mitigating moisture stress and enhancing agricultural sustainability in rainfed areas.

Keywords: Super Absorbent Polymers, Wheat, Rainfed, Moisture.

TILLAGE PRACTICES CONTRIBUTE TO THE WATER CONSERVATION BENEFITS OF RAINWATER HARVESTING IN SEMI-ARID CONDITIONS

Sultan Ahmad Rizvi[*1], Waqas Naseem[1], Danish Majeed[1], Obaid ur Rehman[1]

[1]Soil & Water Conservation Research Institute Chakwal, Pakistan

*Email: engrsultan68@yahoo.com

ABSTRACT

Livelihood in Pothwar region of Pakistan is largely dependent on rainwater. It is therefore, crucial to store and conserve rain water for its subsequent use when required. Amongst various means of in-field moisture conservation, tillage practices play dynamic role especially in loose soils of Pothwar area. Under this study, efficiency of commonly used tillage implements i.e., mold board (MB) plough, disc plough and cultivator were evaluated for moisture conservation and improvement in wheat (*Triticum aestivum* L) yield. The results of three years' study depicted that maximum soil moisture and grain yield was obtained in the field tilled with MB plough followed by disc plough. It has been observed that soil water was improved by 11.3, 10.6, 9.9 and 11.5 % in treatment of MB plough, while this increase was recorded as 5.7, 9.0, 5.2 and 6.8 % in disc plough as compared to cultivator at sowing, 02 months & 04 months after sowing and at harvesting stage, respectively. In the treatment of MB plough, improvements were observed as wheat grain yield 16%, wheat straw yield 19%, productive tillers 6% and plant height by 2%. Furthermore, MB plough enhanced the productivity and profitability with highest benefit cost ratio of 1.83. The role of disc plough in soil water conservation and crop productivity enhancement was observed less as compared to MB plough. From the current study, it was observed that use of MB plough is beneficial in soil water conservation and improvement of crop yield.

Keywords: Cultivator, Disc Plough, Soil Water, Tillage Practices, Rainwater Harvesting.

NITRATE ACCUMULATION AND HUMAN HEALTH RISK ASSESSMENT IN SPINACH IRRIGATED WITH RAW DOMESTIC WASTEWATER BY APPLYING DIFFERENT N-SOURCES

Sadia Bibi[1*], Sana Faeooq[1], Saifullah[1], Muhammed Sabir[1], Sidrah Ashfaq[2], Hammad Raza Ahmed[1]

[1]Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad-38040
[2]Department of Farm Machinery and Power, University of Agriculture, Faisalabad-38040

*Email: sadia_1565@yahoo.com

ABSTRACT

The growing population demands food and water, leading to the necessity of using wastewater for vegetable irrigation. The wastewater collected from residential colonies contains higher amount of nitrate, which poses health risks when consumed. The present study aimed to investigate the rate of nitrate uptake, human health risk assessment, and nitrate-related transfer factor in spinach irrigated with different sources, including raw domestic wastewater effluent (DWW) collected from residential colonies of University of Agriculture, Faisalabad and underground water (UGW). For this purpose, two different varieties of spinach (desi white and hybrid) were cultivated in pots by applying urea and calcium ammonium nitrate (CAN) to fulfill the N requirement. The experiment consisted of 4 treatments (T1: urea +UGW, T2: urea + DWW, T3: CAN + UGW, T4: CAN+ DWW), with 3 replications. Finally, the amount of nitrate in DWW and UGW treated soil (before growing and after harvesting of spinach) was measured. Results showed that T4 has the highest transmission factor. Daily intake (EDI) of nitrate through the consumption of spinach grown in UGW with urea is less than the allowable amount, so the consumption of such vegetables is not dangerous to consumer health. On the other hand, the highest biomass yield was observed in T4 by the application of CAN with wastewater that is followed by T2 >T3 >T1 in descending pattern and maximum nitrate uptake was recorded in T2 that is followed by T4 >T1 > T3 again in descending order. Application of synthetic fertilizers with wastewater irrigation showed high health risk index (HRI) >1 compared to spinach irrigated with underground water (HRI <1).

Keywords: Health Risk Index, Domestic Wastewater, Estimated Daily Intake.

EFFECT OF COMPOST AND ORGANIC MULCHING ON WATER USE EFFICIENCY, SOC AND YIELD OF OKRA IN ARID AND SEMI-ARID REGIONS

Sadia Bibi[1], Hadia Muhammad[1], Saifullah[*1], Muhammad Sabir[1]

[1]Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad-38040

*Email: swcl@uaf.edu.pk

ABSTRACT

Water use efficiency (WUE) is the amount of carbon assimilated as biomass per unit of water used by the crop. Water scarcity is becoming an alarming issue in semiarid areas, where crop production relies on the use of large volumes of water. Improving WUE is necessary for securing environmental sustainability of food production in these areas. Climate change predicts increase in temperature and drought in semiarid regions which leads towards C-pool depletion. The efficient use of water is supposed to be mandatory for global food production. Vegetables show more sensitivity towards water shortage than cereal crops and yield reduction is a serious issue. The main objective of the study is to explore the effect of compost and mulch on WUE, soil organic carbon (SOC) and on okra growth and yield. The compost was made from animal waste. Soil was brought from the Research Farm of the University of Agriculture, Faisalabad. Pot experiment was conducted by using the given treatment plan. It was a two factorial experiment using CRD as a statistical design. 1st factor was compost and 2nd was mulch viz. F1 (Control), F2 (75% N from Urea+ 25% N from compost), F3 (50% N from urea + 50% N from compost), F4 (25% N from urea + 75% N from compost). There was another control in which no mulch was applied (M1), M2 (2-inch mulching), M3 (4-inch mulching) with a total of 7 treatment having 3 replications. At harvest, growth and yield parameters like plant height, root length, shoot and root fresh weight, shoot and root dry weight, no. of leaves and no. of branches were determined. Soil sampling and physico-chemical analysis were done before and after harvesting of the crop. The results indicated that 4-inch mulch with compost significantly increased water use efficiency (12.67 kg ha^{-1} mm^{-1}), as compared to control treatment.

Keywords: Climate Change, Food Production, Thick and Thin Mulching, Drought, Animal Waste

Improving water use efficiency in wheat through reduce irrigation and subsurface application of Farm yard manure

Muhammad Sulaiman[1], Muhamad Imran[1]*, Ahmad Mahmood[1], Muhammad Baqir Hussain[1] and Sarfaraz Hashim[2]

[1]Department of Soil and Environmental Sciences, Faculty of Agriculture and Environmental Sciences, MNS University of Agriculture, Multan, Pakistan
[2]Department of Agricultural Engineering, Faculty of Agricultural Biosystem Engineering and Technology, MNS-University of Agriculture, Multan

Email: m.imrani@mnsuam.edu.pk

ABSTRACT

An international concern today is water scarcity and the rising demand for water across various agricultural sectors. Increasing crop water use efficiency (WUE) is one way to address a major issue facing agricultural production: producing more food with less water. The industry that uses the most water is agriculture, and a key barrier to agricultural productivity is water scarcity. Enhancing WUE in wheat farming is crucial for promoting sustainable agricultural practices. The importance of decreased irrigation in improving the efficiency of water usage and the yield of winter wheat. Enhancing the soil water use efficiency of winter wheat to decrease reliance on irrigation. Decreasing irrigation can enhance the water use efficiency and production of a winter wheat-summer maize rotation. Furthermore, the implementation of limited-irrigation techniques has been shown to effectively control the growth of roots and canopies, resulting in enhanced water usage efficiency and increased soil reservoir capacity for winter wheat. The sustainable management methods and appropriate irrigation strategies as crucial elements for enhancing agricultural water use efficiency in winter wheat. The need of using water-saving irrigation techniques and appropriate agricultural practices to enhance water usage efficiency in wheat production. In limited irrigation, more control is needed over the amount and time of water application than in full irrigation. Nearly 50% less water was helpful to enhance wheat grain productivity and WUE in semi-arid regions. Additionally, the use of drought-resistant cultivars and genetic diversity to increase water production in wheat under situations of limited moisture were proposed as viable strategies to improve WUE.

Key Words:
Soil health, amendments, Tritcum aestivum, WUE, FYM Management, yield components

"Soil Health: A Key to Food Security"

20th INTERNATIONAL CONGRESS OF SOIL SCIENCE

20-22 February 2024, Rawalpindi, Pakistan

SOIL SCIENCE SOCIETY OF PAKISTAN -SSSP-

SOIL SALINITY & BIOSALINE AGRICULTURE

AMELIORATION OF SALINITY STRESS IN MAIZE PLANTS USING ACIDIFIED BIOCHAR: A POTENTIAL STRATEGY FOR ENHANCING CROP RESILIENCE AND PRODUCTIVITY

Tahira Akram[1], Muhammad Zia-ur-Rehman[1, *], Hamaad Raza Ahmad[1], Muhammad Usman[1], Uzair Anjum[1], Ali Rizwan[1], Muhammad Saqib[1], Rubaz Ahmad[1]

[1] Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad 38000, Punjab, Pakistan

Email: ziasindhu1399@gmail.com

ABSTRACT

Salinity stress significantly impedes crop productivity by impacting nutrient uptake and growth. Acidified biochar has been found to improve plant growth and alleviate the negative effects of salt stress on crops. This study delves into the potential application of acidified biochar (biochar treated with nitric acid, phosphoric acid), biochar treated with distilled water and simple biochar to alleviate salinity stress by enhancing nutrient availability and bolstering maize crop growth across diverse salinity levels. The maximum root dry weight varied notably with the application of biochar treated with nitric acid (BNA), measuring at 40.8±2.3, 32.9±3.1, and 27.8±1.3 g/pot in normal, marginal, and highly salt-affected soils, respectively. The application of BNA notably enhanced chlorophyll content, photosynthetic rate, transpiration rate, stomatal conductance, and sub-stomatal CO2 intake in different soil conditions. In normal soil, these attributes increased by 69.5±3.5, 24.4±1.2, 21.2±1.1, 1.0±0.02, and 442.3±20.9, respectively. In marginal salt-affected soil, the increases were 58.0±3.4, 20.3±1.2, 17.7±1.0, 0.9±0.05, and 371.2±21.8, respectively. Meanwhile, in highly salt-affected soil, observed increases were 48.6±2.4, 17.1±0.9, 14.8±0.7, 0.7±0.04, and 311.4±15.6, respectively. Specifically, the BNA application exhibited the highest catalase (CAT) activity, displaying a remarkable 34%, 68%, and 115% increase in normal, marginally salt-affected, and highly salt-affected soils, respectively. The experiment suggests that acidified biochar, particularly BNA, holds promise as a viable and effective strategy to alleviate salinity-induced limitations on crop productivity.

Keywords: Salinity stress, Acidified biochar, BNA, Catalase, Effective strategy, Sustainable solutions

IDENTIFICATION OF SALT TOLERANT WHEAT GENOTYPES THROUGH AGRONOMICAL AND PHYSIO-BIOCHEMICAL TRAITS

Sajida Bibi*[1], Abdul Rasul Awan[1], Muhammad Akhtar[1]

[1]Soil & Environmental Sciences Division, Nuclear Institute for Agriculture and Biology (NIAB), Jhang Road, Faisalabad

*Email: sajidabibi10@gmail.com

ABSTRACT

Salinity stress poses a significant threat to global food security, affecting crop productivity and quality. Wheat is a staple food crop consumed worldwide and thus understanding its tolerance mechanisms to salinity stress is crucial for developing resilient varieties. The current study aimed to investigate the genetic mechanisms of salinity tolerance in sixty (60) wheat genotypes through morpho-physiological and biochemical indices. In a controlled laboratory experiment, three NaCl concentrations (10, 15, and 20 dSm^{-1} were applied under passive hydroponic conditions. A field experiment was also conducted using an alpha lattice design, which in the same wheat genotypes was cultivated in normal and saline soil. Fresh flag leafs were collected for estimation of physio-biochemical analysis and yield and yield related components were recorded at maturity. The results revealed that wheat genotypes, such as SG3/12-21, KCT7/12-44, SCT6/9, SG1/12-41, LU-26-S, Anaj-17, Akbar and Sassui exhibited elevated levels of antioxidant enzymes, maintained higher relative water content, demonstrated a maximum total phenolic content, retained significant chlorophyll content, and exhibited a balanced Na/K ratio. Based on a reduction of less than 50% in various growth parameters, wheat genotypes such as KCT7/12-44, SG3/12-21, LU-26-S, Anaj-17, Akbar, and Sassui were categorized as salt tolerat while those exhibiting such as SG2/12-27, Sarsabz, NIA-Zarkaiz, Sehar-2006 and Galaxy-13 were identified as moderately salt-tolerant, and Dilkash, Khirman, and Bhittai were found less tolerant to salinity. These findings indicate that potential strategies that might be used to identify tolerant genotypes, induced defense response in order to maintain food security in salt-affected regions. The identified salt-tolerant genotypes/ varieties may be included in future breeding programmes for the development of high yielding salt tolerant wheat varieties.

Key words: Wheat, Salt tolerance index (STI), Plant biomass, Antioxidant enzymes , Relative water content, Total phenolic content, Chlorophyll content, Shoot Na^+/K^+

ISOLATION AND CHARACTERISATION OF HALOTOLERANT BACTERIA FOR THE GROWTH OF TOMATO (*SOLANUM LYCOPERSICUM*)

Ahsan Raza Khan[a], Ali Raza Gurmani[a], Ayaz Mehmood[a], Rasheed Ahmed[a], Raheem Shahzad[b], Mazhar Rafique[a] and Jinlin Zhang[c]

[a] Department of Soil & Climate Sciences, The University of Haripur, Khyber Pakhtunkhwa, Pakistan
[b] Department of Horticulture, The University of Haripur, Khyber Pakhtunkhwa, Pakistan
[c] College of Pastoral Agriculture Science and Technology, Lanzhou University, Lanzhou 730000, PR China

*E-mail: ahsanzfr07@gmail.com

ABSTRACT

Salt stress is one of the major stresses among various environmental stresses which drastically limits plants' growth and yield. Application of microbes is regarded as a promising approach among the various adopted approaches to counter salinity stress. In current study, salt tolerant bacterial strains were isolated from the rhizosphere of *Atriplex portulacoides* and *Tribulus terrestris* which are common wild plants grown under saline area to test the efficiency of selected strains in alleviation of salt stress in two tomato genotypes, Debra and Money maker. Salinity tolerance was screened by using optical density at 600 nm (OD_{600} nm). Different concentrations of NaCl (150, 300 and 450) were applied on all isolated strains. Two tolerant strains S2 and S6 were selected based on their salinity tolerance. Molecular identification was performed on isolates that were shown to be positive for growth-promoting activity. The 16S rNA sequence data revealed that S2 and S6 are *Acinetobacter*. Plant microbe experiment under salinity stress was carried out to examine the phyto beneficial potential of these two selected strains. The results showed that both strains S2 and S6 contained genes associated with plant growth promotion (PGP), suggesting that they could promote plant growth. Tomato seed germination, seedling length, vigor index and plant dry weight, total chlorophyll was significantly augmented by inoculation of S2 and S6 under salt stress. Various enzymatic attributes like SOD and POD were increased significantly and CAT activity was decreased in both cultivars. Based on obtained results, both superior strains S2 and S6 were effective to ameliorate the adverse effect of salt stress on tomato seedlings.

***Keywords*:** Salt stress; plant growth; rhizosphere bacteria; wild halophytes

ASSESSING THE IMPACT OF CONVENTIONAL AND MODIFIED ORGANIC AMENDMENTS IN RECLAIMING SALT-AFFECTED SOILS

Saifullah[1*], Nimra Sehar[1], Muhammad Sabir[1], Sadia Bibi[1], and Muhammad Naveed[1]

[1]Institute of Soil and Enviornmental Sciences, University of Agriculture, Faisalabad-38040

***Email**: swcl@uaf.edu.pk

ABSTRACT

Salinity and sodicity-induced soil degradation poses a challenge to the efficient use of soil resources, as crop production is hindered by high salt levels. Saline and sodic soils are of considerable importance as sources of agricultural land, emphasizing the need for their reclamation through appropriate agronomic practices. Organic amendments play a crucial part in enhancing the soil's physicochemical and biological characteristics, thereby promoting crop growth and increasing yield. Organic supplements accelerate the leaching/washing out of salts from the soil due to their beneficial effect on the charactertics of the soil. A lysimetric trial was performed. The experiment was set up using a complete randomized design (CRD) consisting of 5 treatments T_1= Control (good quality water + no amendment), T_2= Saline water + no amendments, T_3= Saline water + Acidulated compost at 1% (W/W), T_4= Saline water + normal compost at 1% (W/W), T_5= Saline water + Farmyard manure at 1% (W/W). The data showed that all the amendments show positive response on soil properties and increased leaching of salts as compared to the control. Among all the tested organic amendments, acidulated compost proved better than rest of the amendments. Results further revealed that the initial leachates displayed a higher salt removal rate, which diminished progressively over time across all soils and treatments. The application of acidulated compost and FM (presumably referring to a specific organic amendment) consistently resulted in significantly improved soil reclamation in terms of pH, ECe, and SAR. Therefore, these amendments can be used for reclamation of salt-affected soils.

Keywords: Acidulated compost, leaching of salts, reclamation, soil properties.

CO-APPLICATION OF PLANT GROWTH PROMOTING RHIZOBACTERIA AND FARMYARD MANURE FOR IMPROVING GROWTH AND YIELD OF ONION UNDER SALINE CONDITIONS

Mohammad Awais*[1], Wajeeha Attiq[1], QuratulAin Tayyab[1], Qasim Ali[1], Maqshoof Ahmad[1]

[1]Department of Soil Science, Faculty of Agriculture and Environment, the Islamia University of Bahawalpur, 63100 Bahawalpur

*Email: awaisgodri99@gmail.com

ABSTRACT

Salinity stress threatens agricultural productivity, especially onion (*Allium cepa* L.), which is sensitive to high soil salt concentrations. This study examined the interactive effects of plant growth-promoting rhizobacteria (PGPR) and farmyard manure (FYM) on onion plants' physiological and biochemical mechanisms under saline conditions to reduce salinity's negative effects on growth and yield. NaCl was used to develop three levels of salinity (control, 4, and 8 dS m^{-1}) in pots. The results showed that PGPR and FYM synergistically reduced salinity stress and improved nutrient absorption, root elongation, and salt-induced oxidative stress in onion via increasing antioxidant enzyme activity. Combined application of PGPR and FYM surpassed to individual treatments or untreated controls. Co-application of PGPR and silicon foliar application significantly improved shoot length (42.49%), shoot fresh and dry weight (65.87 and 75.81%), number of leaves (40%), neck and bulb diameter (24.64 and 76.19%), root fresh and dry weight (75.06 and 42.86%), relative water content (18.86 %), chlorophyll a and b content (96.32% and 65.65%), and carotenoid content (89.59%) as compared to control at 8 dS m^{-1}. Moreover, silicon and PGPR also improved antioxidant enzyme activities, i.e., catalase (14.46%), ascorbate peroxidase (16.27%), pyrogallol peroxidase (4.54%), and guaicol peroxidase (17.27%) at 8 dS m^{-1}. Therefore, PGPR and silicon applications are potential strategies to improve onion growth and yield under abiotic stress.

Keywords: Salinity, Onion, PGPR, FYM, enzymatic activity, nutrient and yield

EFFECT OF ZINC AMINO ACID CHELATES ON GROWTH OF WHEAT IN SALT AFFECTED SOILS

Hafiz Abdullah Shah[1], Ayesha Mustafa*[1], Laiba Shabbir[1], Sabahat Kainat[1], Abdullah Maqsood[1]

[1]Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad

Email: Ayesha.2099@gmail.com

ABSTRACT

Soil salinization and its concomitant challenges pose a serious threat to the sustainability of agriculture. Owing to the high soil pH, deficiency of micronutrients like zinc (Zn) is a common growth limiting factor in salt-affected soils. The current study was conducted to assess the effects of Zn amino acid chelates (ZnAAC) on the growth and Zn uptake in wheat plants under salt stress. Different ZnAACs including Zn-glycine (ZnGly), Zn-methionine (ZnMet), Zn-tryptophan (ZnTrp) and conventional Zn-sulphate ($ZnSO_4$) were applied @ 8, 10, and 12 mg kg^{-1} with three replicates. Regardless of the source, Zn application significantly improved the wheat growth under salt stress conditions. However, promising results were obtained on application of $ZnSO_4$ @ 12 mg kg^{-1}. Plant height, tillers per plant, root and shoot dry weight of wheat plants was increased by 27%, 100%, 80% and 92.6%, respectively, compared to the untreated plants. Additionally, the application of $ZnSO_4$ led to the highest levels of chlorophyll content, photosynthetic rate, transpiration rate, stomatal conductance, and sub-stomatal carbon dioxide in wheat plants grown in salt-affected soil. Furthermore, $ZnSO_4$ application @ 12 mg kg^{-1} resulted in the maximum increase in Zn concentration in soil (127%), grain (73.2%), root (38.5%), and shoot (68.9%) compared to the control. Based on the results, it can be inferred that the application of $ZnSO_4$ is an effective strategy to enhance the wheat growth and Zn uptake in salt affected soil.

Keywords: Wheat, zinc bioavailability, zinc amino acid chelates, salt affected soils

ENHANCING WHEAT GROWTH UNDER SALINITY STRESS: THE IMPACT OF BIOCHAR APPLICATION ON SOIL CHARACTERISTICS AND CROP YIELD

Shahzad Ahmad*[1]

[1]Department of soil science & Environmental science, The Islamia University of Bahawalpur.

*Email: chshahzad473@gmail.com

ABSTRACT

Crop production is decreasing due to various climatic and soil contamination. In salinity, sodium (Na) is non-essential nutrient which affect the soil characteristics and reduces crop growth and yield. In this experiment, a small pot trail was conducted to evaluate the effect of biochar on wheat growth under salinity stress. Pots were filled with 300 g sieved soil. Soil salinity was developed at 0, 30,and 60 mM by using sodium chloride (NaCl) salt. Biochar was applied at the rate of 0, 1 and 2% (w/w). Completely randomize design (CRD) was used for arrangement of experiment with threerepeats. Results showed that salinity at elevated level negatively affected the plant growth, physiological, biochemical parameters and increase sodium concentration in plant tissue. Biochar application lower the effect of salinity and improved the plant height, root length, fresh and dry weight of root and shoot, leaf area, SPAD chlorophyll, chlorophyll a, b and total carotenoids, relative water content (RWC) and potassium (K) concentration in plant tissues. Morover, biochar reduced the electrolyte linkage (EL), proline content, soluble sugars, lipid peroxidation (MDA) and sodium concentration in plant tissue. In conclusion biocahr application could be better strategy to ameliorate the salt effected soil.

COMPARATIVE EVALUATION OF SORGHUM (*SORGHUM BICOLOR L.)* GENOTYPES AGAINST NACL STRESS

Rehman Ali[1*], Muhammad Anwar-ul-Haq[1], Muhammad Saqib[1], Muhammad Sajid Aqeel Ahmad[2], Usama Mustfa[1], Aneela Riaz[1] and Alisha[1]

[1] Saline Agriculture Research Center, Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad 38000, Pakistan
[2] Department of Botany, University of Agriculture Faisalabad 38000, Pakistan

[*]Email: 2016-ag-5241@uaf.edu.pk

ABSTRACT

Salinization and sodication has become a major challenge for sustainability of agriculture in the arid and the semi-arid areas. Salinity is a serious threat to cereal production including Sorghum. The current study aimed at assessing the detrimental impact of salinity on sorghum under varying NaCl levels. A hydroponic experiment was conducted in the wire house of Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad. The experiment followed complete randomized design with five salinity levels including a control (T_1=Control, T_2 = 4, T_3= 6, T_4 = 10 and T_5 = 14 dS m^{-1} of EC) replicated three times. The results revealed significant inter-cultivar differences in shoot length, with FSH-1401 and S-2011 exhibiting the highest growth at high NaCl concentrations, while J.S-2002 showed the least growth. Despite increasing salinity, FSH-1401 and S-2011 demonstrated adaptation to high salinity levels compared to J.S-2002 and Hegari-sorghum. Root development was significantly inhibited at 10 and 14 dS m^{-1} for J.S-2002 and Hegari-sorghum, while FSH-1401 and S-2011 were less affected. Based on the physiological criteria employed in the study, sorghum lines FSH-1401 and S-2011 were classified as tolerant, Hegari-sorghum and FSH-1401 as medium-tolerant, while F-01-14 exhibited medium sensitivity, and J.S-2002 and F-01-14 were categorized as sensitive. The current experiment concludes that FSH-1401 was more tolerant than other verities and most sensitive was J.s-2002. This screening process facilitates the identification of suitable sorghum lines that can be recommended for cultivation in different saline areas, ultimately contributing to improved yields in such challenging environments.

***Keyword*:** Soil salinity, Sorghum, hydroponic, screening, tolerance

EVALUATING NUTRITIONAL QUALITY OF SORGHUM EXPOSED TO SALINITY AND DROUGHT STRESS.

Fatima Aamir[1]*, Iqra Akram[1], Husna Ijaz[1] and Rehman Ali[2]

[1]Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad 38000, Pakistan
[2]Saline Agriculture Research Center, Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad 38000, Pakistan

*Email: fatimaamir9875@gmail.com

ABSTRACT

Sorghum is a grain as well as a forage crop. The average yield levels are generally very low due to various biotic and abiotic constraints operating at different crop developmental stages. Among the abiotic factors, sorghum is greatly affected by drought and salinity. Salinity is a most ubiquitous problem in arid and semi-arid regions of world. Growth and development of crop plants is highly affected by soil salinity. Drought is amongst the main constraints on agricultural production and is expected to increase hydrogen cyanide levels in sorghum. High levels of HCN could pose serious threat to human and animal health. It causes contraction of eyes and skin, tissue anoxia, respiratory paralysis, cardiac irregularities and even the death of many precious animals. Sorghum crop was exposed to three levels of salinity (10, 15, 20 dS m^{-1}) and two levels of water stress (75% and 50% field capacity). At maturity, various parameters related to plant biomass were recorded. Data was statistically analyzed following CRD under factorial arrangements. The data revealed that variety YSS-49 has maximum ash, fiber, protein and fat content as compared to variety YSS-46 of treatment in which add (10dsm^{-1} EC at 100% field capacity). Similarly, YSS-46 showed significant improvement in fresh weight, dry weight and root length even under water and salt stress. The variety YSS-46 has high HCN level as compared to variety YSS-49 at combined stress of 20 dS m^{-1} + water application at 50% field capacity. The data reveaed that YSS-49 was more tolerant than other varieties. This screening process facilitates the identification of suitable sorghum lines that can be recommended for cultivation in different saline and drought areas, ultimately contributing to improved yields in such challenging environments.

Keywords: Drought, Salinity, Hydrocyanic acid, Sorghum

EFFECT OF CALCIUM CHLORIDE SEED PRIMING ON WHEAT SEEDLINGS DEVELOPMENT AND EMERGENCE UNDER SALT STRESS

Asif Muhammad*[1], Muhammad Dilshad[1], Haji Muhammad[2], Siraj Ahmed[3]

[1]University of Agriculture Faisalabad
[2]Asian Institute of Technology, Thailand
[3]Agronomic Research Station, Karor Layyah

*Email: muhammadasif.bzu.edu.pk@gmail.com

ABSTRACT

Wheat (*Triticum aestivum* L.) is a widely cultivated cereal and staple food crop of Pakistan. Wheat production during the 2022-23 was recorded 26.8 million tonnes, from an area of 9.0 million hectares. A large area of Pakistan is severely affected by salinity and sodicity that results in significant reduction in yield of cereals including wheat. Present study was conducted to examine the effect of seed priming to minimize the impact of salt stress and seedling growth of wheat. Treatments comprised of no priming (control), hydro priming, $CaCl_2$ priming with and without salt stress (control, EC=6ds m^{-1} and EC=12ds m^{-1}). Data of seedling growth was recorded using appropriate techniques and then was analyzed by using analysis of variance approach (ANOVA). Results revealed that wheat seedlings exposed to salts without priming produced significantly lower plant growth as compared to $CaCl_2$ priming of seed. The $CaCl_2$ priming performed better in salt stress condition as compared to No priming. The finding of this study suggested that the seed priming at 100mg\l may effectively suppress the salt and increase the seedling growth of wheat.

Keywords: Calcium Chloride; Salt Stress; Seed Priming; Wheat

DIFFERENTIAL RESPONSE OF RICE VARIETIES TO SALINITY STRESS

Muhammad Haider Jamal, Tanveer Ul Haq, Muhammad Arif, Mehwish Sanaullah, Sajeela Sehar and Muhammad Farhan

[1]Department of Soil and Environmental Sciences, MNS – University of Agriculture, Multan

*Email; haiderjamal64@gmail.com

ABSTRACT

Rice is the 2nd most important cereal crop of Pakistan and contributed about 6% to the daily caloric intake. It accounts for 3.1% of the value added in agriculture and 0.7% to GDP of the country. The expanding soil salinity stress poses a serious threat to rice production. The current study aims to evaluate salinity tolerance of rice varieties in a pot culture experiment. There were three rice varieties, two treatments (Control and 10 dS/m) and four replications in this experiment. The rice nursery was grown in the sand culture and one month old seedlings were transplanted in soil filled pots. Salinity was developed by mixing NaCl salt in soil. The plants were grown till maturity and data about growth, physiological parameters and yield traits were recorded. The accumulation of Na, K and Ca was also assessed in 2^{nd} fully expanded leaf at the vegetative stage. Additionally, biochemical markers including osmo protectant accumulation were quantified to evaluate the cellular responses to salinity-induced oxidative stress. Salinity caused in reduction in the shoot fresh and dry weight of all rice varieties, however, the reduction was low in Al-khalid variety compared with BR-47 and BR-61 varieties. In the salt tolerant variety, the accumulation of Na was less whereas maintenance of K was higher in leaves under salinity stress. The study reveals considerable variation in salinity tolerance among used rice varieties, highlighting the possibility of selecting tolerant cultivars with adaptive traits for cultivation in salinity affected areas. This research contributes to sustainable agricultural practices by providing a scientific foundation for the selection and breeding of rice varieties tolerant to salinity stress, ultimately enhancing global food security in the face of climate change.

***Keywords*:** Genetic variation**;** Salinity; Tolerance; Ions Accumulation; Food security

INTERACTIVE EFFECT OF CAFFEIC ACID AND SALINITY ON MORPHO- PHYSIOLOGICAL, IONIC AND BIOCHEMICAL ATTRIBUTES OF WHEAT (*TRITICUM AESTIVUM* L.)

Hassan Mehmood[1*], Ghulam Hassan Abbasi[1], Zaffar Malik[1], Muhammad Ali[2], Muhammad Nadeem[2], Muhammad Ashar Ayub[2], Muhammad Waqar Akhtar[1], Muhammad Irfan[2], Fatima Nisar[1], Muhammad Sohaib[1]

[1]Department of Soil Science, Faculty of Agriculture and Environment, The Islamia University of Bahawalpur, 63100, Pakistan
[2]Institute of Agro-Industry and Environment, Faculty of Agriculture and Environment, The Islamia University of Bahawalpur, 63100, Pakistan

* Email*: malikhassanbwp@gmail.com*

ABSTRACT

Abiotic stress is responsible for a great extent of agriculture and is limited by its role in potential oxidative stress, cellular oxidative damage and reduced plant physiological responses. Salinity is one of the key abiotic stresses in this regard and is a leading cause of reduction in agricultural production in developing countries located in arid to semi-arid regions of the world, such as Pakistan. Many amendments and chemicals can be used to mitigate the negative effects of salinity on crops. Caffeic acid (CA) reduces oxidative stress by quenching reactive rxygen species (ROS). However, little is known about its ameliorative effects on the environment. Therefore, a hydroponics research experiment was performed to explore the role of CA application on the growth, root proliferation attributes, physiological, biochemical characteristics, and antioxidant defense systems of wheat exposed to salinity stress. The growth, physiology, and biochemical attributes of four wheat varieties (Faisalabad-08, Pasban-90, Aas-11 and Zincol-16) at the tillering growth stage (TGS) and stem elongation growth stage (SEGS) were examined to evaluate the interactive effects of caffeic acid (0, 50 CA and 100 µM CA) and salinity stress (0, 80 NaCl and 160 mM NaCl). Our results showed that the application of CA to growing media improved plant growth and helped in the net reversal of salinity-induced toxicity in TGS and SEGS of wheat plants. These responses to CA were due to its role in the upregulation of enzymatic antioxidant production, including Catalase (CAT), superoxide dismutase (SOD) and peroxidase (POD). Exogenously applied caffeic acid (100 µM) improved wheat growth and yield, enhanced K^+ concentration (resulting in increased K^+: Na^+ ratio), enhanced chlorophyll content (SPAD value) and carbon sequestration (photosynthesis response). Caffeic acid has a positive effect on wheat growth under saline conditions and is associated with a decrease in Na^+ accumulation and subsequent translocation to the aerial tissues of plants. ty stress reversal, with a better response at higher application doses.

CA-mediated ROS quenching, improved nutritional and water homeostasis and higher enzymatic

antioxidant responses were the main reasons for these results and salt-tolerant Faisalabad-08 was more responsive than Zincol-16 was. After optimizing reliable and cost-effective caffeic acid sources in a saline environment, it is suitable to recommend its use.

***Keyword**:* Caffeic acid; wheat; salt toxicity; K^+/N^+ ratio, osmotic stress, oxidative stress

CHILIES RESPONSE TO SALINITY IN HYDROPONIC CULTURE

Jameela Naz Jamro[1*], Inayatuallah Rajper[2], Nabi Bux Jamro[1], Ambrin Rajput[3], Ghulam Murtaza Jamro[2], Kaleemullah Shaikh[1] and Hassan Bux Rashidi[3]

[1]Soil Salinity and Reclamation Research Institute Tandojam, Agriculture Research Center, Tandojam, Pakistan
[2]Department of Soil Science, Sindh Agriculture University Tandojam, Pakistan
[3]Soil Fertility Research Institute, Agriculture Research Center, Tandojam, Pakistan

*Email: ambrin2004@gmail.com

ABSTRACT

Climate change is causing agricultural damage worldwide due to more frequent flooding and drought and increased soil salinity. Evaluating salinity tolerant plants using hydroponic approach has been found to be very effective and successful. Several plant species and varieties have been reported as salt-tolerant and sensitive to salinity. However, very little information is available on salinity tolerance of condiment plant species, including chillies. A hydroponic culture experiment was conducted to determine the effect of 60 and 120 mol m^{-3} NaCl salinity levels on the growth and development of chilli (cv. Sangri) in Completely Randomized Design (CRD) with three replications. Results revealed that compared to control, the chilli seedlings grown in 60 and 120 mol m^{-3} salt solutions showed 16 and 34% reduction in their height, had 15 and 25% fewer leaves, 15 and 47% shorter roots, displayed 27 and 63% fewer branches, 34 and 87% lower shoot dry weight, 57 and 85% lower root dry weight. The plants grown in 60 and 120 mol m^{-3} solutions accumulated 1.3 and 1.7% more Na^+ in their leaf tissues over control plants. The results of this study suggested that chilli (cv. Sangri) seedlings were very sensitive to salinity at 120 mol m^{-3}, hence planting of chilli seedlings, in an environment with high salinity should be avoided.

Key words: Hydroponic culture, Hoagland's nutrient solution, salinity levels, growth, yield and chilli seedlings

IMPACT OF SALINIZED WATER ON TWO MALAYSIAN OIL PALM VARIETIES AT THE SEEDLING PHASE

Marvi Memon[1], Allah Wadhayo Gandahi*[1], Nasir Shahzad Memon[2], Saleem Mohammad Sarki[1] and Hafeezullah Babar[3]

[1]Department of Soil Science, Sindh Agriculture University Tandojam
[2]Directorate of On Farm Water Management, Hyderabad, Sindh
[3]Soil Fertility Research Institute Tandojam

Email: awgandahi@sau.edu.pk

ABSTRACT

The most important component in figuring out how soil and/or groundwater salts affect plant growth in coastal regions is salinity tolerance. A pot experiment was laid out in a CRD design replicated thrice in a factorial arrangement to evaluate the effect of the saline water levels, 2.5, 5.0, 7.5 and 10.0 dS m^{-1} on oil palm varieties (3WAY cross and Yangambi PB14) at the post-nursery stage. Data were analyzed statistically for plant height, number of leaves $seedling^{-1}$, trunk girth, number of fronds $seedling^{-1}$, and fronds length. Results of the study revealed that saline water application brought a negative impact on almost all studied growth traits. The pots with the greatest salt level of 10.0 dS m^{-1} showed a decrease in the parameter values. The pots that received non-saline water irrigation, however, yielded the highest value of the evaluated agronomic parameters. Each variety responded more well under control circumstances (non-saline irrigation water). However, the highest value of studied traits was recorded from Yangambi PB14. Results further showed that saline water enhanced the concentration of Na, and Cl in oil palm leaves of both varieties. However, higher leaf K, Ca, and Mg accumulations were recorded in treatments that received normal/ non-saline water throughout the study. Moreover, a significantly different response was noted for both tested varieties. Variety 3Way Cross had more concentration of Na and Cl as compared to Yangambi PB 14. It was concluded that seedling growth of oil palm varieties was inhibited by increasing salt concentration. No seedling of any variety survived at the highest water salinity level of 10.0 dS m^{-1}. Malaysian variety Yangmabi PB14 should be recommended for plantation in coastal area of Sindh Pakistan using irrigation having EC less than 2.5 dS m^{-1}.

Keywords: Oil palm, salinity tolerance, saline water, Seedling stage

NUTRIENT MANAGEMENT OF SALT TOLERANT FORAGE GRASSES FOR ENHANCING FORAGE PRODUCTION AND NUTRITIONAL QUALITY IN SALT AFFECTED SOILS

Muhammad Rizwan*[1], Ayesha Mustafa[1], Abdul Rasul Awan[1]

[1]Soil and Environmental Science Division (SESD), NIAB

Email: rizwansalfi@yahoo.com

ABSTRACT

Salinity problem is increasing day by day in world due to continuous use of brackish groundwater for crop production. The salt-affected areas face the problems of both shortage and quality of fodder to meet feeding/dietary requirements of livestock animals. A comprehensive study was performed to evaluate different doses of nitrogen fertilizer on five salt tolerant forage grasses for biomass production and its forage quality in saline-sodic soil (pH 8.3-8.8, ECe 18-24 dS m^{-1}, SAR 50-60 and sandy loam) at Bio-saline Research Station (BSRS), Pakka Anna. The underground water quality (EC_{iw} 6.2 dS m-1, SAR 60 and RSC 18.6 mmolc L^{-1}) was used for irrigation. Different doses of urea fertilizer @ control, 75%, 100% and 125% of recommended fertilizer dose was applied at three cuttings. Five forage grasses viz. Para, Rhodes Kallar, Tall panic and Sporobolus were grown in filed. On average, Para grass produced maximum biomass yield (12.0 t ha^{-1}) followed by Rhodes grass (10.4 t ha^{-1}), Kallar grass (9.2 t ha^{-1}), Sporobolus (7.0 t ha^{-1}) and Tall panic (6.0 t ha^{-1}). Biomass yield of these grasses increased with increasing the fertilizer application. Maximum biomass yield was observed in Para grass @ 100% of fertilizer application and minimums biomass production was recorded in Sporobolus @ 50% of recommended dose. It was observed that salinity/ sodicity did not affect forage quality i.e crude protein, acid detergent fiber (ADF) and neutral detergent fiber (NDF) of all these grasses. Maximum crude protein was recorded in Rhodes grass (9%) followed by Para grass (8.2%) and minimum was recorded in Kallar grass (7.2%) followed by Sporobolus (6.5%) and Tall panic (6.5%). Maximum crude protein was recorded in urea fertilizer application @ 125% of recommended dose and minimum crude protein was recorded in control. Maximum salinity reduction was recorded in Kallar grass growing plots followed by Para grass, Rhodes grass, Sporobolus grass and Tall panic grass. It is concluded that forage yield and nutritional contents of grasses was enhanced with fertilizer management under high salinity/sodicity soils. Moreover, these forage grasses (Kallar, Para, and Rhodes grasses) have high potential for hay/silage production in salt affected areas for feeding and fattening of livestock animals.

Keywords Forage Production, Bio-saline Agriculture, Nutrient Management, Forage quality.

YIELD FORMATION IN MAIZE AS AFFECTED BY ABIOTIC STRESSES

Muhammad Saqib*[1], Muhammad Saad Bin Zafar[1], Tayyaba Naz[1], Qandil Shafiq[1], Nauman Sattar[1], Numan Zahid[1], Anosha Arshad[1], Aqsa Zafar[1]

[1]Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad.

*Email: m.saqib@uaf.edu.pk

ABSTRACT

Climate change induced stresses like drought, heat and salinity have negative impact on different crops including maize and wheat in Pakistan. The damaging effect of these stresses is particularly evident when the stresses befall at the reproductive stages of the crops as has been seen in the maize and wheat crop in previous years in Pakistan. It has been noted that reproductive stage of wheat is more sensitive to salinity, drought and waterlogging than the vegetative growth stages. For proper grain development, the transport of assimilates is essential at the time of reproductive stage and it is important to study the impact of different stresses on this process. There are enzymes like acid invertase which are involved in these processes and are affected under stress conditions. Here these processes have been studied in pot and field experiments. The role of acid invertase in determining the grain yield performance of maize in response to high temperature and water stress along with application of silicon and boron have been explored. There were six maize hybrids and the stress treatments were applied alone and in combination. The experiment continued till maturity. The individual as well as combined stresses significantly decreased the grain yield of all the maize hybrids/genotypes with a significantly higher reduction in the case of combined stress. The maize hybrids/genotypes differed significantly in response to these stresses. The physiological and biochemical processes of maize hybrids were also affected by the stresses with a better management in the case of stress resistant hybrids.

***Keywords*:** maize, grains, heat, water stress

EVALUATING PHYSIOLOGICAL AND BIOCHEMICAL RESPONSES OF WHEAT (*TRITICUM ASTIVUM L.)* AGAINST WATER STRESS BY USING ORGANIC AMENDMENTS

Muhammad Usama Mustafa[1*], Muhammad Anwar-ul-Haq[1], Alisha[1], Syed Muhammad Mizfar Gohar[1], Aneela Riaz[1], Rehman Ali[1]

[1]Saline Agriculture Research Center, Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad 38000, Pakistan

*Email: usamamustafa30@gmail.com

ABSTRACT

Water scarcity poses a significant threat to wheat production in a variety of climate patterns, particularly in dry and semi-arid zones. Present research aims at determining the impacts of organic amendments applied to the soil on wheat crop growth, development, and yield. There were five treatments T1= (farm yard manure (FYM), T2=poultry manure (PM), T3 press mud (sugarcane waste), T4=crop residue and T5=compost at the rate of 20 t ha^{-1} with three replications arranged in complete randomized design (CRD) with factorial arrangement. The complete set of treatments was tested at three level of field capacity (FC) including (20%, 40% and 60%). Results showed that, the FSD-2008 cultivar responded positively to the application of organic amendments. Application of poultry manure and compost showed the most significant results in improving growth parameters like shoot length, root length, shoot fresh weight, root fresh weight, shoot dry weight, and root dry weight of the wheat plant. Further to this, among all organic amendments, poultry manure performed the best under water stress. At higher water stress including FC 20%, there is 60%, 55% and 40% reduction in growth, physiological and chemical parameters respectively. Current study revealed that application of poultry manure mixed with other organic amendments, could be one of the potential strategies to avoid water stress losses and preserve soil water under water stress conditions.

Keywords: Salinity, organic amendments, wheat, water stress

"Soil Health: A Key to Food Security"

20th INTERNATIONAL CONGRESS OF SOIL SCIENCE

20-22 February 2024, Rawalpindi, Pakistan

SOIL, WATER & ENVIRONMENTAL CHEMISTRY

20th INTERNATIONAL CONGRESS OF SOIL SCIENCE
"Soil Health: A Key to Food Security"

PRESSMUD AND FARMYARD MANURE IMPROVE WHEAT PRODUCTIVITY IRRIGATED WITH TEXTILE WASTEWATER THROUGH INCREASING NUTRIENT UPTAKE AND DYE DEGRADATION

Muhammad Imran[1], Muhammad Aslam[1], Abdul Rasul Awan[1] and Muhammad Akhtar[1]

1Soil and Environmental Sciences Division, Nuclear Institute for Agriculture and Biology, Faisalabad 38000, Pakistan

*Email: imran1361@gmail.com

ABSTRACT

Textile dying produces a huge volume of colored effluent that is used to irrigate wheat at different times from sowing to maturity. This study investigated toxicity of Reactive RedS3B (RRedS3B) to wheat at different growth stages in pressmud (PM) and farmyard manure (FYM) amended soils. PM and FYM were applied at 0 and 20 Mg ha^{-1}, whereas RRedS3B (500 mg kg^{-1} soil) was applied either at sowing (RRedS3B-I$_0$), 1st irrigation (RRedS3B-I$_1$) or 2nd irrigation (RRedS3B-I$_2$). It was found that the application of RRedS3B-I$_0$ and RRedS3B-I$_1$ decreased plant height by 33 and 5%, fertile tillers by 68 and 42%, straw biomass by 85 and 35%, and grain yield by 84 and 40%, respectively compared to simple water irrigation on un-amended soil. However, RRedS3B-I$_2$ did not show toxicity to wheat. Amending soil with both PM and FYM enhanced growth and yield of wheat; however, PM proved more effective in improving yield and decreasing dye concentration in soil. PM lowered RRedS3B concentration by 73, 61 and 71%, while FYM decreased it by 57, 29 and 61% in soils treated with RRedS3B-I$_0$, RRedS3B-I$_1$ and RRedS3B-I$_2$, respectively over control. Furthermore, FYM and PM application increased soil available phosphorus by 2.26- and 7.17-fold, whereas potassium by 1.47- and 1.06-fold, respectively. Accordingly, application of FYM and PM increased phosphorus and potassium uptake by grains whereas RedS3B-I$_0$ and RedS3B-I$_1$ produced opposite effect. It is concluded that RRedS3B is more toxic to wheat during early growth period, and application of PM and FYM is effective in improving wheat yield through mitigating the dye toxicity and increased nutrient uptake.

Keywords: Extractable RRedS3B dye; Phyto-toxicity; Nutrient uptake; Pressmud; Cow dung

ESTIMATION OF LEACHING LOSSES OF PHOSPHORUS IN TEXTURALLY DIFFERENT SALINE-SODIC SOILS

Sadia Sultana[*1, 2], Ayesha Amin[1], Muhammad Sabir[1], Saifullah[1], Ghulam Murtaza[1], Sadia Bibi[1]

1. Institute of Soil and Environmental Sciences, UAF
2. Institute of Soil Chemistry and Environmental Sciences, AARI

*Email: ssadiaiqtidar@gmail.com

ABSTRACT

Salinity-fertility interaction has not been properly explored particularly in saline-sodic soils. A lysimeter study was conducted in wire-house of Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad, to investigate the phosphorus leaching losses in texturally different saline-sodic soils. Three treatments viz: S_0 (Control); S_1 (Saline-sodic level I (EC= 8dS m^{-1}, SAR= 26 $mmol_c\,L^{-1}$)), S_2 (Salinity level II (EC= 16 dS m^{-1}, SAR= 52 $mmol_c\,L^{-1}$)), were tested in two texturally different soils; Silt loam and Sandy loam. The experiment was replicated thrice under completely randomized design. The results reveled a significant interaction between texture, and salinity-sodicity for leaching losses. Maximum volume of leachate (2050 ml) was obtained in control in silt loam soil, while this texture showed minimum volume of leachate (1740 ml) under S_2. Similarly sandy loam soil produced maximum leachate volume (2810 ml) under normal (control) conditions while, high salinity-sodicity level (S_2) had a decreasing effect on leachate volume (900 ml). Salinity-sodicity had a fascinating effect on phosphorus leaching. Results reveled that maximum P (417 ppm) was leached in sandy loam soil under normal conditions while leaching losses were hampered due to salinity-sodicity in S_1 and S_2 (120 ppm, 13 ppm respectively). On the other hand, P leaching loses were markedly fewer in silt loam soil i.e. under normal conditions (S_0) and S_1 the P concentration in leachates was 100 and 120 ppm respectively, which was decreased to 13 pp-m in S_2. Hence it is concluded that, salinity-sodicity has a significant influence on soil P concentration so the availability of P can be enhanced through tailored management practices.

***Keywords*: Phosphorus, Leaching, Texture, Saline-Sodic**

SPATIAL VARIATION OF SALT DISTRIBUTION ACROSS DEPTHS IN DIVERSE SOIL SERIES NEAR TANDOJAM

Nasir khan Katiyar[1], Nazia Rais[1], Inzamam-ul- Haque Khanzada[1] ,Sohail Qureshi[1] and Ghulam Mustafa Banbhan[2]

[1]Soil & Environment Research Institute, Tandojam
[2]Agriculture research institute Tandojam

*Email: nkkjaffri@gmail.com

ABSTRACT

Understanding the physicochemical properties and salt distribution in soil series around Tandojam is crucial for informed agricultural practices, as it provides valuable insights into soil quality, salinity levels, and potential reclamation strategies, ultimately contributing to sustainable and effective land management. a comprehensive investigation was undertaken to examine the physicochemical characteristics and salt distribution within selected soil series near Tandojam. The study focused on seven distinct soil series: Pacca, Ghari, Sultanpur, Shahdra, Lalian, Miani, and Dungi. Soil samples were meticulously collected at varying depths (0-20 cm, 20-40 cm, 40-60 cm, 60-80 cm, and 80-100 cm) from each series. Analysis of these soil samples was conducted to ascertain the properties and salt content at different depths in the soil series under scrutiny.The results indicated that Lalian, Ghari, Miani, and Dungi soils exhibited a heavy texture, while Shahdra, Sultanpur, and Pacca soils were moderately textured. All soil series displayed low organic matter, moderate calcareousness, and a slightly to highly alkaline nature. Salinity assessments revealed that the Ghari Soil Series was highly saline, whereas the others exhibited non-saline characteristics, as evidenced by low electrical conductivity in soil extracts. The distribution of salts across various depths within distinct soil series exhibited variability. However, sodium chloride emerged as the predominant salt in all cases. Notably, the Dungi soil series exhibited a significant presence of sodium bicarbonate, contributing to an elevated soil pH. Further analysis revealed a higher concentration of soluble salts in the topsoil layers, gradually decreasing with increasing soil depth. Based on the classification of soil series for salinity status, it was observed that Ghari was saline and non-sodic, while Dungi was sodic and non-saline. The remaining soil series were classified as non-saline and non-sodic. Consequently, the study concluded that the Ghari soil series could be reclaimed through the application of substantial amounts of canal water, while the reclamation of the Dungi soil series would necessitate the addition of gypsum.

Keywords: Soil Series, soil depths, physicochemical properties, salt distribution, Pacca

RECLAMATION OF DENSE SALINE-SODIC SOILS BY BREAKING SUBSOIL WITH AUGER IN A RICE-WHEAT ROTATION USING GYPSUM, SAND AND RICE HUSK

Muhammad Abdullah[1*] Misbah Abbas [1,] Ghulam Murtaza

[1]Institue of Soil and Environmental Sciences UAF.

Email: ag66009@gmail.com

ABSTRACT

Soil salinity and sodicity alter the physical, chemical, and biological properties of soil and is a huge hindrance to sustainable agriculture worldwide. High levels of salinity and sodicity adversely affect the yield and quality of staple food crops including rice and wheat which needs to be addressed. Reclamation of these dense saline-sodic soils through deep ploughing is difficult under small land holdings and needs mechanized farm machinery. Keeping in view these issues, this study was planned to reclaim these soils by implementing auger hole technique which is a cost-effective approach. A field trial was conducted at Chak No. 62 R/B Tehsil Jaranwala, District Faisalabad (Site 1) and Chak No. 84 G/B Tehsil and District Faisalabad (Site 2) having dense saline-sodic soils. The holes of 100 cm depth were made using auger. Each hole had dimensions of 30 m^2 (6 m × 5 m)* and was filled with rice husk, sand, and gypsum (1:1:1 volume ratio). A wheat-rice crop rotation was practiced. The results indicated that the pH_s, EC_e, of both sites were significantly reduced. Likewise, there was a significant decrease in soluble salts including cation; Na^+ and anions; CO_3^{2-}, HCO_3^-, Cl^- and SO_4^{2-}. On the other hand, Ca^{2+}+Mg^{2+} concentration was increased during reclamation. Due to this increase in Ca^{2+} + Mg^{2+} and decrease in Na^+, the SAR of both sites was significantly reduced. Moreover, the increase in CEC and decrease in free calcium carbonate ($CaCO_3$) was also documented for the soils of Chak No. 62 R/B and Chak No. 84 G/B. The growth and yield parameters of wheat and rice for both sites were also significantly improved. Two-years data showed that 2nd year paddy yield of rice crop increased 18% and 35% as compared to 1st year paddy yield at Chak 62 RB and Chak 84 GB respectively. Likewise, 2nd year grain yield of wheat crop increased 24% and 9% as compared to 1st year grain yield at Chak 62 RB and Chak 84 GB respectively. This study concluded that auger hole technology can be an alternative and cost effective source of reclamation for small landholders.

***Keywords*:** Salinity, Sodicity, Reclamation, Auger hole technique, rice husk, sand, gypsum

PHOSPHORUS LEACHING IN SALINE-SODIC SOILS FERTILIZED WITH PHOSPHATIC FERTILIZER AT DIFFERENT LEVELS

Sheeza Amin[1], M. Sabir*[1], Saifullah[1], Hamaad Raza Ahmad[1], Sadia Bibi[1] and Ejaz Ahmad Waraich[2]

[1]Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad
[2]Department of Agronomy, University of Agriculture, Faisalabad

Email: cmsuaf@gmail.com

ABSTRACT

Phosphorus (P) leaching in saline sodic soils is a critical environmental issue that poses significant challenges to sustainable agriculture and ecosystem integrity. Plants get most of the phosphorus they need for current agricultural production from the soil, while only around 10-25% of the phosphorus fertilizer applied to soil really gets used. To mitigate phosphorus leaching in saline sodic soils tailored fertilization practices and soil management strategies should be adopted. This experiment was conducted with various EC_e (8 and 16 dS m^{-1}) and SAR (26 and 52) levels along with the source of DAP. Desired EC_e and SAR levels were established artificially by using different sources of salt, i.e., Na_2SO_4, NaCl, $CaCl_2$ and $MgSO_4$ calculated through Quadratic equation. This study was conducted to determine phosphorus leaching losses in saline sodic soil. lysimeters (n=27) was filled with 2.5 Kg soil each. After that that three levels of phosphorus was applied. The fertilizer source was diammonium phosphate (DAP). Total of three irrigation sessions were administered using tap water, Plastic canes was used to collect leachate. Volume of leachate was maximum at Salinity level 2 (2400 ml) in leachate 1 as compared to leachate 3. P leaching was low in salinity level 1 by the <20% recommended level of P and high in salinity level 2 by >20% level of P as compared to normal soil in Leachate 1. P leaching was low in salinity level 2 by the <20% recommended level of P and high in salinity level 1 by >20% level of P as compared to normal soil in Leachate 2.P leaching was low in normal soil by <20% recommended level of phosphorus as compared to salinity level 1 and salinity level 2 in leachate 3.P leaching losses was high in >20% recommended level of P as compared to recommended level of P and <20% recommended level of P.

Keywords: ***S****aline-sodic soil, P leaching, DAP, Modeling*

EFFECT OF MICRON SIZED AMENDMENTS FOR ENHANCING CD IMMOBILIZATION AND REDUCING ITS UPTAKE IN DIFFERENT TISSUES OF MAIZE CROP GROWN ON CONTAMINATED SOILS

Mujahid Ali*[1], Muhammad Zia ur Rehman[1], Sana Rana[1], Muhammad Usman[1], Zahra Rana[2] Muhammad Ashar Ayub[3]

[1]Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad, 38040, Pakistan;
[2]Department of Biochemistry, University of Agriculture, Faisalabad, 38040, Pakistan;
[3]Institute of Agro-Industry and Environment, The Islamia University of Bahawalpur, 63100, Bahawalpur, Punjab, Pakistan

Email: ranamujahidali99@gmail.com

ABSTRACT

Contamination of soil with Cd poses severe threats to ecosystem sustainability and agricultural productivity, leading to food insecurity. Past studies have been conducted by using bulk-sized amendments. A pot experiment was conducted to determine the efficiency of micron sized (< 140 µm) gypsum (Gyp), single super phosphate (SSP), rock phosphate (RP), rice husk biochar (RHB), farm yard manure (FYM), and compost (CMP) amendments to determine the ABDTPA extractable Cd concentration in soil, Cd accumulation and uptake in different tissues of maize crop and also evaluated the translocation index, harvest index as well as to determine the health risk index by consuming the maize grains in artificially (30 and 60 mg kg^{-1}) Cd contaminated soils. The results showed that RHB decreased the ABDTPA extractable Cd concentration by 59.14 and 52.08% and similarly decreased Cd concentration in roots (65.85 and 58.13%), shoots (72.57 and 63.74%), and grains (84 and 76.12%) respectively, in both 30 and 60 mg kg^{-1} Cd contaminated soils as compared to control. Cd uptake in roots (33.34 and 25.28%), shoots (39.12 and 29.10%), and grains (67.28 and 54.53%), translocation index (51.40 and 41.40%), harvest index (20.45 and 18.27%) and health risk index (84 and 76.12%) decreased in both 30 and 60 mg kg^{-1} Cd contaminated soils respectively, was measured in soils where RHB was applied. Overall the above results showed that RHB having (< 140 µm) micron size was the most efficient source for reducing the bioavailability of Cd in soil and its uptake and accumulation in different tissues of maize crop and ultimately reduces the health risk index by consuming the maize grains.

Keywords: Micron Sized Amendments, Cd Bioavailability and Uptake, Contaminated Soils, Maize

IMPACT OF VARIOUS AMELIORANTS ON GEOCHEMICAL CHROMIUM DISTRIBUTION AND CO_2-CARBON EFFLUX UNDER PADDY SOIL CONDITIONS

Muhammad Ashir Hameed[1*], Muhammad Mahroz Hussain[1,2,4,5], Irshad Bibi[1*], Nabeel Khan Niazi[1], Muhammad Shahid[2], Muhammad Ashraf[1]

[1] Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad, Faisalabad, Pakistan
[2] School of Emergency Management, School of Environment and Safety Engineering, Jiangsu Province Engineering Research Center of Green Technology and Contingency
Management for Emerging Pollutants, Jiangsu University, Zhenjiang, 212013, People's Republic of China
[3] Department of Environmental Sciences, COMSATS University Islamabad, Vehari Campus, Vehari, Pakistan
[4] University of Wuppertal, School of Architecture and Civil Engineering, Institute of Foundation Engineering, Water- and Waste-Management, Laboratory of Soil- and Groundwater-Management, Pauluskirchstraße 7, 42285 Wuppertal, Germany
[5] HAM Organics (PVT) Limited, Punjab, Pakistan

*Email: irshad.niazi@uaf.edu.pk

ABSTRACT

Chromium (Cr) is a transition element and considered an environmental threat due to its toxic and carcinogenic nature as hexavalent Cr (Cr(VI)) is more mobile and bioavailable compared to trivalent Cr (Cr(III)). Hexavalent Cr is a non-biodegradable and toxic contaminant gains its importance due to its vast industrial application particularly in tannery wastewater. The aim of the study was to use organic (biochar (BC), vermicompost (VC), and sugarcane bagasse (SCB)) and inorganic amendments (fly ash, gypsum and scrap iron) impact on Cr(VI) immobilization and its geochemical fractionation in an incubation study for 45 days with CO_2-C efflux (calculated periodically). Results showed that carbon mineralization rate increased dramatically during incubation period. Carbon dioxide efflux was maximum with VC (2538 CO_2–C mg kg^{-1}) amended soil while minimum with fly ash amended soil i.e., 1002 CO_2–C mg kg^{-1}. Geochemical fractionation data showed that maximum soil Cr exchangeable pool was 33% with fly ash followed by scrap iron (29.9%) compared to other amendments. Organic bound soil Cr fraction was maximum with VC (27%) and BC (20%) of total soil Cr distribution. The CO_2-C efflux regression models showed that decay constant was significantly higher with ($p<0.05$) SCB amended soil (0.0578 ± 0.012) compared to other amendments. However, the soil labile C pool was found maximum with VC and BC amendments i.e., 3508.4 ± 349.4 and 1962.07 ± 217.5 CO_2-C mg kg^{-1}, respectively. Overall, the current study advances our understanding on the pivotal role of organic amendments, notably VC and BC, in immobilizing Cr(VI) under paddy soil conditions with low (CO_2) carbon loss, albeit it is dependent on soil and ameliorant type.

Keywords: Chromium contamination; Biochar; vermicompost; Geochemical Cr fractionation; CO_2–C efflux; Carbon pool; Decay constant

SEDIMENT COLOUR AND GEOCHEMICAL CHARACTERIZATION OF UNDERGROUND SEDIMENTS FOR ASSESSING ARSENIC-CONTAMINATION POTENTIAL OF GROUNDWATER WELLS

Muhammad Mahroz Hussain[1,2,5*], Irshad Bibi[1], Nabeel Khan Niazi[1] Muhammad Shahid[2], and Jorg Rinklebe[5]

[1] Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad, Faisalabad, Pakistan
[2] School of Emergency Management, School of Environment and Safety Engineering, Jiangsu Province Engineering Research Center of Green Technology and Contingency
Management for Emerging Pollutants, Jiangsu University, Zhenjiang, 212013, People's Republic of China
[3] Department of Environmental Sciences, COMSATS University Islamabad, Vehari Campus, Vehari, Pakistan
[4] University of Wuppertal, School of Architecture and Civil Engineering, Institute of Foundation Engineering, Water- and Waste-Management, Laboratory of Soil- and Groundwater-Management, Pauluskirchstraße 7, 42285 Wuppertal, Germany
[5] HAM Organics (PVT) Limited, Punjab, Pakistan

*Email: hmahroz@gmail.com

ABSTRACT

Arsenic (As) geochemistry under dynamically changing redox conditions in underground sediments is complex and controlled by various factors. Here, in this study total As distribution, geochemical As fractionation and other key geochemical attributes in the borehole of underground As-contaminated sediments (up to 120 ft) collected (n = 20) at 6 ft equal depth intervals were investigated. Results showed that the sediments having black colour (10YR 4/2 to 10YR 2/2 as per Munsell chart) had high As concentration (range: 70-92; mean: 71 and median: 78 mg kg^{-1}). However, sediments with grey colour (5Y 6/4 to 5Y 5/1) had low As concentration (46–77; mean: 68 and median 58 mg kg^{-1}). Iron, zinc, sulfur, and manganese concentration ranged from 900–4800, 12–107, 58–724, and 159–775 mg kg^{-1}, respectively in borehole As-contaminated sediments at all the depths (0-120 ft). Geochemical As fractionation using a sequential extraction procedure (SEP) showed that the exchangeable As pool was found to be maximum at 96 ft depth (60%) in dark-grey to black colour (reduced) sediments and it was minimum in off-white to red colour (18-30%; at 18 to 42 ft depth). Arsenic percentage distribution in geochemically extracted As fractions was in the order of exchangeable As > amorphous Fe oxide bound > Mn oxides bound > specifically sorbed > organic bound (at 96 ft depth). The FTIR spectra showed the presence of various surface functional groups (e.g., –OH, –COOH, Si–O, Fe–O, –C=O) in sediments that possibly indicate As reduction and release. Overall, the study highlights that sediments colour can be used to indicate As contamination in underground sediments that are used for pumping groundwater. Based on the integrated information of sediment colour, geochemical As fractionations and spectroscopic coupled with microscopic data, As safe and As-unsafe boreholes can be distinguished for groundwater pumping.

Keywords: Arsenic; source identification; microscopic techniques; Munsell colour chart

COMPARISON OF VARIOUS KINETIC MODELS FOR POTASSIUM RELEASE MODELLING OF ALKALINE SOILS OF DERA GHAZI KHAN, PUNJAB, PAKISTAN

Muhammad Imran1*, Ghousia liaquat1, Tahira Jameel1, Muhammad Ashar Ayub1, Ghulam Hassan Abbasi1, Muhammad Nadeem1, Waseem Hassan2,3, Muhammad Ali1, Muhammad Irfan1

1Institute of Agro-Industry and Environment, Faculty of Agriculture and Environment, The Islamia University of Bahawalpur, 63100, Punjab, Pakistan
2Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad, 38000, Faisalabad, Punjab, Pakistan
3Soil & Water Testing Laboratory for Research, Government of Punjab, Bahawalpur

*Email: mr.imranleghari@gmail.com

ABSTRACT

Potassium release from soil is an important aspect of modern agriculture and its bioavailable concertation is important for crops production. Ammonium Acetate solution (1*N*) is usually used for estimation of exchangeable K contents of soil but shaking time dependent release of K via ammonium acetate extractant is an unknown aspect of research. Moreover, comparison of K release pattern from cultivated and uncultivated soils upon shaking with this extractant is also an unattended aspect of research. For the same purpose present work was planned and conducted to compare K release potential of three different soils (Uncultivated, and 2 cultivated soils from Dera Khazi Khan). A batch desorption experiment was conducted for variable shaking times of extraction with ammonium acetate (1-240 min) and kinetic models were used to evaluate results (Pseudo Second Order Kinetic Model Linear type 1-4 and non-linear, and Elovich equations). The PSO Type 1 was the most effective in explaining K release trend compared with time and the uncultivated soil (S1) and cultivated soil (S2, S3) were found to be having equilibrium K release capacities of 508.6 mg kg^{-1}, 207 mg $kg^{-1}$and 84 mg kg^{-1} with R^2 values of 0.997, 0.998 and 0.996 respectively. The release constant (k) for these soil sets (S1, S2, S3) were of 7.35E-04 (min^{-1}), 2.62E-03 (min-1) and 4.14E-03 (min^{-1}) respectively predicting that k release potential per unit time was higher in S1 than both cultivated soils. Other models (PSO Type 2-4, non-linear; Elovich linear and non-linear) also reported similar comparison among all tested soils but the best model in term of predicting trend (in term of goodness of fit) was PSO-1. The results also revealed that 40 min of shaking with extractant is enough to reach equilibrium concentration of extraction for all three types of soil.

***Keywords*:** Potassium Release, Exchangeable potassium, Equilibrium kinetics

COMPARATIVE RESPONSE OF COATED AND COMMERCIAL UREA ON LETTUCE PRODUCTION AND NITROGEN CONTENT

Mahnoor Baloch[1], Saima Kalsoom Babar[1*], Naseebullah Achakzai1, Zeeshan Mashori[1], Hassan Ali Shujrah[1],

[1]Department of Soil Science, Sindh Agriculture University Tandojam, 70060, Pakistan

*Email: mahabaloch663@gmail.com

ABSTRACT

On cultivable land, nitrogen (N) is commonly lost from urea, which is a renowned and communal source of N. Increasing crop yield by limiting ammonia (NH_3) volatilization is an integral part of mitigating N losses. The present study aimed to compare the effects of coated and commercial urea on lettuce production and N content. Three repetitions of a pot experiment with five treatments (N (zero), 120 & 140 kg N ha^{-1} applied as commercial or coated urea) were carried out under control conditions under the premises of Department of Soil Science, Sindh Agriculture University Tandojam. The results showed that the substantial effect of polymer coated urea on efficient N use in biomass production and N accumulation in lettuce plants. It was observed that maximum growth was recorded where N in the form of polymer coated urea was applied at the rate of 140 kg N ha-1 (p<0.05) as compared to control. Consequently, the maximum fresh weight (93.50 g pot^{-1}), dry weight (5.72 g pot^{-1}), number of leaves (22 pot^{-1}), N content in plants (4.49 %), and N content in soil after harvesting (0.45 %) were determined. However, the minimum growth parameters were recorded under control where no/0 N was applied. A significant effect ($p<0.05$) between variable rates and methods was observed. In conclusion, polymer-coated urea can reduce nitrogen losses and enhance lettuce production by improving N use efficacy.

Keywords: N-losses, green vegetables, palm-stearin coating, urea, hydrolysis rate

PHYTOREMEDIATION POTENTIAL OF CUT-FLOWER PLANTS FOR SELECTED HEAVY METALS

Muhammad Mohsin Raza[1*], Matiullah Khan[1], Shoaib Ahmad[1], RizwanAhmad[1], Hafiz Imran[1], Samiullah[2], Shahid Nadeem[3]

Soil Environment and Chemistry Program, Land Resources Research Institute, NARC, Islamabad.
University of Baltistan Skardu
Horticulture Research Institute, National Agricultural Research Centre Islamabad.

*Email: mohsinraza_5@yahoo.com

ABSTRACT

This experiment was conducted at Horticulture Research Institute with collaboration of soil Environment and Chemistry Program, Land Resources Research Institute, NARC, Islamabad. The experiment focused on assessing the impact of these heavy metals on shoot and root growth as well as their accumulation in plant tissues. Plant height and weight was significantly affected across all three plants with the application of heavy metals treatment. For Static, Stock, and Calendula, the plant height decreased notably after exposure to nickel, lead, and chromium compared to the control group. The highest plant height (33.3 cm) was observed in static under nickel application while, the lowest plant height (22 cm) was noted in stock under lead application. Similar trends were observed in shoot weight as well. All heavy metal treatments suppress shoot weight compared to the control group in all the three flowers. Nickel treatment exhibited the highest shoot weight (12.4g) among the heavy metal treatments for Calendula and Static, while chromium showed inconsistent effects, either causing slightly less reduction or significantly lower shoot weights compared to the control group. Root length and weight were also impacted by heavy metal exposure. Across all three plant species, root length and weight decreased notably after exposure to nickel, lead, and chromium compared to the control group and lowest values of root length (05 cm) were recorded in stock under lead application. However, chromium treatment occasionally showed a slightly lesser reduction in root length and weight compared to lead and nickel, indicating varying impacts of different heavy metals on root development. Calendula exhibited the highest concentrations of nickel and lead in both shoots (120 ppm) and roots (141 and 103 ppm), followed by Static showed moderately high concentrations. Stock, on the other hand, had comparatively lower concentrations of these metals in its shoots and roots. Overall calendula uptake highest concentrations of nickel (224 ppm) and lead (266 ppm). These findings suggest that Calendula might be a suitable candidate for phytoremediation due to its higher metal accumulation capacity, while Stock could also play a role, albeit with lower metal concentrations.

Keyword: Heavy metal, cut flower, Phytoremidiation

SYNTHESIS AND CHARACTERIZATION OF METAL ORGANIC FRAMEWORKS FOR REMOVAL OF PARTICULATE MATTER

Anum Shafique*[1]

[1]Institute of Soil and Environmental Sciences, PMAS Arid Agricultural University Rawalpindi

*Email: anumshafque682@gmail.com

ABSTRACT

In this century contamination of both indoor and outdoor air is increasing especially statistical data about particulate matter (PM) is alarming. Particulate matter is very dangerous for the health of living being especially human. Whole world is facing this problem specially India, China, Pakistan etc. This research work focus on synthesis of ZIF-8/MOF (Metal-Organic frameworks) by solvothermal method. The synthesized ZIF-8/MOF was characterized by FTIR and SEM. The fabrication of ZIF-8/MOF Filters are done by roll-to-roll hot pressing method and the removal efficiency of synthesized ZIF-8/MOF was 74% for PM2.5.

Keywords: Particulate matter, FTIR, SEM.

ORGANIC AMENDMENT ASSISTED LEACHING AND RECLAMATION OF SALT-AFFECTED SOILS.

Saifullah[1*], Zareen Batool[1], Sadia Bibi[1] Muhammed Sabir[1], Sidrah Ashfaq[2]

[1]Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad-38040
[2]Department of Farm Machinery and Power, University of Agriculture, Faisalabad-38040

Email: Swcl@uaf.edu.pk

ABSTRACT

Salt affected soils are the major threats to sustainable crop production in arid and semi-arid area of the world containing Pakistan. Saline-Sodic soils are increasing with time due to misuse of land and water resources which cause serious damage to the world food supply. It is the need of the hour to use some reclamation and management practices for the betterment of soil productivity of degraded soils. These stresses can be ameliorated through different approaches such as leaching, mulching and amendment application. Different amendments (organic and inorganic) have been used to ameliorate saline-sodic soils. The purpose of this study was to evaluate the impact of different factors on organic amendments for leaching of salts and improving salt affected soil. For this purpose, lysimeter experiment was conducted to monitor the effect of farm manure, biochar, and compost on enhancing leaching of salts and improving the soil conditions. The soil was mixed with amendment at the rate of 1% and 2% (wt/wt). The PVC pipes (triplicate) filled with soil and amendments were arranged in completely randomized design. After collecting 3 leachates of water through soil, Leachate as well as soil samples were characterized for various physical (soil texture, density, and porosity) and chemical (EC, SAR, RSC and phosphorous and organic matter) properties. The results of this research showed significant improvement in EC, pH, SAR and ESP of soils with the application of organic amendments. However, biochar application was found superior in increasing the Ca+Mg concentration in soil and at the same time decreasing the electrical conductivity of the soil. Biochar showed more prominent results when applied at 2% compared to 1% rate. The results from current study highlight the importance of biochar application in providing Ca and leaching of soluble as well as exchangeable Na from saline-sodic soils.

Keywords: Leaching, saline-sodic soils, organic amendments

MODELING IMPACT OF N ON MUSTARD CROP USING DSSAT

Nadir Ali[*1], MukhtarAhmed[1], Ghulam Qadir[1], Dr. Ghulam Shabbir [2], Dr Muhammad Asim[3], Mansoor Ali[1], Alvina Faraz[1]

[1]Department of Agronomy, PMAS Arid Agriculture University Rawalpindi-46300
[2]Department of Plant Breeding and Genetics, PMAS Arid Agriculture University Rawalpindi-46300
[3] Coordinator (Oilseeds) Pakistan Agricultural Research Council Plant science Division

Email: nadirtanoli199717@gmail.com

ABSTRACT

In intensive agricultural systems, nitrogen (N) fertilizer is one of the most important factors that influence crop production and N losses. This work aimed at evaluating the N best management practices using the calibrated and validated Decision Support System for Agro-technology Transfer (DSSAT) model for mustard crop to reduce the impact of nitrogen loses on irrigation return flows quality. Treatments includes five nitrogenous levels (No control, N_1= 30 kg ha^1, N_2-60 kg ha^1, N_1= 90 kg ha^1, N= 120 kg ha and Ns 150 kg ha^1) and two nitrogen fertilizer application timings (M_1= full dose at time of sowing and M_2= half dose at sowing time & half at flowering time). Split application method showed best result compared to the full dose application method with increase in LAI 4%, CGR 11%, Biomass 8%, seed yield 10% and oil yield 8%. N150 showed best results. Model simulation results were very close to observed values for all treatments with RMSE values for grain yield 0.32 during 2022-23. This study supports the potential of the DSSAT model to incentivize farmers to adjust their N fertilizer practices to crop requirement and soil properties to ensure production while improving environmental sustainability.

Keywords: Oilseed, Climate Change, Modeling, Nitrogen Use Efficiency, Best management practices.

OPTIMIZING DI-AMMONIUM PHOSPHATE (DAP) COATINGS IN ALKALINE SOIL FOR ENHANCED SOIL FERTILITY AND PLANT GROWTH: A COMPREHENSIVE EVALUATION

Muhammad Tariq[1], Umair Riaz[1*], Muhammad Arif[1], Abid Hussain[1], Ahmad Waqas[2], Tanveer-ul-Haq[1], Haseeb ur Rehman[1]

[1]Department of Soil and Environmental Sciences, MNS-University of Agriculture, Multan-60000, Pakistan
[2]Plant Physiology and Chemistry Section, Central Cotton Research Institute, Multan, Pakistan

*Email: umair.riaz@mnsuam.edu.pk

ABSTRACT

Phosphorus (P) is an essential nutrient required by plants for normal growth and development. The availability of P to plants for uptake and utilization is impaired in alkaline and calcareous soil due to the formation of poorly soluble calcium phosphate minerals. Adding fertilizer P at "normal" rates and with conventional methods may not result in optimal yield and crop quality in these soils common in arid and semi-arid regions. Several fertilizer P management strategies have been found to improve P nutrition for plants grown in alkaline and calcareous soil. Therefore, the chemical coatings of DAP as T1 (control-without coating DAP), T2 (DAP coated with elemental sulphur) (S-DAP), T3 (DAP coated with Humic acid) (HA-DAP), T4 (DAP coated with polymer), (P-DAP) and T5 (DAP coated with mixture of elemental S, Humic acid, and polymer) (M-DAP) were performed to enhanced the phosphorus use efficiency in alkaline soil by testing cotton (*Gossypium hirsutum L.*) crop. The experimental study was conducted under RCBD design at Central Cotton Research Institute (CCRI) Multan field area.The pre-sowing analysis of the soil showed electrical conductivity (EC) 1.25 dS m^{-1}, 8.20 pH, 0.62% organic matter, 8.1 mg kg^{-1} available-P, 110 mg kg^{-1} the available-K and the textural class was loam. All the treatments showed different results as compared to control at non-significant level while T_5 (M-DAP) showed significant ($p \leq 0.05$) results. The application of T_5 (M-DAP) at 'normal rate' improved the plant height a 3.0%, chlorophyll content at 4.0%, number of nodes per plant at 4.0%, number of bolls of cotton plant at 12%, cotton yield at 16.2%, N at 12% and Pat 25% as compared to control (DAP without coating). It was concluded that DAP coating with mixture of elemental S, Humic acid, and polymer can increased the availability of P in alkaline soil even at 'normal rates.

Keywords: Crop yield, fertilizer use efficiency, soil chemistry, alkaline soil, sustainability

OTHERS

PHENOTYPIC EVALUATION OF TOMATO F2 POPULATION IN ARID CLIMATE OF LAYYAH PAKISTAN

Ifrah Javed[1], Sawaira Ashraf[2], Humera Ashraf[*3], Susan Muhammad[4], Muhammad Zahid Ashraf[4], Hammad Ahmed[5]

[1]Department of Plant Breeding and Genetics PMAS, Arid Agriculture University, Rawalpindi, 46300, Pakistan.
[2]Department of Plant Breeding and Genetics, Faculty of Agriculture Sciences and technology, Bahauddin Zakariya University Multan, Multan, 60800, Pakistan.
[3]Guangdong Provincial Key Laboratory of Plant Molecular Breeding; College of Agriculture south China University, Guangzhou 510642, China.
[4] Department of Plant Breeding and Genetics, University of Agriculture Faisalabad, 38000, Faisalabad, Pakistan.
[4]Department of Plant Protection, College of Agriculture south China University, Guangzhou 510642, China.
[5]Department of Plant Breeding and Genetics PMAS, Arid Agriculture University, Rawalpindi, 46300, Pakistan.

*Email: humeraa49@gmail.com

ABSTRACT

Tomato (*Solanum lycoperiscum*) cultivation faces several challenges including poor yields, weed infestations, pest issues, heavy production costs, fluctuating market prices, outbreak of diseases, marketing barriers and other related difficulties. All of these variables contribute to lower Tomato yield and market prices in Pakistan which is exacerbated by challenges such as insufficient storage facilities and a lack of market hubs. To address these issues, researchers are evaluating exotic and hybrid tomato varieties with the goal of increasing yield for future breeding projects. In this situation, an experiment was performed at the University of Layyah's Research Farm, where 50 F2 hybrid plants of tomato were grown in a Walk-in Tunnel. This study aimed to check the quantitative traits at different growth stages such as initial leaf production, early flowering and flower cluster formation till the harvesting phase. According to the present findings, the F2 hybrid performed better in various quality traits, including, plant height, fruit count per plant, weight of the fruit, and other attributes related to yield. A correlation analysis was performed to better understand the link between various features, and it was discovered that yield correlates positively with the number of fruits per plant, fruit weight, and plant height, but negatively affect the number of leaves and dry weight. Further assessments, including statiscal analysis, heredity, and phenotypic trait evaluation, revealed that the F11*F12 hybrid has the potential to increase tomato yields.

Keywords: *Evaluation, Hybrid Tomato, Correlation, Pakistan, Breeding, Quantitative traits*

NUTRIENT MANAGEMENT STRATEGIES FOR SUSTAINABLE COTTON PRODUCTION: A FIELD RESEARCH INITIATIVE IN LAYYAH DISTRICT, PAKISTAN

Ahsan Amin[1], Faiz Ul Hassan[2]*, Umm e Habiba[3], Muhammad Islam [4], Umar sohail[2], Hafiz Muhammad Ali Raza[2], Muhammad Umair[5], Muhammad Faizan Bashir[2], Muhammad Noor Chan[6], Muhammad Usman[7], Muhammad Atif[8]

[1]Department of Plant Pathology, College of Agriculture, Bahauddin Zakariya University, Multan, 60800, Pakistan.
[2]Department of Soil Science, College of Agriculture, University of Layyah, Layyah, 31200, Pakistan.
[3]Department of Agronomy, University of Agriculture Faisalabad, 38000, Pakistan.
[4]Institute of Soil and Environmental Science PMAS Arid Agriculture University Rawalpindi, 46300, Pakistan
[5]Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad, 38000, Pakistan.
[6]Department of Agriculture Extension District Layyah, 31200, Pakistan
[7]Department of Plant Pathology, College of Agriculture University of Layyah, Layyah, 31200, Pakistan.
[8]Department of Agronomy, College of Agriculture University of Layyah, Layyah, 31200, Pakistan

*Email: malikfaizulhassan62@gmail.com

ABSTRACT

Cotton (*Gossypium hirsutum* L,) also known as "white gold" in Pakistan, is a crucial crop for the country's economy. However, cotton production has decreased in recent years, particularly in Distract Layyah, due to deficiencies in essential nutrients in the soil and traditional planting methods. To address this, Muhammad Nawaz Sharif University of Agriculture launched a campaign in 2023 to raise awareness and improve nutrient management for cotton cultivation. Field research was conducted to assess the response of cotton cultivation under different conditions in District Layyah. We applied nutrients using three methods: foliar application, fertigation, and band placement. Nitrogen (N), Phosphorus (P) and potash (K) were applied at rates of 196 kg/ha, 33 kg/ha, and 123 kg/ha, respectively. The foliar method produced the best results, with the highest boll counts, boll weight, and seed cotton yield. Overall, foliar NPK application proved to be beneficial in maintaining a healthy crop in Layyah, Pakistan.

Keywords: *Sustainable Cotton production, Nutrient management, Agriculture Sustainability*

MODELING IMPACT OF CLIMATE CHANGE ON WATER USE EFFICIENCY, CARBON FOOTPRINT, PRODUCTIVITY AND NUTRITIONAL QUALITY OF WHEAT-GROUNDNUT CROPPING SYSTEM

Alvina Faraz[*1], MukhtarAhmed[1], Ghulam Qadir[1], Khasif Sarfraz Abbasi[2], Rifat Hayat[3], Nadir Ali[1] and Aftab Tabasum[3]

[1]Department of Agronomy, PMAS Arid Agriculture University Rawalpindi-46300
[2]Institute of Food and Nutritional sciences, PMAS Arid Agriculture University Rawalpindi-46300
[3]Institute of Soil and Environmental Science, PMAS Arid Agriculture University Rawalpindi-46300

*Email: alvinafaraz999@gmail.com

ABSTRACT

The Agricultural and agronomic methods are being impacted by the way the climate is transforming the world's environment. Climate change has had a significant impact on Pakistan's agriculture system. Presently, this phenomenon has been demonstrated in Pakistan; however, no significant attempts have been undertaken to tackle the issues related to climate change. The primary concern in Pakistan that has been discovered is the use of inefficient nitrogen dosages, which contributes to the generation of greenhouse gasses. One viable and alternative strategy to lower nitrogen dosages and greenhouse gas (GHG) emissions is the legume-based farming system. The Legume-based cropping is thought to be a useful and different approach to lower greenhouse gas (GHG) emissions and nitrogen dosages. Considering the facts, a study focusing on wheat–groundnut cropping system was carried out in the years 2022–2023 in a Pothwar region medium-rainfall area with the assistance of simulation modeling. A spilt-plot design was used for the experiment, and four cropping system treatments were used: wheat-fallow-wheat, wheat-groundnut-wheat, wheat-fallow+groundnut residue in wheat, and wheat-groundnut+groundnut residue in wheat. Four dosages of nitrogen at 0 kg ha^{-1}, 50 kg ha^{-1}, 75 kg ha^{-1} and 100 kg ha^{-1} were applied. The Phenological stage, yield, and nutritional quality data were all documented. Based on field data, the APSIM (Agricultural production system simulator) cropping system was parameterized, validated, and calibrated final findings showed that the wheat-groundnut cropping system may help reduce nitrogen input and is a sustainable approach towards the changing climate.

Keywords: Cropping System, Climate Change, Modeling, Water Use Efficiency, Carbon Footprint.

BIODEGRADATION OF AN EMERGING MICROPOLLUTANT, DICLOFENAC FROM WASTEWATER

Irrum Shahzadi*[1], Sajida Perveen[1], Syeda Fatima Zainab[1], Hira Abid[1], Sobia Jabeen[1], Farzana Kausar[1]

[1]Institute of Soil and Environmental Science PMAS Arid Agriculture University, Rawalpindi, Pakistan

*Email: irrumshahzadi879@gmail.com

ABSTRACT

Diclofenac (DCF) is a polycyclic nonsteroidal and the anti-inflammatory (NSAID) medicine that is extensively identified in the environment due to its excessive usage Diclofenac has been included in the first watch list of European Union of water because it is chemically stable and has low biodegradability. It poisons the surface water has negative impact on the non- target organism of environment. This pharmaceutical chemical is emitted from hospitals, households, and pharmaceutical businesses. Because diclofenac is chemically stable and resistant to biodegradation, conventional approaches have been ineffective in removing it from water. Excessive discharge of this antibiotic in wastewater is an emerging issue. About 8-10 samples of wastewater will be collected from the twin cities Rawalpindi and Islamabad. These samples will be analyzed for the presence of Diclofenac, pH, Electrical Conductivity (EC), Total dissolved Solvents (TDS), Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD). Bacteria capable of degrading diclofenac will be isolated through enrichment, Mineral Salt Media (MSM). Based on the ability to degrade diclofenac 3-4 most efficient strains will be selected for subsequent studies. Degradation rate will be measured by using Spectrophotometer at wavelength of 260nm. Lab scale bioreactor will be designed. Degradation identification will help to develop the bioremediation strategy for wastewater containing the Diclofenac. Bioremediation of diclofenac by selecting efficient bacterial strains could be used effectively for the removal of harmful emerging micropollutants like diclofenac from wastewater.

Keywords: Diclofenac; Domestic wastewater; Bio treatments; Indigenous bacterial strains.

PHENOTYPIC EVALUATION OF 26 TOMATO F1 DEVELOPED FROM EXOTIC GERMPLASMS FOR ITS ADAPTATION IN ARID CLIMATE OF LAYYAH

Susan Muhammad[1*], Sawaira Ashraf[2], Humera Ashraf[3], Ifrah Javed[4], Muhammad Zahid Ashraf[4]

[1]Department of Plant Breeding and Genetics, University of Agriculture Faisalabad, 38000, Faisalabad, Pakistan.
[2]Department of Plant Breeding and Genetics, Faculty of Agriculture Sciences and technology, Bahauddin Zakariya University Multan, Multan, 60800, Pakistan.
[3]Guangdong Provincial Key Laboratory of Plant Molecular Breeding; College of Agriculture south China University, Guangzhou 510642, China.
[4]Department of Plant Breeding and Genetics PMAS, Arid Agriculture University, Rawalpindi, 46300, Pakistan.
[4]Department of Plant Protection, College of Agriculture south China University, Guangzhou 510642, China.

*Email: humeraa49@gmail.com

ABSTRACT

Various factors like environmental stresses, narrow genetic base and low yielding commercialized hybrids of Tomatoes adversely affect the yield of Tomatoes in Pakistan due to which, it is grown on a very small scale. Non availability of high yielding cultivars made it necessary to bring exotic varieties and hybrids from other countries to be utilized for future breeding programs. To find solution to this problem twenty-six F1 hybrids developed from direct crosses of Exotic Germplasm were grown in Walk-in Tunnel to be evaluated for various quantitative traits on phenotypic basis along with commercialized Hybrids in Research Farm of University of Layyah, Punjab, Pakistan. Data was collected for early flowering after 15 days of transplantation and later for other phenotypic traits such as plant height, number of clusters, number of fruits per cluster, fruit weight, fruit area, yield near and at harvesting stage. Results showed thatV2*V1 produced higher yield. Meanwhile, V15*V4 was superior among all hybrid for various other quality traits like Plant Height, number of cluster per plant and number of fruits per plant but has lower yield than V2*V1. Whereas, V2*V5 was best performing hybrid for plant height and fruit weight related attributes. Correlation analysis was carried out to find association among various traits that revealed Yield is positively correlated with various morphological traits like plant height(0.672846),cluster per plant(0.108513) while negative correlation was observed among number of leaves with per fruit weight(-0.00857) and dry weight(-0.06041).Heritability, Regression and Path Analysis concluded that various phenotypic traits positively affect the yield related attributes and these hybrids have various valuable traits that can be used to enhance yield and other traits by using these potential hybrids in breeding programs to develop hybrids and varieties for arid climate.

***Keywords*:** Hybrids, Exotic Varieties, Direct crosses, Quantitative traits, Hybrid vigor, Correlation analysis, Regression, Path Analysis, Heritability.

INVESTIGATING THE CAUSES AND CONSEQUENCES OF OVER-EXPLOITATION OF NATURAL RESOURCES IN SWAT VALLEY OF KHYBER PAKHTUNKHWA, PAKISTAN

Sana Ullah*[1] and Sher Muhammad[1]

[1]Department of Agricultural Sciences, Allama Iqbal Open University, Islamabad, Paksitan

*Email: sher.muhammad@aiou.edu.pk

ABSTRACT

This study was conducted in Swat Valley of Khyber Pakhtunkhwa Province of Pakistan to investigate the magnitude, causes, and consequences of overexploitation of natural resources and ensuing depletion. The study was delimited to two tehsils namely Tehsil Barikot and tehsil Kabal located in the lower reaches of the valley. The universe of the study was divided in to 36 strata based on topographic conditions wherein, focus group discussions (FGDs) were conducted, which were guided by a structured interview schedule. Participants for FGDs were selected through a purposive sampling technique. Moreover, this study also employed time series data from 2011 to 2021, which was retrieved through remote sensing in Esri ArcGIS 10.8.1 software. Paired sample t-test and multiple linear regression (MLR) models were employed for data analysis. Findings of the study revealed that surface water decreased by 39.5%, groundwater by 55.7%, and forest cover by 4.0% over 10 years, whereas a 413.6% increase was observed in woody vegetation (fruit cropping & agro/farm forestry) primarily at the expense of agricultural crop (other than woody vegetation). Results from MLR analysis illustrated that over-dependency on groundwater harvesting and over-drilling through the use of solar photovoltaic pumping irrigation were identified as the key drivers of groundwater decline. Moreover, anthropogenic factors like the expansion of the built-up environment and sand mining further deteriorated the condition of water infiltration for groundwater recharge. Stratum-level consequences of water resource depletion included over-dependency on groundwater in 9 strata, over-drilling issues in 14 strata, disappearance of aquifers (springs, etc.) in 8 strata, and water scarcity issues in 5 strata, whereas individual-level consequences included an increase in drilling cost for 19.8%, decrease in agricultural productivity for 12.7%, water scarcity issues for 25.9% and water quality issues for 11.7% respondents. It has been concluded that groundwater is a highly vulnerable resource, which needs serious attention for its future availability for domestic and agricultural use.

Keywords: Population, agriculture, food

EVALUATING DIFFERENT WHEAT (*TRITICUM AESTIVUM* L.) VERITIES UNDER DROUGHT STRESS

Sawaira Ashraf*[1], Ifrah Javed[2], Humera Ashraf[3], Muhammad Zahid Ashraf[4], Susan Muhammad[4], Samina Majeed[5]

[1]Department of Plant Breeding and Genetics, Faculty of Agriculture Sciences and technology, Bahauddin Zakariya University Multan, Multan, 60800, Pakistan.
[2]Department of Plant Breeding and Genetics PMAS, Arid Agriculture University, Rawalpindi, 46300, Pakistan.
[3]Guangdong Provincial Key Laboratory of Plant Molecular Breeding; College of Agriculture south China University, Guangzhou 510642, China.
[4]Department of Plant Protection, College of Agriculture south China University, Guangzhou 510642, China.
[4]Department of Plant Breeding and Genetics, University of Agriculture Faisalabad, 38000, Faisalabad, Pakistan.
[5]Department of Botany, faculty of Pure and Applied Biology, Bahauddin Zakariya University Multan, 60800, Pakistan.

*Email: humeraa49@gmail.com

ABSTRACT

Wheat (*Triticum aestivum L.*) is a major cereal crop grown during spring and winter seasons and providing a valuable source of dietary fibers and vitamin B. It can be easily stored and eaten throughout the year. However, nowadays wheat is facing numerous challenges, including heat stress and water unavailability. This study aimed to assess various wheat varieties against prevailing and increasing drought conditions globally. The objective was to recommend drought-resistant varieties to farming communities to increase yield even in stressful conditions and meet the growing demand for food. Moreover, fifteen wheat genotypes were cultivated in sandy loam soils at the experimental study region of BZU Bahadur sub-campus Layyah, College of Agriculture, during 2022-2023 wheat season and carry out the Correlations and Analysis of variance at the sample material. Data was collected for various plant characteristics and grain yield. The study found good correlations between grain yield per plant and spike length, and analysis of variance showed that Barani-83 and Akbar-19 had the highest yield under arid conditions in Layyah. This information is valuable for farmers and for breeding purposes to increase wheat crop yield and income. The assessment concludes that under drought stress, Barani-83 and Akbar-19, as well as Punjab-11 in some cases, responded admirably. As a result of the findings, Barani-83 and Akbar-19 were designated as drought-tolerant wheat genotypes.

***Keywords*:** Drought stress, wheat, Correlations, Analysis of variance, food security, genotypes

ASSESSMENT OF QUALITY OF IRRIGATION WATER AND SOILS OF TEHSIL GANDAKHA DISTRICT JAFFARABAD BALOCHISTAN

I. K. M. Hassani[1], S. M. Bhatti*[1], G. M. Jamro[1], N. Depar[2], Z. R. Bughio[3], M. K. Soothar[1]

[1]Department of Soil Science, Sindh Agriculture University Tando Jam Pakistan
[2]Nuclear Institute of Agriculture (NIA) Tando Jam Pakistan
[3]Agriculture Extension Wing, Agriculture Supply and Prices Department, Sindh Pakistan

*Email: smbhatti@gmail.com

ABSTRACT

This is the first-ever comprehensive GIS map-based study that assesses the quality of irrigation water and soils of 88 Dehs of tehsil Gandakha, district Jaffarabad, Balochistan. The irrigation water (canal water) and soil samples (0-20 cm depth) were collected from a selected farm of each Deh, with a record of geographical location. In case of irrigation water, 42 Dehs had severe levels of Cl^- (>10 meq L^{-1}) while the remaining 46 Dehs were slight to moderate in Cl^- concentration (4 to 10 meq L^{-1}). All the Dehs had Ca concentration and pH in irrigation water within the FAO usual range (0 to 20 meq L^{-1} and 6.5 to 8.5 respectively). Only 7 Dehs had Mg concentration in irrigation water above the defined usual range (0 to 5 meq L^{-1}), while 27 Dehs had slight to moderate (0.7 to 3.0 dS m^{-1}) values of EC in irrigation water. Soils of 49 Dehs were very slightly saline to strongly saline (2 to 16 dS m^{-1}). Soils of 87 Dehs were moderately to strongly alkaline (7.6 to 8.7), 75 Dehs were strongly calcareous (>15%), 62 Dehs had low organic matter content (< 0.86%), while 79 Dehs were mainly Clayey in texture (Clay and Silty Clay). Efficient management strategies should be adopted to minimize the values of Cl^-, Mg and EC in irrigation water, and EC and pH values in soils, and improve the values of organic matter in specified areas.

Keywords: Irrigation water, Soils, Quality, Gandakha, Jaffarabad

BIOSTIMULANT THE KEY TO AGRO ENVIRONMENTAL SAFETY: A COMPREHENSIVE REVIEW

Faiz Ul Hassan[1]*, Muhammad Amjad Bashir[2], Muhammad Huzaifa Luqman khan[1], Hafiz Muhammad Ali Raza[1], Muhammad Faizan Bashir[1], Muhammad Islam[3], Ahsan Amin[4], Sammar Abbas[1], Abdul Basit[1]

[1]Department of Soil science, College of Agriculture, University of Layyah, Layyah, 31200, Pakistan.
[2]Department of Soil science, Faculty of Agriculture Sciences and technology, Bahauddin Zakariya University Multan, Multan, 60800, Pakistan.
[3]Institute of Soil and Environmental Science, PMAS, Arid Agriculture University, Rawalpindi, 46300, Pakistan
[4]Department of Plant Pathology, College of Agriculture, Bahauddin Zakariya University, Multan, 60800, Pakistan.

*Email: malikfaizulhassan62@gmail.com

ABSTRACT

The agriculture sector is currently facing the challenge of feeding a growing population while minimizing environmental impact. To address this, various technologies have been utilized to improve agricultural sustainability by reducing the use of synthetic chemicals. One such approach is the use of bio stimulants, which can enhance nutrient uptake, improve soil properties, and alleviate various stresses in an eco-friendly manner. Understanding the use of agricultural technology is crucial for anticipating future developments in agriculture and promoting sustainability. This review, examines the potential of microbial and non-molecular plant bio-stimulants to support agricultural and environmental health. It also addresses the challenges related to formulating and applying these bio-stimulants for sustainable agriculture. Additionally, we provide a balanced analysis of bio-stimulant use within the agricultural framework including the regulatory environment. The findings of this review offer a roadmap for those interested in sustainable agriculture and highlight the potential of bio-stimulants for creating resilient and environmentally friendly farming systems.

Keywords: Biostimulant, Agro-environment safety, agriculture sustainability

BIOSTIMULANT APPLICATIONS FOR IMPROVING CROP WATER USE EFFICIENCY AND AGRO-ENVIRONMENT SUSTAINABILITY: A COMPREHENSIVE REVIEW

Faiz Ul Hassan[1]* Muhammad Amjad Bashir[2], Hafiz Muhammad Ali Raza[1, 2], Irtaz Ali[3], Abdul Basit[1], Muhammad Faizan Bashir[1], Sammar Abbas[1], Muhammad Islam[3]

[1]Department of Soil science, College of Agriculture, University of Layyah, Layyah, 31200, Pakistan.
[2]Department of Soil science, Faculty of Agriculture Sciences and technology, Bahauddin Zakariya University Multan, Multan, 60800, Pakistan.
[3]Institute of Soil and Environmental Science, PMAS, Arid Agriculture University, Rawalpindi, 46300, Pakistan

*Email: malikfaizulhassan62@gmail.com

ABSTRACT

Pakistan is currently facing two major challenges: climate change and population growth. Climate change is negatively impacting agricultural sustainability by reducing plant productivity and quality. Additionally, the excessive use of mineral fertilizers to meet the growing food demand of the population is deteriorating water quality and causing nutrient loss. To address this, various technologies have been utilized to improve agricultural sustainability by reducing the use of synthetic chemicals and increasing water use efficiency. One effective approach is the use of bio stimulants, which can enhance nutrient efficiency, support plants to survival in water deficient-conditions and reduce the need for mineral fertilizer applications, ultimately leading to reduce the water pollution in an eco-friendly manner. Understanding the application of agriculture technology is crucial for predicting future trends in agriculture and promoting sustainability. This review delves into the potential of both microbial and non-microbial plant bio stimulants to promote agro-environmental sustainability and discusses the challenge in formulating and applying these bio stimulants for agricultural sustainability. Additionally, the review provides a balanced assessment of the application of bio stimulants in the agro-environment system by addressing the regulatory environment related to their use. The insights provided in this review serve as a roadmap for stakeholders in sustainable agriculture, revealing the full potential of bio-stimulants in building resilient and environmentally friendly farming systems.

Keywords: Biostimulant, Crop water use efficiency, Agro-environment sustainability, agriculture sustainability

COMPENSATORY RESPONSE OF MAIZE SEEDLINGS TO SHORT-TERM OZONE EXPOSURE: A COMPARATIVE ANALYSIS OF 2H, 4H, AND 6H PRE-GERMINATION SEEDLINGS OF ONE TIME EXPOSURE TO O_3

Sabeen Afzaal*[1], Zakia Khanum[1], Faria Asad[1], Samia Qadir[1]

[1]Department of Environmental Sciences, AIOU, Islamabad, Pakistan

*Email: sabeenshahnaz@gmail.com

ABSTRACT

One of the criteria pollutants for air pollution is ozone; tropospheric ozone concentration is increasing at alarming rate, posing serious threat to agricultural productivity. Compensatory responses can mitigate these effects over time. This study investigates the compensatory response of maize pre-germinated seedlings provided by NARC as one time application to depict short-term O_3 exposure (2h, 4h, and 6h) and identifies potential recovery mechanisms i.e. chemicals or medicines or induction of some adopted genes to repel the effects of O_3 on plants. Maize seedlings were exposed to controlled O_3 concentrations for 2h, 4h, or 6h after exposure four growth perimeters like leaf area, no of leaf buds, no of leaves and shoot length were measured. Plants were harvested after fifteen days to analyze the effects of O_3 on plant fresh and dry weight, root fresh and dry weight and shoot fresh and dry weight. Statistical analyses (mean and standard deviation) were conducted to compare responses of each plant after exposure to O_3. Maize seedlings exposed to O_3 for 2 hours had the highest mean leaf area, number of leaf buds, number of leaves, and shoot length. Seedlings exposed to O_3 for 6 hours had the lowest mean values for all four growth parameters. There was a general trend of decreasing mean values for all growth parameters with increasing exposure time. Overall, these results suggest that O_3 exposure has a negative impact on the growth of maize seedlings. The longer the exposure time, the greater the negative impact on leaf area, no of buds, no of leaves and shoots length. So, further research is needed to elucidate the specific mechanisms employed by maize to combat O_3 stress and explore their potential application in agriculture for improved crop resilience.

***Keywords*:** Ozone exposure, Maize seedlings, Air pollution, agricultural productivity, Compensatory response, NARC.

EFFECT OF ELCTRON BEAM IRRIDATION ON THE PHYSIOCHEMICAL PROPERTIES, BIOACTIVE ELEMENTS AND MICROBIOLOGICAL CHARACTERISTICS OF RADIX OPHIOPOGONIS

Mahendar Kumar Sootahar[1,2,3], Mukesh Kumar Soothar[2,4], Punam Soothar[5], Saibrina Sethar[1,2], Muhammad Aslam Panhwer[1,2], Khalid Khokher[1,2] and Hafeezullah Baber[1,2]

[1]Soil Fertility Research Institute Sindh Agriculture Research Center Tando Jam
[2]Department of Soil Sceicne Sindh Agriuclt758ure University Tando Allahyar
[3]Institute of Environment and Sustainable Development in Agriculture, Chinese Academy of Agricultural Sciences, Beijing, China,
[4]Key Laboratory for Crop Water Requirement and Regulation of Ministry of Agriculture and Rural Affairs, Farmland Irrigatin Research Institute, Chinese Academy of Agriculture Sciences, Xinxiang, China
[5]Department of Statistics Sindh Agriculture University Tando Jam

*Email: mahender_935@yahoo.com

ABSTRACT

Radix ophiopogonis is the root of *Ophiopogonjaponicus*, this herb has been widely used as a traditional Chinese medicine against the diseases caused by yin deficiency, including cough, pharyngitis, sore throat, hemoptysis, and asthenia of heart and lung. This research was focused on different irradiation doses (0, 1, 3, 5, 7, 10, 13, 15, and 25 kGy) were applied on radix ophiopogonis roots, physiochemical properties, bioactive elements, and microbiological Characteristics. The results showed that control (no irradiation) receiving (5.60% and 4.00%) higher aerobic and yeast and mold count. Similarly, the moisture and water-soluble content was decline, the lowest was detected at the highest beam dose. However, alcohol soluble extractive was showing that control had great impact and increasing irridaition dose decreasing the soluble extractive, and the similar results were also obtained in total phenolic content. Whereas the total saponins content or radix ophiopogonis root was decline around 61% compare with control. However, the total polysaccharides content of radix ophiopogonis roots were detected non-significant between 5 to 13 kGy comparing with other treatment, whereas the highest was observed at control. The Pearson correlation showing that total saponins content was observed highly significant with water-soluble content, similarly total polysaccharides content was detected highly significant with moisture, saponins and non-significant with water-soluble and total phenolic content of radix ophiopogonis. However, the total phenolic content was detected non-significant with saponins and water-soluble and polysaccharides content. Overall, this research indicates that higher irradiation doses significantly reducing loss of radix ophiopogonis root, however, some basic radiation doses such as 1 and 3 kGy was not enough to decontaminate the herbal medicine. It is suggested that from this research that we should focused on the higher doses of electron beam irradiation and should considered some more specific parameters of radix ophiopogonis roots and may be considered other herbal medicinal plants.

Keywords: electron beam irradiation (EBI), Radix ophiopogonis roots

ADVANCEMENTS IN SUSTAINABLE SOIL MANAGEMENT PRACTICES: A COMPREHENSIVE REVIEW FOR ENSURING GLOBAL FOOD SECURITY

Muhammad Islam[*1], Kashif Ali Khan[2], Soban Tasawwar[2] Arshad Nawaz Choudhry[3], Irtaz Ali[3], Muhammad Azeem[4,] Muhammad Sohan Akbar[2], Muhammad Tariq[4], Misbah-Ud-Din Ahmed[3], Muhammad Younus[4], Umar Sohail[4]

[1]Institute of Soil& Environmental Science, PMAS, Arid Agriculture University Rawalpindi, 46300, Pakistan
[2]Department of Soil Science, College of Agriculture, University of Layyah, Layyah, 31200, Pakistan

*Email: muhammadislam1524@gmail.com

ABSTRACT

Increasing world population threatens global food security because population explosion is exerting significant impact on limited natural resources, including land, soil, and water. However, soil as a basic resource provides food to the ever increasing population but is prone to many sustainability issues. Depletion of soil fertility is succumbing to encroachment of urbanization, declining groundwater levels, rising micronutrient deficiencies, conversion of fertile soil for brick making, soil structure degradation, and global warming are significant challenges to sustainability. Therefore, concerns regarding current and future food security are high on the sustainable development agenda due to aforementioned factors. Food security is threatens by a number of factors, viz., population growth, rising food prices, natural disasters, and climate change. Implementation of management techniques helps to promote soil health and function as a vital living ecosystem that sustains plant health, plant nutrients, and crop production on large scale. The main goals are to achieve food security and economic growth through sustainable soil management and other natural resources, directly or indirectly. Potential of sustainable soil management techniques and their impact on food security were explored in this review article. This article evaluates the effects of various soil management techniques on crop productivity, soil quality, and overall sustainability in agriculture by conducting an in-depth analysis. Results highlight the significance of effective soil management practices like crop rotation, cover crops and organic farming to prevent environmental deterioration and maintaining an uninterrupted supply of food.

Keywords: sustainable soil management practices, soil health, food security

EFFECT OF CHROMIUM STRESS ON GROWTH PARAMETERS OF TWO TOMATO CULITVARS

Muhammad Aslam Panhwar[1], Mahendar Kumar Sootahar[1], Saibrina Sethar[1], Abdul Qudoos[1], Khalid Hussain Khokhar[1], Hafeezullah Babar[1]

[1]Soil Fertility Research Institute, Sindh Agriculture Research Centre

*Email: aslamjan163@gmail.com

ABSTRACT

Chromium (Cr) is one of the most toxic heavy metals found abundantly in the Earth's crust and has severe effects on plants. A pot experiment was conducted to investigate the response of Chromium stress on two tomato cultivars, Milky Yellow and Pink Jade. Six Cr concentrations were arranged: control (0), 15, 30, 45, and 60 mg/kg. Physiological characteristics, growth parameters (root length, shoot length, and biomass), were determined. The results showed that Milky Yellow had a higher average root length in each treatment compared to Pink Jade. It was also observed that with the increasing Cr concentration, the shoot height, leaf number, and leaf area decreased in both cultivars. Similarly, Milky Yellow had a higher fresh stem weight (38.2 cm), fresh root weight (24.7 cm), and total fresh weight (75 cm) compared with Pink Jade at each Cr concentration. However, the fresh leaf weight of Pink Jade was observed to be higher compared to Milky Yellow at the Cr concentrations. Moreover, similar results were obtained in the control group. When comparing Milky Yellow with Pink Jade, Milky Yellow had a higher dry weight at each Cr concentration level.It is concluded that Milky Yellow has proven to be the best Chromium-resistant tomato cultivar in terms of growth and morphological characteristics. It is suggested that further experiments should focus on Milky Yellow cultivars.

Keywords**:** *Solanum lycopersicum*, tomato cultivars, chromium tolerance, growth evaluation, morphological parameters.

ASSESSMENT OF VARIATION IN AGRO-CLIMATIC ZONE FOR SUSTAINABLE AGRICULTURE IN THE NORTHERN AREAS OF PAKISTAN

Riaz Khan*[1], Ali Raz Gurmani[1], Rasheed Ahmad[1], Ghani Akbar[2]

1Department of Soil & Climate Science University of Haripur Khyber pakhtunkhwa Pakistan 2Climate Energy & Water Resource Institute

*Email: riazkhansst16@gmail.com

ABSTRACT

The research study was carried out to determine "Assessment of Variation in Agro-Climatic Zones for Sustainable Agriculture in the Northern Areas Swat and Dir Upper of Pakistan. The primary objectives include determining quantitative variations in climatic parameters, assessing the impacts of these changes on agriculture, and proposing solutions for sustainable agriculture. The data used for the research was collected from the Pakistan Metrological Department from 2001 to 2020. The data was analyzed statistically using regression analysis. The results of the study show that in Dir Upper, the maximum humidity was 975% in 2005, while the minimum humidity was 472% in 2014. The overall trend showed a decreasing trend in humidity in the past 20 years, due to an increase in temperature and low rainfall. In Dir, the maximum rainfall of 6186 mm was calculated in 2001, while the minimum rainfall of 5317.5 mm was calculated in 2014. The average rainfall shows a decreasing trend with time, and sometimes it shows an increasing trend. Due to the monsoon season, the maximum rainfall occurred in Pakistan in 2010 and 2022 and caused severe damage to land cover, land use, and agriculture. The maximum wind speed in Dir was 156.7615 km/h in 2003, while the minimum wind speed of 0.6 km/h was calculated in 2005. The maximum rainfall of 1465 mm in Swat was calculated in 2010, while the minimum rainfall of 690 mm was calculated in 2001. The overall average rainfall shows a decreasing trend with time. However, in Swat, the maximum humidity (1218%) was calculated in 2015, while the minimum humidity (1046%) was calculated in 2005. The overall humidity shows a decreasing trend with time due to the increase in temperature. The maximum wind speed calculated in Swat was 18.75 km/h in 2009, and the lowest was 0 km/h in 2003. The overall trend suggests an increasing pattern over time. The average temperature in Swat increased from 2010 to 2020 due to deforestation and the increase of greenhouse gases in the atmosphere. . We should construct small dams. We should control air pollution. We should increase agricultural land. The planning should be done for water harvesting.

Keywords: *Climate change, variation, Temperature, Humidity, Rainfall, Wind Speed*

RECENT FLOODS: IMPACTS ON AGRICULTURE IN A CHANGING CLIMATE SCENARIO AND ADAPTATION

Sammia Khurshid*, Azeem Khalid, Muzammil Anjum, Rab Nawaz, Shafi Ullah, Hira Saleem, Khurram Shahzad

Environmental Sciences, Institute of Soil and Environmental Sciences, PMAS, Arid Agriculture University Rawalpindi

*Email: sammiakhurshid651@gmail.com

ABSTRACT

Pakistan's topography is diverse, with north alpines covered with glaciers and southern lowlands bordering the Arabian Sea. The Indus River and its tributaries Chenab, Jhelum, Sutlej and Ravi. The monsoon period which last from mid-July to September brings rain to the entire region. These intense monsoons are the main cause of disasters in various region of Pakistan including flood. Pakistan has disastrous floods in the recent years. These floods have impacts on Punjab's and Sindh's river basins. Flash floods in secondary and tertiary rivers, including hill torrents, are the main cause of damage in Gilgit-Baltistan, Khyber Pakhtunkhwa, Azad Jammu and Kashmir, Balochistan, Federally Administrated Tribal Areas and major portion of Sindh and Punjab. The flood that struck Pakistan in August 2022 is because of rising temperature and continuous precipitation causes the sever destruction. The 2022 flooding deluge, which severely damaged the entire country's southern provinces, is unsurpassed in terms of its immense spatial and temporal scale by any recent events. The flood ranked 2nd in term of human causalities but it was big catastrophe that left 33 million people homeless and significantly affected infrastructure, roads, agriculture and causes various disease outbreaks. Due to sever distruction of agriculture sector there was food shortage for longer period of time even in 2023. The most important upgrades have been determined, and suggestions for effective management of flood risks for agriculture have been made in order to stop future catastrophic flood disasters.

***Keywords*:** Natural disasters, 2022 Pakistan flood, agricultural impacts, climate change, adaptation measures

Detection of Micro-fungi from Different Types of Soil Originated Water Samples of District Bhimber Azad Kashmir, Pakistan

Tanveer Hussain*[1], Muhammad Ishtiaq[1], Muhammad Ajaib[1], Humma Farooq[1]

[1]Department of Botany, Azad Jammu and Kashmir University of Bhimber -10040 (AJK), Pakistan

Email: tanveer.botany@must.edu.pk

ABSTRACT

The current research was focused on micro-fungal assessment of drinking water samples collected from different nature of soils from District Bhimber, Azad Kashmir, Pakistan during the year 2023. The samples of water were collected from specific spots of the study area. For fungal culturing and isolation, two different culture media were used for fungal spores' cultivation. One is potato dextrose agar (PDA) and other is nutrients agar (NA) media. The Baiting Technique and Direct Plate Method (DPM) were used for microfungal culturing and identification from aquatic samples. A total of five sources of each drinking water and polluted water of the selected spots were collected and analyzed. These water sources were tap water, pond water, stream water, rain water, well water and industrial effluent polluted water. The findings indicated that 15 different fungal species were isolated frequently from collected samples and it was estimated that most of the isolated species were predominantly human pathogenic. The occurrence of fungal species was identified in tap water samples (TWS) that were counted 11 species. Similarly, 9 species were isolated from pond water (PW) and 8 species were identified from stream water sample (SWS). It was observed that Penicillium, Aspergillus, Fusarium, Trichoderma and Rhizopus species were the dominant species isolated from drinking water samples. It was noted that TWS of drinking water contained highest frequency of fungal species because it was provided best atmosphere and nutrition for growth and development of the fungal growth. It was also concluded that Dreschlera havaiensis showed maximum CFU value (900 CFU/ml) in TWS.

Keywords: Water Fungi, Azad Kashmir, Paper, Microfungal Isolation, Trichoderma and Rhizopus

RESPONSES OF FUNGAL STRESSES AND CLIMATIC IMPACT ON GROWTH AND YIELD OF CICER ARIETINUM IN DISTRICT BHIMBER, AZAD KASHMIR

Tanveer Hussain*[1], Muhammad Ishtiaq[1], Muhammad Ajaib[1], Rawish Sikander[1], Tariq Saiff Ullah[2]

1Department of Botany, Azad Jammu and Kashmir, University of Bhimber -10040 (AJK), Pakistan
2Department of Botany, University of Kotli, Azad Kashmir 10382, Pakistan

Email*:* tanveer.botany@must.edu.pk

ABSTRACT

The current study was elaborated the responses of microbial stresses and the influence of the climatic factors on the growth and yield of Cicer arietinum in District Bhimber, Azad Kashmir. Both abiotic and biotic stresses reduced the production of chickpea. This research was focused on pathogen-induced biotic stresses which mainly included fungal diseases impact on growth and yield of Cicer arietinum. The fungal diseases identified from collected samples were Ascochyta Blight, Botrytis Gray Mold, Fusarium wilt and Rhizoctonia root rot. The most dominant fungal species were recognized as Fusarium salani, Ascochyta rabiei, Botrytis cinerea, Rhizoctonia solani and Fusarium oxysporum. Highest infection rate 57.14 % was observed against Rhizoctonia salani while minimum infection rate 20.8 % was observed against Ascochyta rabiei pathogen. The highest severity rate was recorded 80 % while the minimum severity rate was recorded as 40 %. The yield of the chickpea crop showed negative correlation with sudden climatic variation in the selected study. A shorter crop cycle observed due to shorter phenological stages after sudden higher temperatures. The low productive/nutrient soils have also negatively influenced on farming when rainfall declines and poor irrigation opportunities. Therefore, it was concluded that both fungal diseases/biotic stresses and drastic chances in climatic/abiotic factors showed negative impact on growth and yield of Cicer arietinum crop in the study area. Hence, the crop of Cicer arietinum reduced significancy due to fungal stresses and poor climatic factors

Keywords: Microbial Stresses, Climatic Factors, Fungal Diseases, Biotic Stresses, Abiotic Factors, Cicer arietinum, District Bhimber, Azad Kashmir

PROSPECTS FOR MAKING BIOORGANIC FERTILIZER FOR SUSTAINABLE AGRICULTURE IN PAKISTAN AMIDST CLIMATE CHANGE

Noshin Ilyas*[1]

[1]Department of Botany, PMAS Arid Agriculture University, Rawalpindi 46300, Pakistan

*Email: noshinilyas@yahoo.com

ABSTRACT

Pakistan is an agricultural country where agriculture not only based economy, with agriculture not only contributes 22.9% to GDP but also provides food for ever growing population. Pakistan falls in the list of countries which are most vulnerable to climatic changes due to which agriculture is facing many challenges particularly decreasing availability of water and fertilizers, changing environmental conditions, and pollution. One of the possible strategies involves the use of tolerant PGPR (Plant Growth Promoting Rhizobacteria) I combination with different soil amendments which can help increase growth and survival of plants particularly under stressed conditions. PGPRs are isolated from naturally stress exposed sites and efficient strains were characterized. Various agro industrial wastes were collected and their solid state fermentation was carried out with the help of efficient strains and bioorganic fertilizers were prepared. Upon inoculation, these bioorganic fertilizers improved germination, morphological parameters (root and shoot length, fresh and dry weight), physiological attributes (chlorophyll contents, membrane stability index, leaf area), biochemical characteristics (proline, protein, total soluble sugars) and antioxidant enzymes. Addition of bioorganic fertilizers also improved soil nutrient and fertility. Hence the use of bioorganic fertilizers can help in mitigating environmental challenges and sustainable agricultural production amidst climate change in Pakistan.

Keywords: Pakistan, Agriculture, Climate change, Bioorganic fertilizers, Sustainable agriculture

"Soil Health: A Key to Food Security"

20th INTERNATIONAL CONGRESS OF SOIL SCIENCE

20-22 February 2024, Rawalpindi, Pakistan

POSTER PRESENTATIONS

“Soil Health: A Key to Food Security”

20th INTERNATIONAL CONGRESS OF SOIL SCIENCE

20-22 February 2024, Rawalpindi, Pakistan

SOIL SCIENCE SOCIETY OF PAKISTAN -SSSP-

SOIL MICROBIOLOGY & BIOCHEMISTRY

INTERACTION OF PLANT GROWTH PROMOTING REGULATORS AND NUTRIENT FORMULATION ON GROWTH AND YIELD OF CHILIES

Muhammad Umar[1], Waqas Mahmood*[1], Kashiuf Asif[1], Uzma Ambreen[1], Hafiz Naeem Asghar[1], Zahir Ahmad Zahir[1]

[1]Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad,

*Email: waqasm761@gmail.com

ABSTRACT

Chili (*Capsicum annum* L.) is a shrub that is grown annually or perennially which is grown globally for its nutritional contents. Chili is the most famous vegetable after potatos and is cultivated in almost all parts of the world. It can be used as spices and condiments. In Pakistan, the national productivity of chili pepper is still very low due to vast range of problems. The main problems involve poor soil fertility, low use of fertilizers, lack of new and resistant varieties, pest and disease attacks, soil salinity and structure issues and management problems. Plant growth regulators (PGRs) play a vital role in the regulation of several important growth as well as behavioral processes in plants. In the recent years, the promising role played by the PGRs regarding improving the plant growth and yield have been well documented by several researchers. They can also protect the plants against the adverse impacts of several stresses such as temperature (low or high), flooding, salinity, drought, and heavy metals etc. The Hoagland solution has been extensively employed for growing various kinds of crops and have been considerably recommended for integrated crop production for enhancing the crop yield and growth. In the current study, the collaborative impact of different concentration of plant growth regulator (L- TRP) and various strengths of Hoagland nutrient solution on the growth and yield promotion of chili crop. Separate application of L-TRP and Hoagland solution were effective to enhance crop growth and yield. But their combined effect was more pronounced in improving crop yield, nutrient intake, and crop quality. Statistical analysis proved that 10^{-3} M L-TRP alone and in combination with Hoagland solution was significantly better than all other combinations.

Keywords**:** PGR's, Formulations, Microbial inoculants, Integrated plant nutrients, Symbionts, L-TRP

SYNERGISTIC EFFECT OF SILICON AND RHIZOBACTERIA FOR IMPROVING GROWTH, SALINITY TOLERANCE AND ANTIOXIDANT STATUS OF ONION

Wajeeha Attiq[1]*, Mohammad Awais[1]*, QuratulAin Tayyab[1], Rabia Afzal[1], Qasim Ali[1], Maqshoof Ahmad[1]

[1]Department of Soil Science, Faculty of Agriculture and Environment, The Islamia University of Bahawalpur, 63100 Bahawalpur

*Email: wajehaatiq@gmail.com

ABSTRACT

Salinity is the main environmental stress that limits the cultivation and yield of crops in arid to semi-arid zones of the world via nutritional, hormonal imbalance and ionic or osmotic stress. Onion (*Allium cepa* L.) is a biennial crop of high commercial value in Pakistan and is considered salt sensitive. Using plant growth-promoting rhizobacteria and silicon is an emerging technique to mitigate salinity stress through various mechanisms of action. Considering the importance of onions, the effectiveness of silicon and salt-tolerant plant growth-promoting rhizobacteria in reducing the negative effects of salinity on onion seedlings was examined in a pot experiment. Experimental treatments include three salinity levels (control, 4, and 8 dS m^{-1}), silicon foliar spray after 35 days at the rate of 200 ppm, and *Paenibacillus polymyxa* 'IA7' PGPR strain in the following combination: Control, PGPR, Silicon, Silicon + PGPR. Results revealed that salinity adversely affected morphological, physiological, ionic, and biochemical parameters. Various morphological attributes (shoot length, number of leaves, root and shoot weight, bulb diameter, neck diameter, root length, leaf sheath, and blade length) and physiological parameters (electrolyte leakage, relative water content, chlorophyll a, b content, and carotenoid contents) were negatively affected. However, PGPR and silicon foliar application significantly improved shoot length (42.60%), shoot fresh and dry weight (80.99 and 88.43%), number of leaves (46.15%), neck and bulb diameter (36.36 and 85.71%), root fresh and dry weight (94.29 and 98.08%), relative water content (40.%), chlorophyll a and b content (36.27% and 57.58%) sas compared to control at 8 dS m^{-1}. Moreover, silicon and PGPR also improved antioxidant enzyme activities, i.e., catalase (58.74%), ascorbate peroxidase (62.77%), pyrogallol peroxidase (66.31%), and guaicol peroxidase (68.78%). Therefore, PGPR and silicon applications are potential strategies to improve onion growth and yield under abiotic stress.

***Keywords*:** Salinity, onion, PGPR, Silicon, Foliar application, Catalase, Peroxidase, physiology

EFFECT OF CO-INOCULATION WITH *RHIZOBIUM* AND PLANT GROWTH PROMOTING RHIZOBACTERIA ALONG WITH BIOGAS SLURRY ON GROWTH AND YIELD OF MUNG BEAN (*Vigna radiata* L.)

Saba Malik[1*], Muhammad Javed Akhtar[1]

[1]Institute of Soil & Environmental Sciences, UAF

*Email: sabaawan3571@gmail.com

ABSTRACT

Legume-Rhizobium symbiosis is important for agricultural production and therefore has great economic significance. Studies suggest that beneficial bacteria in soil affects the symbiotic performance of rhizobia in a positive manner. To determine the effect of co-inoculation with *Rhizobium* and plant growth-promoting rhizobacteria (PGPR) along with biogas slurry (BGS), mung bean was selected as a test crop and a pot experiment was conducted in the research area of Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad. The PGPR *B. subtilis* Y16 and *Rhizobium* MG6 strain were used in this experiment. Mung bean seeds of AZRI Mung 2006 variety were inoculated with *Rhizobium* singly or in a combination with PGPR and two levels of biogas slurry (600 and 800 kg ha^{-1}) were mixed with soil to evaluate their effect on growth and yield parameters. The experiment was conducted by following CRD with three replications. Crop was harvested at maturity and data regarding shoot and root length, shoot fresh and dry weight, root fresh and dry weight, grain yield and other physiological parameters were recorded. Thus, the results suggest that the combination of *Rhizobium*, PGPR and BGS (800 kg ha^{-1}) caused the highest increase in growth and grain yield of mung bean crop. Treatment II where alone BGS at the rate of 800 kg ha^{-1} was used showed the increased water use efficiency in plants. Inoculation or co-inoculation with *Rhizobium* and PGPR significantly enhanced the number of nodules, root-shoot dry weight, 1000 grain weight as compared to un-inoculated treatment. Thus, the study emphasizes that the use of biogas slurry along with co-inoculation of *Rhizobium* and rhizobacteria may be economically efficient strategy to improve growth of legumes.

***Keywords*:** Co-inoculation, Rhizobium, PGPR, Biogas slurry, Mung bean

EXPLORATION OF SOIL MYCODIVERSITY AND ORGANIC COMPOUNDS FROM DIFFERENT SOIL SAMPLES COLLECTED FROM DISTRICT BHIMBER AZAD KASHMIR PAKISTAN

Tanveer Hussain*[1], Aroosa Azeem[1], Saba Basharat[1]

[1]Department of Botany, Azad Jammu and Kashmir University of Bhimber -10040 (AJK), Pakistan

Email: tanveer.botany@must.edu.pk

ABSTRACT

The investigation was conducted to find out the fungal diversity in soil samples collected from seven sites of Tehsil Samahni, District Bhimber, Azad Kashmir. During this research work, 41 fungal species were identified from the collected soil samples. From the fungal isolates most of the species belonging to genera *Aspergillus.* The fungi were isolated and identified by using soil plate method and soil dilution method. The fungi have been examined microscopically with Lacto phenol cotton blue dye for their further clear identification. The results were indicated that out of seven observed sites, Achylarecurva spp. (7), Chaetomium reflexum (7), Mucor varians (7), Penicillium carylophylum (7) and Zygorhynchus moelleri (7), were isolated from all selected sites. While the minimum occurrence was observed against Aspergillus versicolor (1) and Penicillium viridicarum (1) fungal species from single site. The highest CFU/gm (colony forming units) of fungi Zygorhynchus moelleri (32.5 CFU/gm) and the lowest CFU/gm of fungi *Aspergillus fumigatus* (4.5 CFU/gm) were measured and documented. The frequency of five isolated soil fungal species Achyla recurva, Chaetomium reflexum, Mucor varians, Penicillium carylophylum and Zygorhynchus moelleri were observed maximum (100%) while lowest frequency was appeared against Aspergillus versicolor (14.2 %) and Penicillium viridicarum (14.2 %). The results of organic compounds analysis showed that the highest ratio of organic compound was observed in region Broh (6.5 g) and the lowest ratio was measured from Bandala (2.5 g). The region Bundala showed highest salinity rate (5.4 ppt) while the region Broh indicated lowest salinity rate (0.06 ppt). The different micronutrient analysis was also documented for better comparative exploration of fungal species. It was concluded that soil microbiota have diverse fungal flora due to high frequency of micronutrients and suitable ecoclimatic conditions in soil of Tehsil Samahni, District Bhimber, Azad Kashmir.

Keywords: Fungal Diversity, Soil Microflora, Salinity Rate, Organic Compounds, District Bhimber, Azad Kashmir

ROLE OF MICROBIAL DECOMPOSERS ON COMPOSTING OF SOME INVASIVE WEEDS

Tauseef Tabassam[1*], Tauseeq Haider[2], Ali Raza Gurmani[2], Tariq Sultan1, Mazhar Rafique[2], Sair Sarwa[1]

[1]Land Resources Research Institute, National Agricultural Research Centre, Islamabad
[2]Department of Soil & Climate Sciences, The University of Haripur, KPK

*Email: tauseefrwp@gmail.com

ABSTRACT

Composting is one of the useful methods that can directly consume many wastes for compost production that can be used as a source of nutrients to improve organic matter and enhance plant growth. Bacteria are the most active factor in soil, playing an important role in the decomposition of cellulose in straw. Extracellular enzymes secreted by microorganisms are the main microbial enzyme for straw decomposition. Parthenium weed, globally invasive is a good source of nitrogen (2.54%), phosphorous (0.44%), potassium (1.23%) and other nutrients. Hemp is one of the fastest-growing plants on the planet but good source of carbon. The objective of the present study was to investigate the best decomposer bacterial strain for rapid decomposition and quality compost production from parthenium, hemp and cattle manure. Three decomposition bacterial isolates i.e. isolate 1: RGD 6(4), isolate 2: RND 6(1), isolate 3: RGD 6(1) were utilized. Treatments consist of: T1: Parthenium+ Hemp+ Cattle Manure+ Isolate 1, T2: Parthenium+ Hemp+ Cattle Manure+ Isolate 2, T3: Parthenium+ Hemp+ Cattle Manure+ Isolate3, T4: Parthenium+ Hemp+ Cattle Manure+ Isolate 1+2+3. Treatment 1 and 4 performed significantly better for almost all standard composting quality parameters i.e. pH, Ec, temperature, moisture content percentage and total organic carbon than the control but further testing and evaluation of selected strains is needed on different substrates to select promising bacterial strains for quality compost formulation in short time.

Keywords: Microbial decomposition, Parthenium, Hemp, Compost

INTERACTIVE EFFECT OF BIOCHAR, ORGANIC AMENDMENT AND MICROPLASTICS ON CARBON MINERALIZATION AND ENZYME ACTIVITIES IN SOIL

Alishba Aslam[1*], Muhammad Farooq Qayyum[1]

[1]Department of Soil Science, Faculty of Agricultural Sciences & Technology, Bahauddin Zakariya University Multan, Pakistan

*Email: alishbaaslam433@gmail.com

ABSTRACT

The addition of microplastics to the environment can harm the environment and soil ecosystems, as well as carbon mineralization. There is a need to investigate their impact on soil and plants, especially the soil microbes and their activities. We conducted an incubated experiment in which the interactive effect of biochar (BC), organic amendments (WS: wheat straw) and microplastics (MPs) on carbon mineralization and enzyme activities was studied. It was a completely randomized three-factorial experiment; BC application (control and BC application), WS (control and WS application) and MPs (control and microplastics). There were 8 treatments each with three replications. The amended soil was incubated for 60 days, and carbon dioxide release was calculated at different time intervals (2, 8, 16 ,29 , 55 , 60 days). After incubation, soil samples were analyzed for urease activity, dehydrogenase activity, soil organic matter (SOM), microbial biomass carbon (MBC), pH and EC. The results show that CO_2 release was higher in organic amendments as compared to biochar and microplastics confirming the carbon sequestration potential of BC. The application of BC and WS increased SOM and MBC as compared to the control (no BC and no WS), indicating that they enhanced soil quality and microbial activity. However, the MPs decreased SOM and MBC compared to the control (no MP). The urease activity was increased in BC and WS amended soil as compared to the control (no BC and no WS), suggesting that they increased soil nitrogen availability and cycling. Similar trend was observed for the dehydrogenase activity. In treatments where BC and WS were applied along with MPs, the negative effects on enzymatic activities and carbon mineralization were minimized. In conclusion it is stated that biochar minimizes the effect of microplastic on soil microbial activity such as carbon mineralization and enzymatic activities.

Keywords: Microplastics, carbon mineralization, urease, fumigation extraction

ROLE OF BACTERIAL INOCULATION ON GROWTH OF BRINJAL PLANT IN LEAD CONTAMINATED SOIL

Uzma Ambreen*[1], Amina Zia[2], Hafiz Naeem Asghar[1], Zahir Ahmad Zahir[1], Fahad Rasool[3]

[1] Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad
[2] Institute of Microbiology, University of Agriculture, Faisalabad
[3] Department of Agronomy, University of Agriculture, Faisalabad
*Email: uzmambreen22@gmail.com

ABSTRACT

Heavy metal pollution is an emerging worldwide environmental issue due to its potential toxic effects on human health and agriculture. Environmental contamination has increased due to industrial, agriculture and household activities. Lead (Pb) is a toxic metal that has been used in many consumer products including gasoline, paint, tin canes, batteries, and pottery. Lead-polluted soil can be restored by different biological, physical, and chemical approaches. Among biological approaches bioremediation is one of the best ways to remediate metal-contaminated soil. Due to toxic effects of metals, plants grow slowly and produce less biomass. In metal stress, rhizobacteria help plants to gain sufficient biomass via different plant growth-promoting activities. The present study was planned to observe and measure the effects of Pb on brinjal plant in the presence of PGPR. The roots of the plants were inoculated with three different bacterial strains S1, S2 and S3 with and with concentration of Pb added in the soil. At harvesting data regarding plant height, root length, plant fresh and dry mass, chlorophyll contents, transpiration, sub-stomatal CO2 conductance, stomatal conductance, water use efficiency and the Pb content in the plant were recorded. The results showed that the lead contamination caused a significant reduction in growth and yield parameters. However, inoculation with PGPR improved the plant growth and yield in lead-contaminated soil. It was observed that inoculation with PGPR increased the yield of plants in Pb stress as compared to plants grown in lead contamination without inoculation. Results showed that PGPR also reduced the uptake of lead in plants.

***Keywords*: PGPR's, Bioremediation, Heavy metals, microbial inoculant**

INTERACTIVE ROLE OF DROUGHT TOLERANT RHIZOBACTERIA AND PRESSMUD FOR IMPROVING GROWTH AND YIELD OF TOMATO UNDER SKIPPED IRRIGATION

Muhammad Suleman Amjad[1], Fatima Siddiqa[1], Hafiz Naeem Asghar[1], Zahir Ahmad Zahir[1]

[1]Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad

***Email**: sulemankahloon12@gmail.com

ABSTRACT

The Earth's climate is undergoing constant changes primarily driven by human activities, including deforestation and overpopulation. Among the various abiotic stressors affecting plant health, water stress stands out as a prominent challenge. This condition can lead to the overproduction of reactive oxygen species (ROS), resulting in oxidative stress that adversely affects vital physiological processes, eventually leading to cell death in plants. Hence, it becomes imperative to bolster the water stress tolerance of plants to ensure their survival in such conditions. This current study represents an effort to harness the potential of environmentally friendly drought-tolerant rhizobacteria (DTR) and pressmud to enhance the growth and yield of tomatoes in water-scarce or drought conditions. The strain SBQ9, which had been previously isolated and characterized, was obtained from the Soil Microbiology and Biochemistry laboratory at the University of Agriculture, Faisalabad. In the wire house of the Institute of Soil and Environment Sciences, University of Agriculture, Faisalabad, a pot experiment was conducted to assess the impact of drought-tolerant rhizobacteria (DTR) and pressmud on the growth and yield of tomatoes under conditions of skipped irrigation. The tomato seeds were treated with the pre-isolated DTR strain SBQ9. The experiment consisted of three stages: full irrigation, skipped irrigation at the flowering stage, and skipped irrigation at the fruiting stage. There was a total of twelve treatments, each with three replications. The inoculation of SBQ9 DTR resulted in significant improvements in the growth and yield of the plants in pots, both under drought conditions at the flowering and fruiting stages, as well as under full irrigation. Furthermore, the combined application of DTR and pressmud positively influenced the water relations of the crop by enhancing relative water contents and proline levels, while reducing electrolyte leakages. It can be inferred that the inoculation of DTR in combination with pressmud is a viable strategy for promoting drought tolerance or mitigating the adverse effects of drought in tomatoes.

Keywords: Drought, Reactive Oxygen Species, Climate Change, Drought Tolerant Rhizobacteria

INTERACTION OF SULFUR WITH BIOFERTILIZER/BIOHERBICIDE TO IMPROVE THE YIELD OF WHEAT (*TRITICUM AESTIVUM* L.)

Zahoor Mujdded Choudary[1], Esha Mujtaba[1], Zahir Ahmad Zahir[1], Muhammad Adnan Shahid[2], Hafiz Naeem Asghar[1]

[1] Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad
[2] Department of Irrigation and Drainage, university of Agriculture, Faisalabad

*Email: z.mujdded@uaf.edu.pk

ABSTRACT

Food security is a concerning issue of the current era due to the increase in world population leading towards urbanization and industrialization while reducing land for agricultural activities. Wheat is a primary staple food worldwide; global population growth rates and dietary changes necessitate substantial yield gains over the next several decades to meet this escalating demand. Wheat production has been reduced due to several factors including low fertility status of the soil, inferior quality water, poor agricultural practices, and weed manifestation. Biocontrol of weeds by bioherbicide is a sustainable and environmentally friendly approach to suppress or control the growth and spread of weeds using bacteria without causing harm to the main crop and the environment. These bacteria release certain chemicals such as germination inhibitor substances, membrane-degrading enzymes, cyanide, antibiotics, extracellular polysaccharides, and excessive amounts of plant growth regulators. Burrakh, a biofertilizer cum bioherbicide, developed in Soil Microbiology and Biochemistry Laboratory, University of Agriculture Faisalabad. Sulfur is reported to increase selectivity and optimize the activity of bioherbicides. It may also enhance soil quality and plant development by boosting the nutrient content. Different combinations of sulfur (S) with different methods of application of Burrakh were evaluated in a field trial on wheat. The experiment was laid out in randomized complete block design (RCBD) with three replications. It was observed that the yield of wheat was increased by suppressing the weeds population. Physiological and yield parameters were taken, and the data was analyzed using R. The results showed that there was a significant increase in growth parameters of wheat and the grain yield was increased by 9.67% with the application of Burrakh as fertigation along with sulfur while suppressing the weeds population up to 96.97%.

***Keywords*:** Food security, Biocontrol, Soil health, Biofertilizer, Allelopathy

EXPLORING THE POTENTIAL OF FAST-FOOD WASTE AS CO-SUBSTRATE IN ANAEROBIC DIGESTION FOR METHANE PRODUCTION

Iman Fatima*, Muzammil Anjum

Institute of Soil and Environmental Sciences, PMAS Arid Agriculture University, Rawalpindi, Paksitan

*Email: imanfatimamohammad@gmail.com

ABSTRACT

At present, the world is advancing towards the most convenient and accessible food: fast food, which is leading toward to the production of billions of tons of fast-food waste during the making in the kitchens of different restaurants around the world such as potato peels, cabbage, lettuce, meat leftovers, and bread. As the demand for fast food is increasing, with more use of resources, it is not possible to decrease the demand of fast food, yet the kitchen waste produced during its making could be used to produce valuable products. The aim of this study was to produce methane by using FFW as co-substance with sludge through the process of anaerobic co-digestion. The experiments were carried out using both wastes with different mixing ratios (100% SS: 0%FFW, 0%SS: 100%FFW, 50%SS: 50%FFW, 25%SS: 75%FFW and 20%SS: 80%FFW) where the efficiency of the process was measured through various parameters such as biogas potential, COD and VS etc. The best ratio 25%:75% (SS: FFW) was evaluated through degradation of parameters mainly COD and VS where the COD removal efficiency was 90.78% and VS removal efficiency was 73.91%. The maximum concentration of methane in ratio 25%:75% (SS: FFW) was 62.9% and maximum methane accumulation was 2076ml/L as compared to control 0%:100% (SS: FFW), whose maximum concentration of methane was 56.5% and maximum methane accumulation was 1865ml/L. Afterwards the pseudo1st kinetic model and pseudo 2nd kinetic model were applied on methane data and as a result, pseudo 2nd kinetic model was most suitable model because the R^2 and K_2 value were high for 25:75 (SS:FFW) 0.992 and 0.016, respectively as compared to Control (100%FFW) whose R^2 and K_1 value obtained were 0.987 and 0.013, respectively. Overall, the results of study could be helpful in developing methane-based renewable energy resources by utilizing FFW with SS in anaerobic co-digestion systems.

***Keywords*:** Fast Food Waste; Co-substance; Sludge; Kinetic model; Biogas; Anaerobic co-digestion.

HARNESSING THE POTENTIAL OF FUNGI TO DEGRADE INDUSTRIAL WASTEWATER SLUDGE INTO MICROBIAL BIODIESEL

Bushra Noor*[1], Muzammil Anjum[1], Waqar un Nisa[2], Azeem Khalid[1], Samia Qadeer[3]

[1]Institute of Soil and Environmental Sciences, Institute of Soil and Environmental Sciences, PMAS Arid Agriculture University, Rawalpindi, Paksitan
[2]Department of Center for Interdisciplinary Research in Basic Science (Environmental Sciences)
International Islamic University Islamabad, Pakistan
[3]Department of Environmental Sciences, Allama Iqbal Open University, Rawalpindi, Pakistan

*Email: noorbushra21@gmail.com

ABSTRACT

In terms of toxicity, industrial waste from the wastewater treatment plant immediately contaminates the environment. Pakistan is experiencing a severe energy crisis due to the scarcity of petroleum products, and little attention is being paid to microbial biofuel alternatives. The current study seeks to use an oleaginous filamentous fungal strain for industrial waste treatment and the generation of cleaner energy in the form of biodiesel. The fungi were isolated from different sources and analyze for their potential to grow on sludge and simultaneous production of biodiesel. The industrial wastewater sample was collected from the CDA Sewage Treatment Plant, I-9 Islamabad. Based on screening seven pure strains were isolated. Based on growth and lipid accumulation potential efficient strain B97 was selected the experiments were performed in which lipid accumulation potential and waste degrading parameters were monitored and physicochemical conditions were optimized like pH, temperature, incubation time, shaking conditions, carbon, and nitrogen. The results of lipid accumulation potential under optimized conditions for B97 strain was 70%. The lipid profile of B97 strain was also further characterized by FTIR and GC-MS analysis that ensures the presence of essential lipid compounds. The CDW under optimized conditions resulted as 16.43g/l of dry biomass. Similarly, the potential of B97 for COD degradation was 80%. The Volatile solids degradation was 65% for B97 strain. Following that, the extracted lipids were exposed to the transesterification process to produce biodiesel. Later, trans-esterified biodiesel was subjected to GC-MS analysis for FAME profile that ensures the presence of essential fatty acids in the form of oleic acid, palmitic acid, stearic acid, erucic acid and arachidic acid. This study ensures a sustainable technique for treating industrial waste with oleaginous filamentous fungi and producing efficient microbial oils in terms of biodiesel.

***Keywords*:** Industrial wastewater, Fungi, Biodiesel, Lipids

EFFECT OF PLANT GROWTH PROMOTING RHIZOBACTERIA (PGPR) FOR ENHANCING PLANT GROWTH AND YIELD OF CHILI (*CAPSICUM ANNUUM* L.) CROP

Sohail*[1], Muhammad Saleem Sarki[1], Qurban Ali Panhwar[2] and Amanat Ali[2], Allah Wadhayo Gandahi[1]

[1]Department of Soil Science, Faculty of Crop Production, Sindh Agriculture University, Tandojam 70060, Sindh, Pakistan

[2]Soil & Environmental Sciences Division, Nuclear Institute of Agriculture (NIA), Tandojam 70060, Sindh, Pakistan

*Email: sohail@gmail.com

ABSTRACT

Plant growth-promoting rhizobacteria (PGPR) are free-living bacteria which colonize the plant roots and enhance plant growth. The study was carried out at the Nuclear Institute of Agriculture (NIA) in Tandojam, to screen and evaluate the impact of PGPRs for growth and yield enhancement of Chilli crop. All selected isolates showed positive catalase activity and antagonistic effect. Most of them were Gram negative (-ve) and biofilm producer. The highest IAA production (9.43 mg L^{-1}) was recorded in NIA PGPR47 and minimum (6.27 mg L^{-1}) was in NIA PGPR3. NIA PGPR2 showed the highest P-solubilization efficiency (28.77%). The isolates were screened and evaluated for the enhancement of growth and yield of chilli crop in the field. Seven treatments with three replications were used in the experiment, which was set up using a randomized completely block design (RCBD). Experimental treatments were as, T_1= Control, T_2 = Recommended chemical fertilizer (RCF), T_3 = 50% of RCF, T_4 = 75% of RCF, T_5 = PGPR bio-inoculant, T_6 = 50% RCF + PGPR bio-inoculant, T_7 =75% RCF+PGPR bio-inoculant. The result showed maximum bacterial abundance in inoculated treatments. The highest population (11.04 log CFU g^{-1} soil) was observed in 75%RCF+PGPR bio-inoculant. The maximum plant height (36 cm), number of leaves (71), branches (30), flowers (20), fruits (17), yield (15 kg), girth (7.53 cm), width (1.86 cm), moisture content (86.51%), root length (21.5 cm), shoot length (24.66 cm) in 75% RCF+PGPR bio-inoculant treatment. Similarly, the highest SPAD value (61.33) and nutrient uptake were found in 75% of RCF+PGPR bio-inoculant. Hence it is concluded that PGPR bio-inoculant along 75% recommended chemical fertilizer gave maximum growth and yield by reducing 25% of chemical fertilizer application in chilli crop.

Keywords: Crop, Yield, Microbes

EFFECT OF EXOGENOUS APPLICATION OF SALICYLIC ACID ON THE GROWTH OF *brassica oleracea l.* UNDER LEAD STRESS

Aneela Kousar[1]*, Farheen Nazli[1], Ghulam Hassan Abbasi[1], Qasim Ali[2], Muhamad Hamza[2]

[1]Institute of Agro-Industry and Environment, The Islamia University of Bahawalpur, Bahawalpur 63100, Pakistan
[2]Department of Soil Science, Faculty of Agriculture and Environment, the Islamia University of Bahawalpur, 63100 Bahawalpur

*Email: aneelakousarch@gmail.com

ABSTRACT

Heavy metal pollution has become a huge problem due to its negative effects on people, plants, animals, and the environment. Heavy metals such as lead (Pb) in agricultural soils must be eliminated to meet the world's tremendous food demand. Many physical, chemical, and biological approaches are used to remediate heavy metal-contaminated soils. However, foliar application of growth hormones such as salicylic acid is gaining popularity due to its low cost and environmental friendliness. Salicylic acid is involved in plant physiological functions, growth stimulation, and yield improvement. Therefore, different levels of salicylic acid were evaluated to improve the growth and lead immobilization in cabbage under Pb-contaminated soil. Lead chloride was used to spike the soil with four different levels of lead (0, 200, 400, and 600 ppm). It was observed that applying salicylic acid improved cabbage growth, physiology, and antioxidant status while decreasing lead toxicity at all levels of Pb. At the highest heavy metal level (i.e., 600 ppm), a larger application SA (0.45 g L^{-1}) significantly increased the cabbage's shoot and root dry weights (47 and 65%, respectively), relative water contents (38%), chlorophyll a and b contents (28 and 32%, respectively), and grain production (52%). Furthermore, there were significant reductions in the quantities of Pb^{2+} (32%) in shoot, catalase (49%), superoxide dismutase (23%), and peroxide dismutase (52%), translocation factor (61.06%), and bioconcentration factors (33 and 48%) for root and shoot following SA treatment. It is concluded that SA can enhance heavy metal tolerance and improve cabbage growth under heavy metal-contaminated soil.

Keywords: *Lead, Cabbage, Heavy metal stress, Growth hormones, Salicylic acid, Antioxidants*

ENHANCING PHOSPHORUS USE EFFICIENCY OF WHEAT BY APPLYING POLYMER COATED PHOSPHATIC FERTILIZERS

Zain Mushtaq[1*], Maria Hashmi[2], Salwa Saeed[1]

[1]Department of Soil Science, Faculty of Agricultural Sciences, University of the Punjab, Lahore
[2]Institute of soil and environmental sciences, university of agriculture, Faisalabad

*Email: zain.ss@pu.edu.pk

ABSTRACT

The alkaline calcareous character of Pakistani soils results in limited phosphorus availability. The main issue facing the world is poor wheat output, which is also linked, among other things, to low phosphorus use efficiency (PUE). A relatively new concept among the many methods being utilized to improve the efficiency of phosphorus utilization is polymer-coated fertilizer. To improve wheat growth, yield, and phosphorus usage efficiency, a field study was carried out to evaluate the effectiveness of polymer coated diammonium phosphate (DAP), triple super phosphate (TSP), single super phosphate (SSP), and nitro-phosphate (NP). Fertilizers with and without polymer coatings were applied at various percentages 25, 50, 75, and 100%—of the suggested rate. Three replications and a randomized complete block design (RCBD) were included in the study's planning. Various growth and yield metrics were determined using standard operating techniques. Several physicochemical parameters were measured, including phosphorus, nitrogen, and potassium concentrations in grain and straw, number of tillers, plant height, number of grains per wheat spike, 1000 grain weight, number of spikes, and wheat's phosphate use efficiency (PUE). The STATISTIX 8.1 program was used to do a statistical analysis on all the data that had been gathered.

Keywords: Fertilizer use efficiency, Soil fertility, Plant growth

EVALUATING THE EFFECT OF PHOSPHORUS SOLUBILIZING BACTERIA AND ORGANIC AMENDMENTS ON QUINOA TO REDUCE THE DISPROPORTIONATE USE OF CHEMICAL FERTILIZERS INDUCING ENVIRONMENTAL POLLUTION

Tayyaba Samreen[1]*, Samia Arshad[1], Sidra Tahir[1], Faraz Anjum[1], Muhammad Zulqernain Nazir[1], Muhammad Ahmad[1]

[1]Institute of Soil and Environmental Sciences University of Agriculture Faisalabad, Pakistan.

*Email: tybasamreen@gmail.com

ABSTRACT

Quinoa (*Chenopodium quinoa* Wild.) is one of the major food products of high nutritious value. Chemical fertilizers are being used in disproportionate quantities to enhance crop yield which pollutes the environment. For this purpose, phosphate solubilizing bacteria (PSB) were isolated from the rhizosphere of the soil by using Pikovskaya's agar medium. The most efficient strains PSB2 and PSB4 were used in the pot experiment. The experiment was performed by using two isolates of PSB2 and PSB4 with twelve treatments and three replications including control. The different sources of organic amendments such as cow dung (CD), poultry manure (PM) and inorganic fertilizers N, P, and potassium (K) at 75, 50 and 50 kg ha^{-1}, respectively were applied. The maximum increase in chlorophyll contents was 62.90 SPAD (43.29% increase over control). The maximum plant height was 105.67 cm (40.54% increased over control), shoot fresh weight 54 g (77.78% increased over control), shoot dry weight 17 g (70.58% increased over control), root length 38 cm (68.42% increased over control), root fresh weight 27.23 g (65.73 % increased over control), root dry weight 14.67 g (79.55% increased over control), grain yield 19.72 g (46.14% increased over control). The maximum available P (62.26%) in grains was obtained by inoculating PSB2 with RP and CD. Results indicated that the inoculation of PSB and organic amendments has the potential to enhance P availability and crop yield and reduce the use of chemicals that are polluting the environment.

Keywords: Phosphate solubilizing bacteria; Cow dung, Poultry manure, Quinoa

VARIOUS LEAVE COMPOST ROLE IN ENHANCING SOIL PHYSIOCHEMICAL PROPERTIES, SOIL CONSERVATION AND CROP PRODUCTIVITY

Mueen Akram*[1], Muhammad Murtaza[2], Abdul Basit[2,3], Aisha Alam[2], Ahtasham Khan[1], Shamsa Bibi[1], Kashifa Shabeer[2], Muhammad Hammad[4], Muhammad Khalid[4]

[1]Department of Soil Science, FAS&T, BZU, Multan
[2]Department of Soil Science, University of Layyah
[3]Department of Fertilizer Quality Control, Evyol Group, Multan
[4]Department of Agriculture, MNS Agriculture University Multan

*Email: mueenakram342@gmail.com

ABSTRACT

Crop productivity is continuously disrupting due to unbalanced application of synthetic fertilizer and reduced soil fertility. During the 2022 cropping season, a pot experiment was carried out to assess the effects of long-term soil conservation techniques. *Triticum aestivum* L. was planted under the influence of partially and fully decomposed leaf compost (LC) derived from *Moringa oleifera*, *Conocarpus erectus, Albizia lebbeck* and *Vigna radiata*. Significant positive improvements in *Triticum aestivum* L. yield were observed under each LC. Positive effects on soil physiochemical properties were also observed, with significant improvements in soil pH, electric conductivity, organic matter, potassium, and phosphorus levels. Moreover, *Vigna radiata*'s partially decomposed leaf compost and fully decomposed leaf compost revealed a biological yield of 7.20 g and 7.59 g per plant, respectively, along with a grain yield of 1.09 g and 1.50 g per plant, respectively, surpassing other LC variants. The highest harvesting index percentage was recorded for *Albizia lebbeck* (24%), *Moringa oleifera* (23%), and *Conocarpus erectus* (21%) among the various LC treatments. Consequently, the application of LC is recommended for enhancing both soil health and yield rates. To study comprehensive impacts, further research is essential.

Keywords: Soil Health, Leaves Compost, Soil Conservation, Crop Productivity.

PLANT GROWTH-PROMOTING BACTERIA AS SUSTAINABLE ALLIES IN ALLEVIATING DROUGHT STRESS FOR MUNG BEANS

Hafsa Maqsood[1], Rimsha Sharif[1], Najma Majeed[1], Tehreem Fatima[1], Muhammad Noman Sheeraz[1], Muhammad Arif[1], Muhammad Ahmad Mahmood[1], Muhammad Baqir Hussain[1]

[1]Department of Soil and Environmental Sciences, MNS-University of Agriculture Multan

*Email: baqirhussainus@gmail.com

ABSTRACT

Mung bean (*Vigna radiata*) is an important nutritious crop that plays an important role in global food security. However, drought stress has a significant impact on its synthesis, leading to lower photosynthetic rates, oxidative damage, and poor nutrient absorption. The impacts of drought stress on mung bean yield emphasize the significance of resolving this issue for global food security.Drought stress hampers mung bean growth and ultimately the grain yield. Therefore, a need for novel techniques to improve mung bean resilience to drought under climate change scenarios. In this perspective, plant growth-promoting bacteria (PGPB) have shown their potential to rescue mung bean growth and productivity under drought stress. These bacteria are known to synthesize various plant growth regulators (Auxin, IAA, Cytokinin, Gibberellin, and Abscisic acid), enzymes like catalase, 1-aminocyclopropane-1-carboxylase (ACC), superoxide dismutase (SOD), and peroxidase (POD), etc. Furthermore, PGPB influences proline levels, a proteinogenic amino acid vital in plant stress responses. PGPB enhances plant development and improves nutrient availability in the rhizosphere, minimizing the detrimental effects of drought stress on mung bean. The use of PGPB is a long-term option that has the potential to increase mung bean productivity and quality while also contributing to food security. In terms of climate change adaptation, PGPB not only improves mung bean resilience but also helps to reduce greenhouse gas emissions and contribute to soil carbon sequestration. It is crucial to understand the complex relationship of microorganisms to sustainable agriculture, and climate change. The inoculation of efficient microbial strains into soil ecosystems has emerged as a critical technique for restoring soil health and promoting sustainable farming practices. The critical significance of microbial treatments in enhancing mung bean yield and resilience, as well as maintaining food security in the face of increasing climate change are discussed in this study.

***Keywords*:** Mung beans, drought stress, plant growth-promoting bacteria, sustainable strategies, food security in climate-resilient agriculture.

RESPONSE OF GARLIC CULTIVARS TO APPLIED BIOCHAR AND PLANT GROWTH PROMOTING RHIZOBACTERIA (PGPR) UNDER SALINE-SODIC CONDITIONS

Muhammad Arslan Asir[1], Muhammad Usman Jamshaid*[1], Tanveer Ul Haq[1], Khuram Mubeen[3], Ahmad Mahmood[2], Hafiz Shahzad Ahmad[1], Javed Iqbal[1], Ahsan Qureshi[1]

[1]Department of Soil and Environmental Sciences, MNS University of Agriculture, Multan, Pakistan, 66000
[2]Department of Climate Change, MNS University of Agriculture, Multan, Pakistan, 66000
[3]Department of Agronomy, MNS University University of Agriculture, Multan, Pakistan, 66000

*Email: usman.jamshaid@mnsuam.edu.pk

ABSTRACT

Garlic is most important vegetable crop in globe as well as in Pakistan, but its yield is decreasing due to various biotic and abiotic stresses. Salinity negatively affects the growth and productivity of garlic. Different approaches are used to overcome the salinity stress in garlic. Therefore, a pot study was planned to improve the garlic production by application of biochar and plant growth promoting rhizobacteria (PGPR) under saline conditions. The study was laid out according to a complete randomized design with three replications. Treatments was two factor (i) treatments (T_0: Control (Control EC+SAR); T_1: 02 dS m^{-1} + 04 SAR; T_2: 04 dS m^{-1} + 08 SAR; T_3: 02 dS m^{-1} + 04 SAR + Biochar; T_4: 04 dS m^{-1} + 08 SAR + Biochar; T_5: 02 dS m^{-1} + 04 SAR + PGPR; T_6: 04 dS m^{-1} + 08 SAR + PGPR) and (ii) three varieties (Desi (V_1), Pink (China) (V_2) White (China) (V_3)). Later, different morphological (shoot length, shoot fresh and dry weight) chlorophyll (SPAD) and yield parameters were collected. The experimental data was statistically evaluated by applying appropriate statistical software. An increase in Desi variety was observed in T_4 and T_6 (44.4 and 42.8%) respectively, in plant dry weight. Our experiment results revealed that biochar and PGPR amended treatments pots improved shoot fresh weight, shoot dry weight and SPAD value of garlic varieties. Hence, it is concluded that biochar and PGPR can ameliorate the effect of salinity and it will increase the yield of garlic crop in saline-sodic conditions.

Keywords: Salinity, Rhizobacteria, Biochar, Screening, Garlic

MAXIMIZING MAIZE (*ZEA MAYS*) GROWTH AND SOIL HEALTH: HARNESSING THE POWER OF AUXIN (IAA)

Muhammad Hamza Khalil[1*], Muhammad Naveed[1], Munazza Rafique[2], Ahmed Hassan[1] Muhammad Farhan Qadir[3], Muhammad Sabir[1], Ameer Hamza[1]

[1]Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad, Pakistan
[2]Soil Bacteriology Section, Ayub Agricultural Research Institute, Faisalabad, Pakistan.
[3]College of Resources and Environment, Xinjiang Agricultural University, 311 Nongda East Road, Urumqi, 830052, Xinjiang, China

*Email**:** m.hamzakhalil2125@gmail.com

ABSTRACT

In response to the challenges posed by a growing global population and the environmental impact of chemical fertilizers and pesticides, a study focused on the use of auxin (IAA), a plant growth regulator (PGR), to boost crop production and protect the soil microbial population. The study investigated several application methodologies and IAA concentrations, emphasizing the importance of sustainable agriculture practices for maize. Auxin's beneficial impacts on plant development and soil microbes were also highlighted. By understanding and utilizing IAA effectively, sustainable crop production can be achieved while minimizing negative environmental impacts. Auxin, a plant hormone that plays a crucial role in various developmental processes such as root development, leaf abscission and fruit development was the focal point of the study. The aim was to understand and effectively utilize auxin to promote a healthier and more sustainable approach to farming. To better understand the effects of auxin, various application methods and concentrations of auxin were investigated. Foliar spraying, soil drenching, seed treatment, and root dipping were all investigated. The most suitable IAA concentrations 3.5mg to 4g per acre were critical for achieving the desired effects while causing no harm to plants or soil microbes. The study discovered that auxin had a positive impact on soil microbes, increasing beneficial activity. This resulted in a healthier soil environment, which improved nutrient uptake and plant health overall. It emphasized the importance of understanding the effects of auxin on plant development and soil health to properly use it in agriculture. Finally, the study emphasized that limited concentration and foliar application methods positively influence maize productivity. Sustainable agriculture could be promoted by understanding the application methods and IAA concentrations, ensuring the protection of natural resources for future generations.

Keywords**:** Auxin, IAA Plant growth regulators, Sustainable agriculture, Crop production, Soil Microbes

ABUNDANCE AND DIVERSITY OF EARTHWORM (ANNELIDA) IN SUBDIVISION RAWALAKOT AZAD JAMMU KASHMIR

Nasir Rahim, Samia Shabbir, Majid Mahmood Tahir, Afshan Majeed and Aqsa Kanqal

[1]Department of Soil & Environmental Sciences, University of Poonch Rawalkaot AJK

*Email: nasirrahim@upr.edu.pk

ABSTRACT

Earthworms are considered the most important soil-inhabitant animal group, of phylum Annelida and class Oligochaeta. These creatures play very important role in the physical, different processes and chemical properties within the soil. Earthworms modify the biodiversity of soil. The present study were carried out in Sub-Division Rawalakot of District Poonch, Azad Jammu and Kashmir to explore Earthworm fauna and estimates its diversity. These macro invertebrates were collected from five different localities by hand sorting and digging method. Soil samples (500g) were taken to measure, EC, O.M, pH moisture content, organic carbon, P, N and K. The collected specimens were preserved in 5% formalin. The adult specimen were recognized up to species level by using Gerard and Sims (1985) key of earthworm identification. Taxonomic characters of collected specimens were studied by using microscope. The identified specimens were reposited in the Departmental Lab of Soil and Environmental Sciences. A total 263 specimens of earthworms were collected. Nine species; *Eisenia fetida, Bimastos parvus, Eisenia andrel, Aporrectodea rosea, Perionyx excavates, Lumbricus rubellus, Allolobophora chlorotica, Aporrectodea caliginosa and Drawida pullucida* belonging to 3 families *Lumbricidae, Megascolecidae and Moniligastridae* were identified. Diversity of the earthworms was calculated by using Shennon-Wiener andSimpson's diversity index. Richness of the earthworms was calculated by using Margelf's and Menhinck index while Shennon-equitability and Nakamura index was used to record the richness of Earthworms. The collected specimens were identified up to the species level. The purpose of the research study was to explore the Earthworm fauna, find out the abundance and biodiversity of earthworms and calculate the abundance and diversity of earthworms from cultivated soils of Rawalakot Azad Jammu and Kashmir.

Keywords: earthworms, soil health, soil fertility

Environmental Sustainability through Advanced Photocatalysis: Black TiO_2 Synthesis for Efficient Treatment of Poultry Feed Manufacturing Wastewater

Amna khursid Nawaz*[1], Sajida Parveen[1], Muzammil Anjum[1]

[s1]Institute of Soil & Environmental Sciences, Pir Mehr Ali Shah Arid Agriculture University Rawalpindi, 46300, Pakistan

*Email: amnabaloch025@gmail.com

ABSTRACT

In addition to various environmental problems such as enhanced GHGs concentration, loss of biodiversity, water scarcity and production of poultry products have serious environmental concern. Poultry products use a lot of nutrients, water, and land for installation of project. Large volumes of water will be utilized in the evisceration, cleansing, and washing procedures in poultry slaughterhouses. Poultry products have high organic content that causes nutrient enrichment in water bodies and hence toxic to aquatic biota. Compared to other wastewater treatment methods, TiO_2-based photocatalyst will be very successful for removing organic pollutants from wastewater. In the present study, Synthesis, and characterization of black TiO_2 will be performed using advanced techniques like, SEM, XRD and FTIR. A sample of the wastewater will be collected from poultry feed manufacturing. Physiochemical characterization will be performed for the analysis of parameters such as BOD, COD, pH, color, and turbidity. Fermentation of poultry feed manufacturing will be conducted and to remove the remaining organic constants photocatalysis of fermented wastewater will be performed.

***Keywords*:** Photocatalysis; Bioenergy; Black TiO_2 ; Poultry Feed Manufacturing,

"Soil Health: A Key to Food Security"

20th INTERNATIONAL CONGRESS OF SOIL SCIENCE

20-22 February 2024, Rawalpindi, Pakistan

SOIL SCIENCE SOCIETY OF PAKISTAN -SSSP-

SOIL FERTILITY AND PLANT NUTRITION

STRATEGIC MAPPING OF SOYBEAN CULTIVATION ZONES IN SUBTROPICAL DESERT CLIMATES THROUGH GEOSPATIAL TECHNIQUES

Noman Ahmad[1], Hamaad Raza Ahmad[1*], Muhammad Ashar Ayub[2], Ayesha Siddique[1], Tariq Aziz[3]

[1]Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad 38040, Pakistan
[2]Institute of Agro-Industry and Environment, The Islamia University of Bahawalpur, Bahawalpur 63100, Pakistan
[3]Sub campus Depalpur, Okara, University of Agriculture, Faisalabad, Pakistan

*Email : hamaadkhan@uaf.edu.pk

ABSTRACT

Soybean (*Glycine max*), a protein-rich oilseed crop extensively used for cooking oil and poultry feed, faces significant challenges due to adverse global climatic conditions aggravated by the ongoing climate crisis. In response to this critical issue, this study was initiated to assess suitable zones for soybean cultivation, aiming to facilitate informed land use decisions within the semi-arid terrestrial ecosystem of Pakistan. Through the utilization of geostatistical interpolation, data layers encompassing soil, irrigation water, land use and land cover, topographic features, and climate information were generated and overlaid based on criterion weightage derived from the Analytic Hierarchy Process. The accuracy of land use and land cover was rigorously evaluated, yielding a 70% overall accuracy and a Kappa (*K*) value of 0.61, signifying an acceptable level of precision. Validation through the Receiver Operating Characteristic (ROC) curve for soybean crop suitability demonstrated a highly satisfactory area under the curve of 0.738. The study estimates that out of 172,618.66 hectares, approximately 47.46% of the land is highly suitable (S1) for soybean production, followed by 21.36% moderately suitable (S2), 11.91% marginally suitable (S3), 7.00% currently not suitable (N1), and 12.28% permanently not suitable (N2). Conclusively, the findings suggest that the study area exhibits conducive climatic conditions, optimal soil health, and access to quality irrigation water, all of which have the potential to support soybean crops with improved agronomic practices. This investigation offers valuable insights to both farmers and policymakers concerning irrigation water quality, agricultural productivity, and soil degradation.

Keywords: Receiver Operating Characteristic Curve; Land Suitability; Water Quality; Climatic Conditions; Weighted Overlay Analysis; Analytical Hierarchy Process

POTENTIAL OF SILICON IN ENHANCING YIELD AND GRAIN QUALITY OF RICE UNDER WATER STRESS

Amina Kalsom*[1], Abdul kareem[2], Ana Aslam[1], Ifra saleem[1], Qudsia Nazir[1], Nisa Mukhtar[1], Raheela Naz[1], M. Arfan-ul-Haq[1], Muhammad Arif[1] and Muhammad Nasim[1]

[1]Soil Chemistry Section, ISCES, AARI, Faisalabad, Pakistan
[2]Engro Fertilizers Limited, Pakistan

*Email: amina.kalsom.ao@gmail.com

ABSTRACT

Silicon (Si) is known to improve biotic and abiotic stress resilience and productivity in several crops. Although it is not considered an essential nutrient it is recognized as a beneficial element due to its important role in plants, especially for rice under stressed conditions. The goal of this study was to: (1) evaluate the effect of Si application on rice yield and grain quality under water deficit stress, (2) evaluate the optimum rate of Si for rice production, and (3) evaluate Si absorption of rice using foliar -applied Si. The experiment was laid out in a split-plot design with three replications. The main plots had 100 and 70% irrigation schemes and sub-plots had silicon rates (0, 50, 100, 150, 200, 250, and 300 mg L^{-1}). Urea, Diammonium phosphate, and sulfate of potash were applied at the recommended rates of 135-90-60 kg ha^{-1} NPK. Potassium silicate was used as a silicon source. Foliar application of Si was made after 30 and 45 days of transplanting. Results indicated that the maximum rice grain yield was achieved by the application of Si at 300 mg L^{-1} which was not statistically different from the application of Si at 250 mg L^{-1}. Results also showed that the Si application significantly increased Si concentration and uptake in rice grown under water stress. Based on these results, it is concluded that the application of Si 250 mg L^{-1} in combination with the recommended NPK fertilizers could be used to obtain the optimum grain yields under water stress.

Keywords: Drought, Foliar Si solution, Nutrient accumulation, Si uptake, standard fertilizer practice

IMPACT OF BAND PLACEMENT OF PHOSPHATE FERTILIZER ON PHOSPHORUS ACQUISITION AND YIELD OF WHEAT IN CALCAREOUS SOIL

Ana Aslam[1*], Ifra Saleem[1], Amina Kalsom[1], Raheela Naz[1], Muhammad Arfan ul Haq[1], Muhammad Arif[1], Muhammad Nasim[1] and Sarfraz Hussain[2]

[1]Soil Chemistry Section, Institute of Soil Chemistry & Environmental Sciences, Ayub Agricultural Research Institute, Faisalabad, Pakistan
[2]Institute of Soil Chemistry & Environmental Sciences, Kala Shah Kaku, Pakistan

*Email: anaaslam1704@gmail.com

ABSTRACT

Crop phosphorus acquisition is a major challenge in arid and semi-arid regions due to the formation of insoluble phosphorus complexes which restrict phosphorus mobility. The reduced availability of phosphorus is often related to poor crop productivity. Hence, the banding of phosphorus can increase its acquisition and crop yield. Therefore, a field experiment was conducted on wheat to explore the role of band placement of phosphate fertilizer on yield, biomass, phosphorus content in plants, and phosphorus mobility in soil. The experiment was laid out according to a Randomized Complete Block Design with three replications. The band application of di-ammonium phosphate at different rates (0, 57, 114, 171, and 228 kg ha^{-1} of P_2O_5) was made along with the recommended rates of nitrogen and potassium. Results showed that the banding of phosphate fertilizer at rates of 171 and 228 kg ha^{-1} increased the grain yield (4.27 and 4.22 t ha^{-1}, respectively) and biomass (11.30 and 11.06 t ha^{-1}, respectively) of wheat compared to the control. A significant increase in the phosphorus content of wheat grain was observed in treatment receiving 228 kg ha^{-1} of phosphate fertilizer compared to other treatments. Results also revealed that available phosphorus content in soil decreased with increasing soil depth. Maximum available phosphorus content in soil was found at 2 cm depth followed by 4, 6, 8, 10, and 12 cm depth in treatment where banding of phosphate fertilizer at the rate of 228 kg ha^{-1} was done. It was concluded that the band application of phosphate fertilizer at a higher rate resulted in increased phosphorus acquisition and improved wheat yield.

Keywords: Phosphorus application, mobility, uptake, biomass, wheat

APPRAISAL OF PECAN NUT COMPOSITION USING VARIOUS PHYSICO-CHEMICAL AND NUTRITIONAL FUNCTIONS

Muhammad Qasim[1,2,3*], Naseem Akhtar[2], Tayyaba Naz[1,3], Maryam Safdar[2], Maham Naeem[1,3], Muhammad Umair[1,3], Muhammad Mazhar Iqbal[4], Iqra Ghafoor[1,3] and Muhammad Anwar-ul-Haq[1,3]

1Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad.
2Biochemistry Section, Ayub Agricultural Research Institute Faisalabad.
3Saline Agriculture Research Center, University of Agriculture Faisalabad.
4Department of Soil and Environmental Sciences, University of Sarghoda–Pakistan.

Email: ranaqasim7175@gmail.com

ABSTRACT

Pecan (*Carya illinoinensis*) nuts are known for their richness in nutritional contents, which includes healthy fats, protein, fiber, and a variety of vitamins and minerals. The high monounsaturated fat content and primarily oleic acid promotes cardiovascular health, while antioxidants such as tocopherols and polyphenols have anti-inflammatory and anti-cancer properties. Furthermore, pecans are high in manganese, zinc, and vitamin E, which promote overall health and immune function. Aside from their nutritional benefits, pecan nuts serve an important function in agricultural and economic landscapes. Planting pecan orchards is a sustainable agroforestry approach that promotes biodiversity and soil conservation. The expanding global demand for this versatile nut emphasizes the economic relevance of pecan cultivation. Pecans contribute significantly to the livelihoods of farmers and the economies of the regions where they are grown as a cash crop. The present study was carried out to determine the physcio-chemical and nutritional composition (antioxidant potential, total soluble solids, crude protein, crude fat, ash, crude fiber, pH, acidity) of pecan nut those were collected from several orchards of Murree, Pakistan. The antioxidant activity of the infusion was assessed using the 2,2-diphenylpicrylhydrazyl (DPPH), and β-carotene/linoleic acid systems. The nutritional composition of pecan nut shells and the total phenolic and condensed tannin contents of pecan nutshell infusion was also determined. In the study, it was found that the Kanza cultivar of pecan nuts have a minimum antioxidant potential of 58.4% and a maximum antioxidant potential of 80.6% for dried fruit. The results showed that pecan nuts have the maximum crude fat i.e., 41.6% and minimum of crude fat was 32.4%. According to the findings, pecan nuts have the highest total soluble salt content 1.6% and the lowest value was found to be 1.4%. The pH range for pecan nuts is from 4.64 to 6.53. The acidity of pecan nuts ranges from 0.460 to 0.52. Pecan nuts had the highest ash concentrations 1.4% and the lowest ash contents 1.3%. Pecans have the highest crude protein content 11.9%, whereas the lowest crude protein content was recorded as 10.0%. Pecan nuts have the highest proportion of crude fibre value of 71.3% with the lowest percentage of crude fiber i.e., 30.6% found in this variety.

Keywords: Pecan nut, *Carya illinoinensis*, Antioxidant, Total soluble solids, Protein, Nutritional Composition

EXTRACTION AND CHARACTERIZATION OF HUMIC AND FLUVIC ACIDS FROM ORGANIC SOURCES: AN INNOVATIVE WASTE MANAGEMENT STRATEGY

Siraj Ahmed Baloch[1,2*], Ghuam Murtaza Jamro[1], Inayatullah Rajpar[1], Javed Ahmed Shah[3]

[1]Department of Soil Science, Sindh Agriculture University Tandojam, Pakistan
[2]Agriculture Extension Department, Government of Baluchistan, Pakistan
[3]Soil and Environmental Sciences Division, Nuclear Institute of Agriculture, Tandojam, Pakistan

Email: ahmedbaloch2023@gmail.com

ABSTRACT

Extraction of humic (HA) and fulvic (FA) from farmyard manure (FYM), banana waste compost (BWC), and sugarcane pressmud (SPM) can increase organic waste utilization, minimize environmental issues and assist sustainable crop growth. The assessment was carried out to extract humic and fluvic acids from organic sources, as well as analyses of their functional groups and elemental content. Humic and fulvic acids were extracted, and purified, and their functional groups, and element concentrations were determined. It was found that fulvic acid had greater total acidity (7.5%), carboxyl group (5.7%), and phenolic-OH (1.9%) groups than humic acid (7.3%, 5.4%, and 1.9%, respectively) extracted from organic sources. Fulvic acid extracted from FYM, BWC, and SPM had a highest E4/E6 ratio or optical densities at 465 and 665 nm (2.66%, 2.32%, and 2.07%), then humic acid (2.63%, 2.16%, and 1.42%). Furthermore, it was observed that the nitrogen content was higher in FA extracted from FYM (N 2.66%), followed by 2.63 in BWC, and the P content was higher in FA extracted from FYM (2.16%), followed by BWC (1.86%), and in SPM (1.76%) as compared to humic acid in SPM (0.56%), BWC (0.52%) and in FYM (0.16%) respectively. The potassium content was greater in humic acid extracted from BWC (18.4%), followed by FYM (17.6%) and in SPM (13.6%), as compared to FA extracted from FYM (11.6%), followed by BWC (10.4%) and in SPM (9.6%). It is concluded that humic acid and fluvic acid are valued sources of nutrients, can improve soil health, and can be useful in organic waste management without harming the environment.

Keywords: Humic acid, Fulvic Acid, Extraction, Management, Environment

EVALUATING NUTRIENTS USE EFFICIENCY, GROWTH, AND YIELD OF WHEAT THROUGH THE APPLICATION OF COMMERCIAL VALUE-ADDED FERTILIZER

Mansoor Ali Shah[1*], Ghulam Murtaza Jamro[1], Khalid Hussain Talpur[1], Syed Shahid Hussain Shah[2], Muhammad Umair Mubark[2], Inayatullah Rajpar[1], Pir Ahmed Naqi Shah[3], Aftab Ali Chohan[1]

1Department of Soil Science, Sindh Agriculture University Tandojam, Pakistan
2Engro Fertilizers Ltd. Lahore, Pakistan
3Department of Agronomy, Sindh Agriculture University Tandojam, Pakistan

*****Email: mansoor.rashdi110@gmail.com

ABSTRACT

Low nutrient use efficiency limits. Improving nutrient use efficiency (NUE) is crucial to accomplish estimated production. The most important management approach for improving fertilizer efficiency is utilizing an optimum amount of fertilizer to achieve sustainable wheat production. Value added fertilizers have been introduced to increase NUE. In view, Zarkhez plus a commercial value-added fertilizer was assessed to increase NUE and yield and growth of wheat in field experiment. Field experiment was conducted in Randomized Complete Block Design including six (6) treatments; T_1= Farming Practice (Standard Urea + DAP + MOP), T_2= Farming Practice (Std. Urea + DAP + MOP) + (Zingro + Zoron), T_3 = 100% ZKZ plus + 100% Std. Urea, T_4 = 100% ZKZ plus + 100% Std Urea + (Zingro + Zoron), T_5 = 100% ZKZ plus + 75% Std Urea + (Zingro + Zoron), and T_6 = 100% ZKZ plus + 50% Std Urea + (Zingro + Zoron) with three (3) replications. The results indicated that most of the agronomic parameters including plant height, spike length, number of spikelets per spike, number of tillers m^2, grain yield maunds (ha), and N, P and K uptake and physiological efficiency of N, P and K of wheat was significantly affected by the application of ZKZ plus. These results might be related to the fact that ZKZ plus likely made greater available nutrients for longer period than the standard urea. Furthermore, it was additional indicated that 25% of standard urea could be reduced with the application of ZKZ plus combining with the positive effect on soil quality, which needs to be assessed. Thus, the ZKZ plus can be considered as potential value fertilizer for improving yield and growth and NUE in wheat.

Keywords: Zarkhez Plus, Wheat, Nutrient Uptake

SELECTION OF POTENTIAL RICE (O*RYZA SATIVA* L.) GENOTYPES FOR ZINC-BIO-FORTIFICATION USING DIFFERENT AGRONOMIC STRATEGIES

Ghulam Murtaza Kaleri[1], Rabia Asma Memon[1], Saeed Akhtar Abro[1] and *Nizamuddin Depar[2]

1Institute of Plant Sciences, University of Sindh, Jamshoro
2Nuclear Institute of Agriculture (NIA), Tandojam

*Email: ndepar@gmail.com

ABSTRACT

Selection of rice genotypes/mutants having greater capabilities of absorbing and accumulating higher Zn densities and less phytic acid in grains is the best approach for both improving the yield and nutritional value of rice. In this regard, a field study was carried out potential rice mutants for accumulation high Zn densities and paddy yield. Six rice genotypes (Shua-92, Shadab, NIA-Mehran, IR-8, Sarshar and Shandar) were irradiated with 100, 150, 200 and 250 Gy doses of Gamma rays. The irradiated material was sown and transplanted in the field and 40 potential stable mutants (M_6 generation) were selected. The selected mutants were further tested under control or without Zn (T_1) and soil Zn application of 10 kg Zn ha^{-1}. The soil used in the study was heavy in texture, calcareous and alkaline in nature, deficient in organic matter and DTPA extractable Zn. Results revealed that out of total irradiated population 12 highest potential stable mutants were selected on the basis of productivity, grain zinc concentration, uptake and bioavailability. Grain yield varied from 9.0 to 12 tons ha^{-1}, Zn concentration 10.12 to 42.30 µg g^{-1}and Zn uptake from 42 to 170 g ha^{-1}, respectively. Phytic acid to Zn molar ratio of selected mutants was significantly decreased by 30 to 60%. Estimated Zn bioavailability of screened out mutants by using tri-variate model was also significantly increased. The highest recorded Zn bioavailability was 5.12 mg/300g/day. Mean Zn bioavailability of selected mutants improved by the factor more than 2.50. It can be concluded based on analytical findings that augmentation of mutation breeding and agronomic Zn biofortification of rice may be an easy, adaptable, sustainable and short-term approach to enhance paddy harvest, Zn concentration and bioavailability for food security and Zn malnutrition in humans.

Keywords: Rice, mutation breeding, biofortification, zinc, nutrition

EVALUATING THE EFFECT OF SILICON AND BIOCHAR ON THE GROWTH, PHYSIOLOGICAL AND BIOCHEMICAL ATTRIBUTES AND Cd ACCUMULATION IN BRASSICA UNDER WATER DEFICIT STRESS

Iqra Ghafoor[1,2*], Tayyaba Naz[1,2], Muhammad Mazhar Iqbal[3], Shah Nawaz[4], Muhammad Anwar-ul-Haq[1,2], Tayyaba Akhtar[1], Naqshe Zuhra[1], Muhammad Umair[1,2], Muhammad Qasim[1,2], Maham Naeem[1,2]

[1]Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad
[2]Saline Agriculture Research Center, University of Agriculture Faisalabad
[3]Department of Soil and Environmental Sciences, University of Sarghoda, Pakistan
[4]School of the Environment, Geography and Geoscience, University of Portsmouth

***Email:** dr.iqraghafoor.uaf@gmail.com

ABSTRACT

Abiotic stress is one of the major causes of reduction in growth and productivity of crops. Water deficit and heavy metal stresses have drastic effects. Heavy metals toxicity is not only largely affecting the growth of many plants but also creating an alarming condition on consumer's health. For many years, Agriculture sector in Pakistan is facing the scarcity of edible oil. Brassica is essential oil seed crop of Pakistan that is providing 31% of total oil seed production in Pakistan. Its growth and yield are decreasing due to toxicity of metals like Cd and scarcity of water. Various methods have been used to overcome toxic heavy metals and water deficit stress. Silicon (Si) and Biochar is utilized to protect agricultural plants from the damaging impacts of Cd. Keeping in view the importance of Brassica, a pot experiment was conducted in the green house at Institute of Soil and Environmental science, University of Agriculture Faisalabad to assess the effect of Cd (control and 25 mg kg^{-1}) and water deficit stress (100% and 50% field capacity) on the growth and yield of Brassica with Si amendments (control and 200 mg kg^{-1}) and Biochar (control and 1%) under complete randomized design with the factorial arrangement and three replications. It was clearly observed that shortage of water and Cd stress reduced the growth and yield of Brassica. Different physiological parameters, growth parameters, Biochemical parameters and chemical parameters were studied, and data was analyzed using statistical software. The results illustrated that Cd and water deficit stress caused significant reduction in chlorophyll contents, relative water contents, plant height, spike length, seed yield and leaf K^+ concentration. Moreover, the result showed that the combined application of 200 mg/kg Si and 1% Biochar is more effective in enhancing growth and yield of Brassica. The interaction effect of Si and Biochar application against Cd toxicity and water stress significantly improved physiological parameters, growth and yield of brassica and reduced the uptake of Cd in shoot, root, and seed of Brassica. Finally, it could be concluded that Si and Biochar displayed substantial potential in reducing harmful effects of Cd on the growth and yield of Brassica under water deficit stress.

Keywords: Silicon, Biochar, Cadmium, Brassica, Physiology, Chemical parameters.

RESIDUAL EFFECT OF GREEN MANURING AND SOIL ZINC APPLICATION ON GRAIN ACCUMULATION OF CADMIUM AND ZINC IN WHEAT GROWN ON CADMIUM-CONTAMINATED SOIL

Raza Abbas*[1], Muhammad Intissam Rana[1], Shahid Hussain[1], Ammara Basit[1]

1Department of Soil Science, Faculty of Agricultural Sciences and Technology, Bahauddin Zakariya University, Multan 60800, Pakistan

*Email: hdaniyal072@gmail.com

ABSTRACT

Cadmium (Cd) is a toxic metal that poses a health risk for both plants and humans. Wheat grown on Cd-contaminated soils may accumulate toxic levels of Cd in grains. In addition, zinc (Zn) deficiency is another major concern in alkaline calcareous soils. The present study investigated the residual effect of green manuring and soil Zn application on the accumulation of Cd and Zn in grains of wheat grown on Cd-contaminated soil. Before sowing of last crop (that was maize fodder), two types of soils (green manured and fallow land) were collected for pot studies. The soils were then spiked with two levels of Cd [0 (control) and 8 mg Cd kg^{-1}] and supplied with two Zn rates (0 and 8 mg Zn kg^{-1}). Results revealed that in both soils, Cd-spiking decreased plant yield and Zn accumulation, and increased Cd accumulation, particularly in wheat grains. Overall, the negative effects of Cd were more prominent in plants cultivated on fallow land as compared to those plants cultivated on green-manured soil. In contrary to Cd, Zn application to soil resulted in increased yield and Zn accumulation, and decreased Cd concentration in edible plant parts. Conclusively, these results emphasize the potential of green manuring to lower Cd uptake in plants, as well as suggesting soil Zn application as a strategic approach to increase yield and Zn concentration and decrease Cd accumulation, particularly in edible plant parts. Ultimately, these results provide safer and more nutritious food for human consumption.

Keywords: Accumulation, Cadmium, Green manuring, Soil, Wheat, Zinc

NITRATE UPTAKE IN MUSTARD, SPINACH, AND CARROT IRRIGATED WITH WASTEWATER

Tayyaba Akhtar*[1], M. Aamer Maqsood,[1], Naqshe Zuhra,[1]Tariq Aziz,[2] M. Zia-ur-Rehman,[1]Hamaad Raza Ahmad[1], Iqra Ghafoor,[1] Muhammad Rizwan Yasin,[1] Ayesha Chaudhary[1]

1Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad
2UAF Sub Campus Depalpur, Okara, University of Agriculture, Faisalabad, Pakistan

*Email: tayyaba.akhtar914@gmail.com

ABSTRACT

Pakistan generates annual wastewater of about 962,335 million gallons, including 674,009 million gallons from municipal and 288,326 million gallons from industrial use (Pakistan Water Sector Strategy, 2002). Agriculture in Pakistan consumes 98% of available water which exerts pressure on available freshwater resources. Wastewater is considered a low-cost irrigation water substitute as it is reported to contain essential nutrients, especially nitrogen content of 40–50 kg per ton. However, it also holds heavy metals that adversely impact plant growth. A pot experiment was conducted to investigate the impact of wastewater (WW), canal water (CW), and groundwater (GW) on chromium (Cr), and nitrate (NO_3) uptake in vegetables with the following treatments T_1 (GW), T_2 (WW), T_3 (CW), T_4 (CW+ WW), T_5 (CW+GW), T_6 (GW+CW+WW). Plants uptake nitrogen in two forms NO_3^- and NH_4^+. Plant samples were analyzed for NO_3^- and Cr uptake. The experiment was a complete randomized design (CRD) with three replications. The results concluded that the T6 showed the maximum uptake of NO_3^- in mustard, spinach, and carrots with minimal Cr accumulation which promotes vegetable growth. The mustard and spinach harvest showed maximum nitrate-nitrogen uptake compared to the carrot. Based on these results, we concluded that the T_6 treatment in which we used mixed water (groundwater, canal water, and wastewater) showed maximum NO_3^- uptake and plant growth with minimal heavy metals uptake. Vegetables treated with only wastewater reflected the lowest yield due to the presence of heavy metals as heavy metals influence the nitrogen assimilation process. Maximum nitrate-nitrogen uptake was recorded in mustard compared to other vegetables when irrigated with groundwater, wastewater, and canal water.

Keywords: Wastewater, Nitrate-nitrogen, Chromium, Vegetables

MAIZE YIELD AND FOOD SECURITY ENHANCEMENT BY DAIRY MANURE-AMENDMENTS

Naqshe Zuhra*[1], Muhammad Aamer Maqsood[1], Tariq Aziz[2], Muhamamd Rizwan Yasin[1], M. Zia ur Rehman[1], Hamaad Raza Ahmad[1], Abdul Qadeer[1], Tayyaba Akhtar[1], Dua Waheed[1], Riyan Ashraf[1]

1Institute of soil and Environmental Sciences, University of Agriculture Faisalabad
2Sub-Campus Depalpur, Okara, University of Agriculture, Faisalabad, Pakistan

*Email: naqshezuhra@gmail.com

ABSTRACT

Maize is a vital cereal crop in Pakistan, but its production is constrained by low soil fertility and high food demand. In Pakistan, maize is the third most important cereal after wheat and rice. It accounts for 4.8% of the total cropped area and 3.5% of the value of agricultural output. It is planted on an estimated area of 0.9 million hectares with an annual production of 1.3 million tonnes. Increasing food demand in Pakistan is causing food security issues. This study aimed to assess the impact of dairy manure and its combinations with organic and inorganic amendments on maize yield in a pot experiment. The experiment was in a complete randomized design with four treatments and three replications: T_0 (Control: 100% urea), T_1 (Slurry 100%), T_2 (Manure 100%), T_3 (75% Urea + 25% Slurry + Wheat Straw), and T_4 (75% Urea + 25% Manure + Wheat Straw). Nitrogen (N), phosphorus (P), and potassium (K) were applied at the rates of 80, 46, and 37 kg ha^{-1}, respectively. Standard statistical protocols were used to scrutinize the data. The results showed that T_1 had the highest maize yield, followed by T_2, T_3, and T_4, while T_0 had the lowest yield. The study concluded that dairy manure and its combinations with organic and inorganic amendments can improve maize yield and soil fertility.

Keywords: Dairy Manure, Organic-Inorganic Amendments, Maize Yield, Food Security

UPTAKE, PARTITIONING, AND REMOBILIZATION OF CADMIUM AND ZINC IN STANDARD AND Zn-BIOFORTIFIED WHEAT CULTIVARS GROWN IN Cd-CONTAMINATED SOIL

Ayta Umar[1], Shahid Hussain*[1]

1Department of Soil Science, Faculty of Agricultural Sciences and Technology, Bahauddin Zakariya University, Multan 60800, Pakistan

*Email: shahid.hussain@bzu.edu.pk

ABSTRACT

Cadmium (Cd) is a hazardous heavy metal that poses a significant threat to human health. Wheat, a cereal crop, may accumulate toxic levels of Cd in grains when cultivated in Cd-contaminated soils. Soil zinc (Zn) application is already known to decrease Cd accumulation in wheat grains. This study compared the effects of soil Zn application on the uptake, partitioning and remobilization of Cd and Zn in standard and Zn-biofortified wheat cultivars grown on Cd-spiked soil (8 mg Cd kg^{-1}). This pot experiment consisted of two cultivars [Jauhar-2016 (standard wheat) and Zincol-2016 (Zn-biofortified wheat)], two soil Zn rates (0 and 8 mg Zn kg^{-1}) and eight harvesting stages (from tillering to maturity). Soil Zn application increased parameters related to yield and grain Zn concentration, and decreased grain Cd concentration in both cultivars. The cultivars differed in grain Cd partitioning and net Cd remobilization to grains. Zincol-2016 exhibited higher grain Cd partitioning, while Jauhar-2016 had higher net Cd remobilization to grains. Both cultivars accumulated most of their grain Zn and Cd from remobilization of shoot reserves. However, the cultivars differed in the share of post-anthesis Cd and Zn uptake in above-ground biomass in their grain accumulation. Compared to Jauhar-2016, Zincol-2016 had higher post-anthesis Cd and Zn uptake in above-ground biomass and a greater share in grain accumulation of these metals. However, the grain Zn concentration in Zincol-2016 was only marginally below the desired level ($\geq$37 mg Zn kg^{-1}). On the other hand, the concentration of Cd in mature grains of Zincol-2016 was above the permissible limit ($\geq$0.2 mg Cd kg^{-1}) in all treatments. Jauhar-2016 had Cd in grains within the permissible levels but only if supplied with soil Zn. These findings underscore the need for excess Zn fertilization for Zincol-2016 in Cd-contaminated soils and emphasize the importance of metal-specific genetic biofortification for future initiatives.

Keywords: Cadmium, Contaminated soil, Remobilization, Soil Zn application, Zn-biofortified wheat

EVALUATING THE ROLE OF NUTRIENTS IN GRAIN BIOFORTIFICATION OF WHEAT TO MITIGATE THE NUTRITIONAL DEFICIENCY AND FOOD SECURITY UNDER CHANGING CLIMATE

Muhammad Ramzan[1], Sajid Hussain[*1, 2], Muhammad Zeshan Mansha[3], Sadia Afzal[1], Dilshad Hussain[1], Nabeel Arslan[1], Naseem Abbas[1] and Muhammad Sameed[1]

[1]Department of Agronomy, Faculty of Agriculture, University of Layyah, Layyah, Pakistan
[2]Carbon Management and Sequestration Center, School of Environment and Natural Resources, 414B Kottman Hall, 2021 Coffey Road, Ohio State University, Columbus, OH 43210, USA
[3]Department of Plant Protection, Faculty of Agriculture, University of Layyah, Layyah, Pakistan

*Email: drsajidhussain@ul.edu.pk

ABSTRACT

The world is facing many problems that are occurring day by day, by the change of climate. This is the really a big cause in decrease of productivity ultimately causes low yield which enhance the danger of food security. In the Asian countries which are under development like Pakistan their staple food is wheat but unluckily its yield decreasing gradually due to many serious factors including inadequate supply of nutrients. According to recent reports the yield of wheat crop decreased up to 50% because of un-proper application of fertilizers. For the better improvement in increasing the productivity of wheat crop, a research trial was designed to investigate the integrated amount of nutrients on the quality and yield of wheat in 2021 and 2022. The design was randomized complete block design (RCBD). The applied treatments were control, 100% NPK (100:60:40), 125% NPK (100:60:40), 50% NPK (100:60:40) kg/acre along with 12 kg ha^{-1} Zinc in the form of zinc sulphate with 27% chelated zinc. The results including plant height, number of tillers, 1000 grain weight and grain yield obtained were found to be maximum and superior in experimental unit receiving maximum NPK and Zinc. While the quality traits among the seed were also higher in those experimental units which have maximum values of inorganic fertilizer and zinc. The result demonstrates that by the addition of macro-nutrients (NPK) with good ratio will make farmer wheat yield higher and more profitable. Similarly, the BCR values for the treatment receiving 125% NPK (100:60:40) + $Znso_4$ were found 2.8:1.

Keywords: Fertilizer, Nitrogen, Phosphorus, Potassium, Wheat, Yield, Quality

SELF-SUFFICIENCY OF OIL PRODUCTION THROUGH CANOLA PRODUCTIVITY WITH AUGMENTED SUPPLY OF INORGANIC FERTILIZER UNDER SEMI-ARID CONDITIONS

Kashif Raza[1], Sajid Hussain[*1,2], Muhammad Zeshan Mansha[3], Muhammad Usman[1], Muhammad Zubair[1], Muzamil Jawad[1], Muhammad Aatif[1], Muhammad Afaq[1], Yousra Kalsoom[1] and Danial Akhtar[1]

1Department of Agronomy, Faculty of Agriculture, University of Layyah, Layyah, Pakistan
2Carbon Management and Sequestration Center, School of Environment and Natural Resources, 414B Kottman Hall, 2021 Coffey Road, Ohio State University, Columbus, OH 43210, USA
3Department of Plant Protection, Faculty of Agriculture, University of Layyah, Layyah, Pakistan

*Email: drsajidhussain@ul.edu.pk; awankashi246@gmail.com

ABSTRACT

The world's second-most important oil crop, after soybean, is canola (*Brassica napus* L.). Growing over 31.2 thousand hectares, it produces 49 thousand tonnes of oil and 130 thousand tonnes of seed in Pakistan. Protein, minerals, vitamins, and energy are all present in good amounts in canola oil. Plant germination, growth, and yield are significantly influenced by fertilizers such as NPK. There are many causes of low yield of canola are limited use of improved cultivars, inadequate plant population, improper weed control measures, and deficiency of adequate nutrients for the growth and development. A field experiment was conducted at the College of Agriculture, University of Layyah with RCBD simple design containing three replications in 2021 and 2022 respectively. The aim of this study was to increase canola production by examining the impact of inorganic fertilizers on the crop. AARI canola is hand-drilled and sown after eleven fertilizer treatments. After careful data collection and statistical analysis, it was observed that the NPK@ 120: 90: 60 treatments produced the highest plant height, primary and secondary branches, biological yield, and grain production. All other treatments due to less nutrition resulted in minimum growth and productivity of the crop resulted in significantly reduced yield and less productivity. According to this study, using NPK@120:90:60 in soil may result in maximum productivity and higher yields. So, it is recommended to the growers of canola that it must be incorporated in the cropping pattern and its benefit cost ratio is 2.5:1.0. Also, self-sufficiency in canola production is highly recommended.

Keywords: Canola, Fertilizer, Inorganic, Growth, Yield

CONVERTING DESTROYED DEPLETED SOILS TO SUSTAINABLE HEALTHY SOILS THROUGH MANAGEMENT PRACTICES: HISTORY, FACTS & SOLUTIONS

Muhammad Atta ul Mustafa Awan[*1], Abid Subhani[2], Shahid Zia[2], Areeba Shoukat[2] and Farah Farooq[2]

[1]Lok Sanjh Foundation, Islamabad
[2]Rural Business Development Center (RBDC Pvt Ltd.), G-9/4, Islamabad

*Email: malikattaulmustafaawan@gmail.com

ABSTRACT

The soil is a living organism with a complete cycle of each nutrient. If one disturbs it, it would be harmful. In ancient times, thousands of species were living in forests by the rule of 'Give and take'. The soil used to be enriched with dead decomposed waste of all living organisms. Then humans started destroying forests to cultivate specific crops, and the destruction of the ecosystem started. Submerging soil under water damages the life of aerobic microorganisms. After the Green Revolution, people started taking two or more crops in a year from the same piece of land. They did not even return the residue to the soil. To increase the yields of crops, they started applying nutrients in the form of chemicals which led to the complete death of soil. Extensive tillage operations also created hard pans and aggregate disturbances like water logging and salinity. Surface runoff followed by soil erosion and irrigation with poor quality ground water played a major role in depleting soil. More carbon emissions into the environment created global warming which disturbed the life under the soil. The solution to this huge deterioration comprised of different practices that are being demonstrated at two RBDC centers for restoring soil health: breaking down hard pans to allow maximum water infiltration; adding plenty of organic matter to increase soil carbon; green manuring to enhance soil organic N reserves; practice crop rotation with diverse crops to maintain the nutrient reservoir of soil; practicing zero tillage, direct seeding or permanent raised bed system; return residue of each crop to the soil, keep the soil covered; maintain biodiversity by adding different species of grain crops, vegetables, shrubs, creepers and trees. Using farmland for grazing animals for 2-3 years and then converting into cropland.

Keywords: Soil depletion, Solutions, Healthy soils

BALANCED USE OF MICRO AND MACRONUTRIENTS IMPROVES CROP YIELD AND SUCROSE CONTENTS OF SUGARCANE

Abdul Majeed[1]*, Muhammad Zafar[1], Imran Rashid[1], Muhammad Akhlaq Mudassir[1], Muhammad Shafique[1], Hafiz Bashir Ahmad[1], Mahmood-ul-Hassan[1], Muhammad Shahzad Afzal[1], Abdul Khaliq[1], Naeem Fiaz[1], Mubashra Yasin[1], Salma Niaz[1], and Syed Saqlain Hussain Shah[1]

[1]Sugarcane Research Institute, Ayub Agricultural Research Institute, Faisalabad, Pakistan

*Email: drmajeed1805@gmail.com

ABSTRACT

Balanced use of micronutrients in soils is essential for optimized nutrient use efficiency, environmental conservation, and long-term sustainability of agroecological systems. As a result, maintaining correct micronutrient levels in the soil is essential not only to meet plant needs and maintain agricultural productivity but also to avoid nutrient buildup. The present study aimed to investigate the effect of micronutrient application on the yield and sucrose content expressed as the polarization of sugar cane juice (POL%) under field conditions. There were seven treatments, viz. T0 = No micronutrient application (control); T1 = ZnSO4 at the rate of 30 kg ha-1; T2 = $CuSO_4$ at the rate of 10 kg ha^{-1}; T3 = $FeSO_4$ at the rate of 30 kg ha^{-1}; T4 = borax at the rate of 2 kg ha^{-1}; T5 = half dose of $ZnSO_4$, $CuSO_4$, $FeSO_4$ and borax at the rate of 15, 5, 15 and 1 kg ha^{-1} and T6 = full dose of $ZnSO_4$, $CuSO_4$, $FeSO_4$ and borax at the rate of 30, 10, 30 and 2 kg ha^{-1}, arranged in randomized complete block design in triplicate. With the application of $ZnSO_4$ at 30 kg ha^{-1} along with recommended doses of NPK, 30% more income was generated as compared with the control. First plant and ratoon crop yields were 19.1 and 22.0% higher, respectively, than in the control. Similarly, Zn application resulted in 5.91% and 8.64% greater sucrose contents (POL%) in plant and ratoon crops, respectively, when compared with the control. The application of $ZnSO_4$ at the rate of 30 kg ha^{-1} along with recommended doses of NPK had a significant impact on the yield and sucrose contents of sugarcane.

Keywords: Micronutrients, Macronutrients, Sucrose content, Cane yield

IMPACT OF PLANT GROWTH PROMOTING RHIZOBACTERIA ON MICROBIAL ACTIVITIES IN RHIZOSPHERE AND BULK SOILS

Anam Naz[1*], Husnain Jawad[2], Nawal Chaudary[1], Muhammad Rizwan[1], Ahmad Mujtaba[1], Muhammad Sana Ullah[1*]

[1]Climate Change and Agro-ecosystems Lab, Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad 38000, Pakistan.
[2]Plant Physiology Section, Agronomic Research Institute, Faisalabad

*Email: msanaullah@uaf.edu.pk

ABSTRACT

Chemical fertilizers are important agricultural inputs for improving crop productivity. However, their nutrient use efficiency is very low. Plant growth-promoting rhizobacteria (PGPR) play a vital role in improving soil health and are considered a promising solution to enhance nutrient use efficiency (NUE). It is very important to confirm their spatial activities in soil. The objective of this research was to assess the impact of PGPR on soil microbial activities, to evaluate their potential in enhancing nutrient cycling, and their role in promoting plant growth. Therefore, a field experiment consisting of six treatments: *Azospirillum, Azotobacter, Pseudomonas, Bacillus*, consortium, and control was conducted. To incorporate PGPR into soil the method of seed inoculation was used. The results revealed that wheat yield was observed significantly higher with the individual applications of *Azospirillum* and *Azotobacter* as compared to the control. Compared to bulk soil, the application of *Azospirillum* and *Azotobacter* significantly increased soil microbial biomass carbon under rhizosphere soil at the wheat vegetative stage by the breakdown of complex organic compounds to enhance the availability of carbon substrate for microbial utilization. Whereas *Azospirillum*, *Azotobactor*, *Pseudomonas*, and bacillus increased the β-glucosidase activity at the wheat vegetative stage under both bulk and rhizosphere soil while *Azospirillum* and consortium improved chitinase activity at wheat vegetative stage under bulk soil. Similarly, significant high acid phosphatase activity was observed with *Azospirillum*, *Pseudomonas*, and bacillus applications under rhizosphere soil at the wheat vegetative stage. All the treatments positively influenced leucine aminopeptidase activity under rhizosphere soil as compared to bulk soil. It was concluded that PGPR application could be an efficient approach to improve soil health and microbial activity in rhizosphere soil.

Keywords: PGPR, Soil health, Microbial activity, Rhizosphere

IMPACT OF FARMYARD MANURE ON SOIL PHYSICAL PROPERTIES AND MAIZE GROWTH

Osama Tanveer[1*], Muhammad Iqbal[1], Laiba Tahir[1]

[1]Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad

*Email: osamatanveer324@gmail.com

ABSTRACT

Mulching is a widely recognized management practice for enhancing water conservation, with organic mulches providing additional benefits such as increasing soil organic matter, content, fostering biological activity, improving soil structure, and augmenting plant nutrient availability. In this research, the impact of mulch and dairy manure on soil fertility, bulk density, and maize yield was investigated. Four different treatments were applied to plots i.e. control, 0.5, 1, and 1.5 mg of combined mulch and dairy manure. Continuous monitoring under these treatments demonstrated a consistent increase in soil nutrient contents and organic matter. The rate of increase organic matter, phosphorus (P), and potassium (K) in treatments with manure addition surpassed that in treatments without manure application. This enhanced nutrient and organic matter content had varied effects on the production of two crops in the annual double-cropping system. The results indicated a significant improvement in maize production with the incorporation of mulching techniques. Notably, the various mulching practices played a pivotal role in maximizing soil moisture conservation. Furthermore, the findings of this experiment that soil with a higher amount of manure enhanced root growth, overall soil biological activity, and nutrient acquisition. Importantly, this approach also mitigates the risk of nitrate leaching, thus contributing to sustainable agricultural practices. The study found that the multifaceted benefits of urban agriculture practices, emphasizing the positive impact of mulching and manure application on soil health, crop yield, and overall sustainability in developing countries.

Keywords: Mulch, Dairy manure, Maize, Soil health, Organic matter

NUTRIENT INDEXING OF MANGO ORCHARDS OF RAHIM YAR KHAN DISTRICT OF THE PUNJAB PROVINCE

Niaz Ahmed[1]*, Muhammad Abid Ali Khan[1], Muhammad Kashif[1], Muhammad Mubashir[2], Javed Iqbal[3], Muhammad Tariq Malik[4]

[1]Department of Soil Science, Faculty of Agricultural Sciences and Technology, Bahauddin Zakariya University, 60800-Multan, Pakistan,
[2]Soil and Water Testing Laboratory for Research Multan
[3]Mango Research Station Shujabad, Pakistan
[4]Mango Research Institute, Multan, Pakistan

*Email: niaz.ahmad@bzu.edu.pk

ABSTRACT

Mango (*Mangifera indica*) is the national fruit of Pakistan and plays a pivotal role in human diet, economic development, and poverty alleviation. A comprehensive nutrient indexing survey of twenty -nine mango orchards in different parts of district Rahim Yar Khan was conducted to evaluate the soil characteristics and plant nutrient status. Representative leaf tissues were collected from all sides of randomly selected 20 trees 4-5 leaves from the middle of 4-6-month-old from non-fruit bearing branches and associated composite soils from three depths (0-15, 15-30, and 30-45 cm) were also collected. Twenty healthy and uniform mango trees were sampled from each site to get a composite leaf sample. The soil samples were analyzed for pH, electrical conductivity (EC), soil organic matter (SOM), and calcium carbonate ($CaCO_3$). The soil and leaf samples were analyzed for macro and micronutrients. It was found that most of the orchard soils of district Rahim Yar Khan were moderately alkaline (pH 7.42-8.70), moderately calcareous (2.9 to 14.25%. $CaCO_3$), non-saline (1.00 - 4.35 dSm^{-1} S m^{-1} EC) and low in SOM (0.20 to 0.92%) More than thirty percent (35%) soil samples of were deficient in phosphorus. Most of the soils of mango orchards Soil analysis data revealed that more than fifty percent (55%) of mango orchards were found deficient in B. More than forty percent of the mango orchards in Khan (44%) had low soil Zn contents. Foliar analysis indicated that 73% of mango orchards were deficient in N content more than fifty – five percent (58.2%) of mango leaves showed P deficiency. Foliar analysis showed more than forty percent (44.18%) leaf samples were deficient in B More than sixty percent (67.75%) leaf samples of mango orchards were found Zn deficient. There were few mango orchards of Rahim Yar khan district which contain less than critical levels of Cu, Fe and Mn. Most of the samples of plants and soils had adequate concentration of these nutrients.

Keywords: Mango, Leaf analysis, Calcareous nutrient deficiency, Macronutrients, Micronutrients Nutrient indexing, Soil characteristics

GROWTH AND YIELD RESPONSE OF COTTON CROP TO FOLIAR APPLICATION OF NITROGEN AND SALICYLIC ACID

Shahabudin[1], Mohammad Saleem Sarki[1], Ambrin Rajput[1], Anila Mastoi[1]

[1]Department of Soil Science, Faculty of Crop Production, Sindh Agricultural University, Tanndojam

*Email: bahalkanishahabudin@gmail.com

ABSTRACT

Cotton (*Gossipium hirsutum* L.) is an important cash crop that plays a major role in the economic development of the country. It grows on an area of 2,079 thousand hectares with a total production of 8,329 thousand tons. Nitrogen (N) also has a major role in photosynthetic processes. Salicylic acid (SA) plays an important role in plant growth and development due to important physiological roles, such as increasing the plant's response to stress conditions. The study was conducted during Kharif season 2023 at Soil Fertility Research Institute Tandojam, on Cotton Mehran was sown by hand in ridge and furrows in Randomized Complete Block Design (RCBD) with three replications and five treatments. Recommended levels were applied of P (60 kg ha^{-1}) and K (50 kg ha^{-1}). T_1 = Control, (0 kg N & SA), T_2 = Recommended N + 1% SA spray ha^{-1}, T_3 = N + 2 % SA ha^{-1}, T_4 = 75% N+1% N spray ha^{-1}, T_5 =75% N + 2% N spray ha^{-1}. A minimum number of bolls average was showed (30.3) in all treatments T_1, and the maximum number of bolls was showed (53.2) in all treatments T_5. Results indicated that foliar application of N and SA proved beneficial with recommended levels P and K. In the future, different combinations of macro and micronutrients should be explored to find alternatives for higher cotton yield.

Keywords: Cotton, Nitrogen, Salicylic acid

USE OF PGPR TO ENHANCE WHEAT PRODUCTIVITY AT DIFFERENT SOWING DATES UNDER CLIMATE-INDUCED HEAT STRESS

Nawal Chaudary*[1], Husnain Jawad[2], Anam Naz[1], Muhammad Rizwan[1], Abdul Qadeer[1], Muhammad Sana Ullah[1]

[1]Climate Change and Agro-ecosystems Lab, Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad 38000, Pakistan.
[2]Plant Physiology Section, Agronomic Research Institute, Faisalabad

*Email: msanaullah@uaf.edu.pk

ABSTRACT

The global temperature rise is considered an important indicator of climate change that is posing a threat to crop production. Temperature rise causes heat stress, which has a detrimental impact on the grain filling period and generally reduces the crop yield. The plant growth-promoting rhizobacteria (PGPR) that colonize across the plant rhizosphere have an impact on the shoot and root growth and grain yield of wheat (under heat stress). This study was carried out to evaluate the influence of PGPR on wheat yield to mitigate climate-induced heat stress across two different sowing dates: SD1(15 November) and SD2 (15 December). The field experiment consisted of six treatments including seed inoculation with *Azospirillum, Azotobacter, Pseudomonas, Bacillus*, consortium, and control. The results evaluated that a significantly high wheat yield was observed with the application of azotobactor under SD1 by cell elongation and root development due to the production of auxin and gibberellins. At the wheat vegetative stage pseudomonas increased the shoot nitrogen (N) under SD2 while N content in grains was significantly high with *Azospirillum* application. Whereas shoot and grain phosphorus (P) contents were high with the applications of *Azospirillum* and *Bacillus* under SD2 while potassium (K) content in shoot and grains increased with the application of azotobactor under SD1. Furthermore, the soil microbial biomass carbon content at the vegetative stage was observed significantly high under SD2 with the application of pseudomonas but after harvesting it was observed highest under *Azospirillum* application due to the presence of siderophores which suppress harmful pathogens and create favorable conditions for beneficial microbes. The application of *Pseudomonas*, *Bacillus*, and consortium showed the highest β-glucosidase activity under SD2 while chitinase activity was high under SD1 with the application of bacillus. Furthermore, the application of pseudomonas and bacillus significantly enhanced acid phosphatase and leucine aminopeptidase activities under both rhizosphere and bulk soil. It was concluded that the application of PGPRs could be an efficient approach to increase wheat productivity under heat stress.

Keywords: PGPR, Climate change, Heat stress, Soil health

NUTRIENT STATUS OF CITRUS AND GUAVA FRUITS GROWN IN ALKALINE CALCAREOUS SOILS OF PUNJAB

Nisa Mukhtar[1]*, Ifra Saleem[1], Qudsia Nazir[1], Amina Kalsom[1], Ana Aslam[1], Muhammad Aftab[1], M. Arfan ul Haq[1], Raheela Naz[1], Farah Rasheed[1], Muhammad Arif[1], Muhammad Nasim[1], Sarfraz Hussain[1]

[1]Soil Chemistry Section, Institute of Soil Chemistry and Environmental Sciences.

*Email: nisa_mukhtar_409@yahoo.com

ABSTRACT

Citrus and Guava fruits are very nutritious, offering a host of vitamins, minerals, and plant compounds that keep us healthy. The average yields of our orchards (9.5 tones ha^{-1}) are much less when compared with the world average yield of more than 25 tones ha^{-1}. Non judicious use of chemical fertilizers especially micronutrients are the main cause of yield reduction in many orchards of Pakistan, especially in Punjab. A lot of awareness has been created for the use of macronutrients alone, but little work has been done to identify micronutrient deficiencies that limit fruit yield and quality. Macro and micronutrients are very important elements for plant growth, high yield, and fruit quality. Their deficiency is reported in Punjab but how much deficiency of specific elements occurs in specific areas, is not reported. To overcome the nutrient deficiency in orchards, first need to assess the current nutrient status of fruits. importance: in view their importance; this study has been planned to assess the nutrient status of citrus and guava orchards in Faisalabad, Toba Tek Singh, Sheikhupura, Jhang, Sahiwal, and Sargodha districts. For this purpose, 1200 samples were collected from different orchards of said districts. Fruit samples were analyzed for N, P, K, Ca, Fe, Zn, Cu, and Mn concentrations. The results revealed that in citrus orchards a significant deficiency of macro and micronutrients was noted and it was found in more than 85% of orchards. These samples showed lower values of nutrients (N, P, K, Ca, Fe, Zn, Cu, and Mn) than their required limits (<2.2%, <0.12%, <1.2%, <1.09%, <60ppm, <25ppm, <5ppm and <25ppm) respectively. In guava orchards, the situation is somewhat better where deficiency occurred in almost more than 50% of orchards. Based on these results, there is a dire need for time to use balanced nutrition in which both macro and micronutrients should be applied to orchards to increase fruit production and to improve fruit quality.

Keywords: Citrus, Guava, Fertilizers, Fruit

OPTIMIZING BORON-TOLERANT BACTERIA AND PRESS MUD SYNERGIES FOR SUSTAINABLE CANOLA SEED PRODUCTION AND INCREASED CROP YIELDS

Ghulam Fareed*[1], Tayyaba Samreen[1], Muhammad Aftab Akram[1]

[1]Institute of Soil and Environmental Sciences, University of Agriculture, 38040-Faisalabad, Pakistan.

***Email:** fareedirfan786@gmail.com

ABSTRACT

Canola *(Brassica napus L.)* stands out as a crucial oilseed crop cultivated worldwide, contributing significantly to agricultural economies. Oilseed production in Pakistan falls short of meeting domestic demand. Due to a lack of sufficient nutrient supply to plants. To optimise canola seed production and address concerns about boron (B) utilisation. While certain B-tolerant bacteria have been identified, their potential impact on nutrient uptake by plants remains unclear. This study aims to investigate the synergistic effects of press mud and boron-tolerant bacteria on canola growth, yield, soil health, and nutrient availability. Prior to seeding, soil samples were examined to kickstart the experiment. The pot experiment included twelve treatments, each replicated three times, and was carried out at the University of Agriculture, Faisalabad Soil Science. There was a control group (T1: NPK), separate additions of boric acid (T2) and borax (T3), the application of specific bacterial strains (T4), the application of press mud (PM) (T5), and various combinations of these additives. The results revealed the beneficial impact of press mud application and boron-tolerant bacteria on canola growth. This was evidenced by increased plant growth, elevated chlorophyll content (SPAD-value), enhanced photosynthesis active radiation, improved fluorescence yield, and an increased electron transport rate. The combined treatment significantly augmented both plant growth parameters and physiological indicators, concurrently fostering a positive influence on the soil microbial community. The study suggests that the applications of press mud and boron-tolerant bacteria enhancing microbial activity, crop growth and yield of canola.

Keywords: Canola, Press mud, Boron-tolerance bacteria, Leaf chlorophyll, Soil microbial community

VERTICAL FARMING-SMART URBAN AGRICULTURE FOR ENHANCING RESILIENCE AND SUSTAINABILITY IN FOOD SECURITY

Tayyaba Tanveer[1]*, Mehwish Liaquat[1]*, Shafiq Ur Rehman[2], Muhammad Tahir Akram[1], Sarvet Jehan[3], Aleena Khalid[1], Naveed Ur Rehman[1]

[1]Department of Horticulture, Faculty of Agriculture, PMAS- Arid Agriculture University, 45320-Rawalpindi, Pakistan.
[2]Department of Environmental Sciences, Faculty of Life Sciences, University of Okara, Pakistan.
[3]Institute of Soil and Environmental Sciences, PMAS- Arid Agriculture University, Rawalpindi, Pakistan.

*Email: mehwishliaquat@uaar.edu.pk,; tayyabatanveer4835@gmail.com

ABSTRACT

With the increase in global population growth and increasing rate of urbanization, traditional agriculture is facing unpredictable challenges to meet growing food demands. At the same time, climate change, resource depletion and the need for sustainable practices have been emerged. In this regard, vertical farming could be an innovative solution to address these farming ways for better results. Vertical farming involves growing crops in vertically stacked layers or sloped surfaces, often in a controlled indoor environment. By making the most of limited urban space and optimizing resource efficiency through technologies such as hydroponics, aeroponics, and artificial lighting, vertical farming offers an attractive alternative to traditional farming. This pattern shift not only minimizes land use, but also reduces water consumption, eliminates the need for harmful pesticides, and enables year-round production regardless of external climatic conditions. Integrating cutting-edge technologies such as data analytics, Internet of Things (IoT), and automation further increases the efficiency and productivity of vertical farms. These smart farming systems enable real-time monitoring and precise control of environmental variables, ensuring optimal growing conditions for each crop. Additionally, vertical farms' proximity to urban centers reduces transportation-related emissions, contributing to overall sustainability goals. The resilience of vertical farming is demonstrated by its ability to mitigate the effects of climate change on agriculture. Vertical farms can operate independently of external weather conditions, making them less susceptible to extreme weather events and temperature fluctuations. This inherent adaptability makes vertical farming an important part of a climate-resilient food system, ensuring a stable and consistent supply of fresh produce regardless of external climate change.

Keywords: Automation, Climate change, Food security, Sustainable agriculture, Vertical farming.

SUSTAINABLE PRACTICES: NURTURING SOIL HEALTH FOR ENHANCED FOOD SECURITY IN HORTICULTURE

Aleena Khalid[1]*, Mehwish Liaquat[1]*, Shafiq Ur Rehman[2], Muhammad Tahir Akram[1], Tayyaba Tanveer[1], Sarvet Jehan[3], Misbah-Ud-Din Ahmed[3], Naveed Ur Rehman[1]

[1]Department of Horticulture, Faculty of Agriculture, PMAS-Arid Agriculture University, Rawalpindi, Pakistan.
[2]Department of Environmental Sciences, Faculty of Life Sciences, University Of Okara, Pakistan.
[3]Institute of Soil and Environmental Sciences, PMAS-Arid Agriculture University, Rawalpindi, Pakistan.

***Email:** mehwishliaquat@uaar.edu.pk; aleenakhalid630@gmail.com

ABSTRACT

Sustainable agriculture is at the forefront of global efforts to ensure food security, with a specific emphasis on horticulture crops. Sustainable agriculture practices enhanced food security within horticultural crops. As the demand for diverse and nutritious crops rises, the imperative to sustainably manage soil resources becomes paramount. We examine the current state of soil health in horticulture, considering the impact of various agricultural practices on soil structure, nutrient content, and microbial communities. The significance of adopting sustainable approaches, encompassing organic farming, precision agriculture, smart agriculture and agro-ecological principles, to foster the production of horticultural crops. The objective is to identify key strategies for nurturing soil health that can contribute to resilient horticulture systems capable of withstanding environmental challenges while meeting the escalating global food demands. By adopting sustainable agricultural practices seeks to inform policymakers, researchers, and practitioners about the critical role of soil health in achieving sustainable food security and offers insights into practical measures to enhance the resilience of horticulture crop production.

Keywords: Sustainable agriculture, Horticulture crops, Soil health, Food security, Nutrient management.

PROMOTING SUSTAINABLE AGRICULTURE THROUGH BIOFERTILIZER IMPLEMENTATION

Mehwish Liaquat[1*], Muhammad Tahir Akram[1], Zain Mushtaq[2], Shafiq Ur Rehman[3], Tanveer Hussain[1], Sarvet Jehan[4], Sakeena Tul-Ain Haider[5]

[1]Department of Horticulture, Faculty of Agriculture, Arid Agriculture University, Rawalpindi, Pakistan.
[2]Department of Soil Science, University of the Punjab, Lahore, Pakistan.
[3]Department of Environmental Sciences, Faculty of Life Sciences, University of Okara, Pakistan.
[4]Institute of Soil and Environmental Sciences, Arid Agriculture University Rawalpindi, Pakistan.
[5]Department of Horticulture, Faculty of Agricultural Sciences and Technology, Bahauddin Zakariya University, Multan, Pakistan.

***Email:** mehwishliaquat@uaar.edu.pk

ABSTRACT

The worldwide increase in human population raises a big threat to the food security of each people as the land for agriculture is limited and even getting reduced with time. Therefore, it is essential that agricultural productivity should be enhanced significantly within the next few decades to meet the large demand of food by emerging population. Not to mention, too much dependence on chemical fertilizers for more crop productions inevitably damages both environmental ecology and human health with great severity. Exploitation of microbes as biofertilizers is considered to some extent an alternative to chemical fertilizers in agricultural sector due to their extensive potentiality in enhancing crop production and food safety. It has been observed that some microorganisms including plant growth promoting bacteria, fungi, Cyanobacteria, etc. have showed biofertilizer-like activities in the agricultural sector. Extensive works on biofertilizers have revealed their capability of providing required nutrients to the crop in sufficient amounts that resulted in the enhancement of crop yield. The use of biofertilizers in order to promote plant growth and also provides protection against different plant pathogens. The applications of biofertilizers play an important role in different sectors including agriculture, horticulture, bioremediation and ecology.

Keywords: Biofertilizer, Crop production, Ecosystem, Sustainable agriculture.

AGRONOMIC FORTIFICATION OF WHEAT WITH ZINC NANO-PARTICLES TO IMPROVE GROWTH, YIELD AND PHYSIOLOGICAL CHARACTERISTICS UNDER ALKALINE CALCAREOUS CONDITIONS

Faisal Hayat[1] and Muhammad Ashraf[1, 2*]

[1]Department of Soil Science, Faculty of Agricultural Sciences and Technology, Bahauddin Zakariya University, Multan, Pakistan.
[2]Department of Soil Science, College of Agriculture, University of Sargodha, Sargodha, Pakistan.

***Email:** ashraf.muhammad@uos.edu.pk

ABSTRACT

Being deficient in zinc (Zn), wheat may contribute to human malnutrition, particularly in Asian countries where it serves as major staple food. The situation is more critical in Pakistan where over 70% of wheat cultivated soils are Zn deficient, and causing Zn deficiency disorder in about 40% of the people. Agronomic fortification can be a promising strategy to ameliorate Zn deficiency in plants, and combat malnutrition in humans. Field trials were planned to evaluate the effect of zinc oxide nano-particles (ZnO-NPs) on wheat growth, yield and Zn contents in plants, grains and flour during 2022 and 2023. Experimental plan comprised of three Zn levels through soil application (control, 10 and 20 kg ha^{-1}), two levels through foliar spray (0.25 and 0.5% Zn solution) and combination of soil application and foliar spray making total nine treatments. Experiments were conducted according to randomized complete block design with five replications. Zn nutrition in all levels and methods of application improved the wheat productivity, with highest improvement by the combination of soil application and foliar spray. Physiological characteristics in terms of chlorophyll contents, relative water contents, membrane stability index, transpiration, stomatal conductance and photosynthesis were improved, with highest improvement in photosynthesis by 68.62% and 95.31% during 2022 and 2023, respectively at combined soil application of 20 kg ha^{-1} and foliar spray of 0.5% Zn solution (SZn-20+FZn-0.5) compared to control (Zn-0). Plant growth and yield attributes were improved with highest improvement in grain yield of 29.63% and 32.45% during 2022 and 2023, respectively at SZn-20+FZn-0.5 compared to control. Grain quality characteristics were improved, and highest improvement in crude protein was 41.44% and 38.25% during 2022 and 2023, respectively at SZn-20+FZn-0.5 compared to control. In conclusion, relatively higher Zn level is required for optimum wheat productivity under alkaline calcareous conditions.

Keywords: Foliar spray, Grain quality, Physiological characteristics, Soil addition, Wheat, Zinc.

ENHANCING PHOSPHORUS USE EFFICIENCY AND PROFITABILITY FROM WHEAT THROUGH HUMIC ACID APPLICATION IN COMBINATION WITH ROCK PHOSPHATE AND SINGLE SUPER PHOSPHATE

Ijaz Amin[1] and Dost Muhammad[1]

[1]Department of Soil & Environmental Sciences, Faculty of Crop Production Sciences, The University of Agriculture, Peshawar-Pakistan.

*E-mail: dost@aup.edu.pk

ABSTRACT

Field experiment was conducted to evaluate the role of humic acid (HA) in enhancing the P use efficiency (PUE) from rock phosphate (RP) applied in different combinations with commercially available single super phosphate (SSP). Phosphorus: 90 kg P_2O_5 ha^{-1} was applied from RP and SSP at 100:0, 75:25, 50:50: 25:75 and 0:100% ratios with and without 10 kg HA ha^{-1}. These treatments were arranged in 2 factorial randomized complete block design (RCBD) with three replications. The experiment was conducted on wheat CV Akbar-2017 at research farm, the University of Agriculture, Peshawar during 2021-22. Results showed that plant height, spike length, grains $spike^{-1}$, 1000-grain weight, biomass and grain yield all increases with increase in proportions of SSP and humic acid in the given treatment combination. Addition of HA, however, enhanced the yield and yield traits over sole application of the given treatment combination suggesting increases in P availability with HA. Post-harvest soil AB-DTPA ext. P and total uptake of N, P and K as well as P use efficiency in 50% RP + 50% SSP in combination with HA was also as better as 100% SSP treated plots without HA, demonstrating the role of HA and appropriateness of this treatment This combination of RP with SSP in equal ratios was also the most economical in term of value cost benefit ratio and yield outputs. The overall results conclude that application of 90 kg P_2O_5 from RP and SSP at equal ratio with 10 kg HA ha^{-1} is recommended for higher economic indices, P use efficiency and improved soil properties under the given agro-climatic conditions of Peshawar area.

Keywords: Available soil P, Cost-benefit ratio, Humic acid, Rock phosphate, Wheat yield.

NURTURING SOIL HEALTH THROUGH SUSTAINABLE AGRICULTURE

Farhat Ullah[1], Muhammad Noman[1], Abdullah Shafi[1], Hamza[1], Rahila Akhtar[1], Um-e-Aiman[1], Ahmad Mahmood*

[1]Department of Soil and Environmental Sciences, MNS-University of Agriculture, Multan, Pakistan.

***Email:** ahmad.mahmood@mnsuam.edu.pk

ABSTRACT

Amidst the backdrop of escalating global food demand and the consequential strain on agricultural systems, this academic exploration investigates the pivotal role of sustainable agricultural practices in fortifying soil health. The pressing need to address these challenges has led to an in-depth examination of practices such as agro-ecology, agroforestry, composting, and Integrated Pest Management (IPM), which collectively contribute to the establishment of resilient and sustainable agricultural ecosystems. The analysis begins by recognizing the current challenges faced by global agriculture, including the imperative to feed a growing population while safeguarding soil resilience, biodiversity, and long-term sustainability. Against this backdrop, agro-ecology emerges as a cornerstone practice, enhancing soil health through the integration of diverse crops, deployment of cover crops, and the reduction of tillage. The cascading effects include heightened organic matter content, improved soil structure, and optimized nutrient retention. Moving forward, the exploration delves into the symbiotic relationship between trees and crops within the realm of agro-forestry, highlighting its positive impacts on soil health. These include increased water infiltration, enhanced nutrient cycling, and augmented microbial diversity. Simultaneously, composting, as an essential waste management strategy, enriches soil health by infusing crucial nutrients, improving soil structure, and fostering microbial activity. The analysis then shifts focus to the strategic implementation of Integrated Pest Management (IPM), illustrating its profound influence on soil health. By curbing reliance on chemical pesticides, preserving soil microbial communities, and mitigating harm to non-target organisms, IPM not only safeguards soil health but also contributes to a reduction in pollution and environmental damage associated with conventional pesticides. In conclusion, this examination underscores the specific mechanisms through which sustainable agricultural practices contribute to enhancing soil health.

Keywords: Soil health, Sustainable agriculture, Agro-ecology, Composting, Integrated Pest Management (IPM)

SOIL SOLUTION-P AND ITS CONCENTRATION IN PLANTS FROM SELECTED WHEAT FIELDS FOR YIELD AND TRAITS

Tehleem[1], Maria Mussarat[1] and Dost Muhammad[1]

[1]Department of Soil and Environmental sciences, Faculty of Crop Production Sciences. The University of Agriculture Peshawar, Khyber Pakhtunkhwa, Pakistan.

*****Email: tahleem.khan@gmail.com

ABSTRACT

Along with soil type, growth stage and plant species, the critical P concentrations for optimum crop yield vary with P extraction methods. The aim of the research was to assess the correlation between different P extraction methods and total soil P concentrations, plant P concentrations, wheat yield, and yield traits. Soil samples were collected during the wheat's anthesis and maturity stages from various research farms and farmers' fields. The samples were examined for physico-chemical properties and analyzed using different methods to extract P, including AB-DTPA, Olsen, water-soluble, paste, resin, and acid-soluble total P. Plant samples were also collected from the same fields and evaluated for yield, yield traits, and concentrations and uptake of nitrogen, phosphorus, potassium, and zinc. At the anthesis stage, the AB-DTPA extractable P showed a significant correlation only with suspension P, while other correlations were weak or non-significant. Grain yield of wheat had a weak correlation with AB-DTPA P, suspension P, and total P, but a strongly significant correlation with plant P. However, at the post-harvest stage, these correlation values decreased, suggesting that the anthesis stage was better for P analysis. These findings indicate that the anthesis stage is preferable for soil and plant nutrient analysis to predict yield potential. Additionally, instead of relying on a single method, determining plant P, AB-DTPA extractable P, and water-soluble P would provide a more accurate prediction of wheat yield potential. Furthermore, grain yield varied widely and significantly correlated with plant density, suggesting the importance of maintaining optimal density for higher yields. Conducting such studies with a large number of samples and ensuring uniformity in crop variety, irrigation, and management practices would further help in identifying the best method or combination of methods to predict crop yield potential in the area.

Keywords: Soil solution P, Prediction, Wheat yield, Plant P concentration.

"Soil Health: A Key to Food Security"

20th INTERNATIONAL CONGRESS OF SOIL SCIENCE

20-22 February 2024, Rawalpindi, Pakistan

SOIL SCIENCE SOCIETY OF PAKISTAN -SSSP-

SOIL SALINITY & BIOSALINE AGRICULTURE

INTERACTION BETWEEN NaCl AND $CdCl_2$ DIFFERENTLY INFLUENCES Na AND Cd UPTAKE BY WHEAT

Sajid Masood[1]*, M. Zafar ul Hye[1], and Qaiser Hussain[2]

[1]Department of Soil Science, Faculty of Agricultural Science & Technology, Bahauddin Zakariya University, 60800-Multan, Pakistan.
[2]Institute of Soil & Environmental Sciences, PMAS-Arid Agriculture University, 46300-Rawalpindi, Pakistan.

*Email: sajidmasood@bzu.edu.pk

ABSTRACT

Soil salinity together with soil metal contamination severely affect the plant growth and yield. The present study aimed at evaluating the interaction between varying levels of $CdCl_2$: 0, 1.0, and 2.0 mM Cd and NaCl: 0, 50, and 100 mM NaCl on Na and Cd accumulation in wheat leaves. Wheat seeds were cultivated in clay loam soil and subjected to $CdCl_2$ either alone or in combination with NaCl salinity. The results revealed that NaCl counteracted phytotoxicity of Cd and vice versa in wheat leaves up to moderate levels of Cd stress. Further, moderate Cd and NaCl stresses enhanced the proline accumulation in wheat leaves as well as activities of various antioxidant enzymes like superoxide dismuates (SOD), peroxidase (POD), and catalse (CAT). In spite of this, high levels of NaCl (100 mM) and Cd (2 mM) enhanced the production of reactive oxygen species (ROS), which is an indicative of oxidative stress or damage to the plant membranes. Consequently, the increased ROS production was not quenched by antioxidative enzymes, thereby inhibited the growth of wheat. In conclusion, NaCl alleviated phytotoxicity caused by Cd stress through the increased proline accumulation and antioxidative enzymatic activity of wheat leaves and differently affected Na and Cd accumulation under moderate to severe NaCl and Cd stresses.

Keywords: Antioxidants; Cd contamination; NaCl salinity; Phytotoxicity; Wheat growth

INVESTIGATING THE SYNERGISTIC APPLICATION OF ACIDIFIED CO-COMPOSTED BIOCHAR AND BACILLUS ENDOPHYTE FOR ENHANCING THE GROWTH AND YIELD OF SOYBEAN GROWN IN SALINE SODIC SOIL

Muhammad Umair[1,2*], Tayyaba Naz[1,2], Muhammad Naveed[1], Faiz Ul Hassan[3], Muhammad Mazhar Iqbal[4], Muhammad Qasim[1,2], Fazal Maqsood[1,2], Iqra Ghafoor[1,2], Maham Naeem[1,2]

[1]Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad.
[2]Saline Agriculture Research Center, University of Agriculture Faisalabad.
[3]Department of Soil Science, College of Agriculture, University of Agriculture, Layyah, Pakistan.
[4]Department of Soil and Environmental Sciences, University of Sargodha, Pakistan.

Email: muhammadumair4019@gmail.com

ABSTRACT

Soybean holds significant importance in agriculture not only for its oil and superior protein but also by enriching the soil with nitrogen and organic matter due to its association with nitrogen fixing bacteria. One of the abiotic elements affecting soybean growth cycle and yield is salinity and sodicity. Present experiment was conducted with the aim to analyze the potential of combined effect of acidified co-composted biochar and bacillus endophyte AS-53 on soil health and growth of soybean against saline-sodic soil. Soybean genotype AARI was analyzed against saline-sodic condition (Control, and EC 6 dS/m with SAR 15). Treatments used were; Compost Normal (N), Co-composted Biochar (N) (80% Compost, 20% Biochar), Compost Acidified (A) and Co-composted Biochar (A). All these amendments were applied at 1% along with the control. The result showed the negative impacts of salinity and sodicity on the growth and yield of soybean resulting in reduced plant growth, yield, chlorophyll content (SPAD-value), membrane stability index, relative water content, shoot fresh weight and dry weight, and soil microbial population. While acidified co-composted biochar and bacillus endophyte AS-53 lessened the negative effect of salinity and sodicity and improved soybean growth in normal and saline soil conditions. It significantly enhanced plant growth parameters and physiological parameters and increased soil microbial community. The study suggests the combined application of acidified co-composted biochar and bacillus sp. for agro-environmental and economic benefits.

Keywords: Soybean, Salinity, Sodicity, Composted Biochar, Bacillus Endophyte

RESPONSE OF THREE EGGPLANT CULTIVARS TO COMBINED SALINITY AND SODICITY STRESS

Mehwish Sanaullah[1*], Tanveer Ul Haq[1], Muhammad Arif[1], M. Haider Jamal[1], Sajeela Sehar[1], Ayesha Ali[1], Minahil Ather[1], and Najma Majeed[1]

[1]Department of Soil and Environmental Sciences, MNS – University of Agriculture, Multan

*Email: tanveer.ulhaq@mnsuam.edu.pk

ABSTRACT

Vegetables are recognized to be more profitable than major crops in Pakistan. Keeping in view the prevalence of salinity and sodicity issues together, the current study aims to evaluate the response of three eggplant genotypes to the combined stress of salinity and sodicity. In this experiment there were three eggplant genotypes viz. Advanta-303, Rajni, and Punam and three combined levels of salinity – sodicity i.e. Control, Level 1 = EC 4.0 dS m^{-1} + SAR 15, Level II= EC 8 dS m^{-1} + SAR 25. The greenhouse experiment was planned in a complete randomized design (CRD) with four replications. After four weeks of germination eggplant seedlings were transplanted in soil filled pots according to the layout plan. The plants were grown for 80 days and data were recorded about shoot length, shoot fresh weight, shoot dry weight, chlorophyll content, photosynthetic rate, water use efficiency, stomatal and sub-stomatal conductance. Data revealed that at salinity sodicity level-I the reduction in the shoot fresh weight, shoot dry weight and shoot length was 30.3, 35.7 and 27.9%, respectively for variety Rajni. Similarly, under salinity sodicity level II, the reduction was observed in all eggplant varieties, however, the highest reduction was registered in Punam as compared to non-saline control. The maximum reduction in photosynthetic rate (53.1%) was observed in variety V3 under salinity sodicity level II, compared with control. Compared with control the variety V1 showed 23.7% reduction in photosynthetic rate under salinity sodicity level II. The variety V2 has shown 50% higher photosynthetic rate under both treatments when compared with control treatments. Additionally, the lowest concentration of K+ was observed in V3 under Salinity sodicity level II compared to control. Whereas, comparing with control the maximum concentration of K+ was 9.94% in V2 under saline sodic level I. Based on above results it has been found that variety Rajni is relatively more tolerant to combined salinity sodicity and could give better production under saline-sodic soils.

Keywords: Eggplant; Soil Salinity; Sodicity; Genetic variation; Salt tolerance

EFFECT OF HIGH RSC WATER ON PHYSICAL PROPERTIES OF SOIL UNDER RICE-MUSTARD ROTATION

Muhammad Faisal Nawaz[1]*, Khalil Ahmed[1], Muhammad Qaisar Nawaz[1], Muhammad Ashfaq Anjum[1], Ghulam Qadir[1], Muhammad[1] and Muhammad Rizwan[1]

[1]Soil Salinity Research Institute Pindi Bhattian, Pakistan

*Email: faisaluos06@gmail.com

ABSTARCT

Arid to semi-arid climate of Pakistan necessitates the artificial irrigation to undertake the agricultural pursuits and farmers are being forced to use the underground water reserves which are 60 to 70 % brackish in nature. The blind use of this resource without any management practice is building up salinity even in the soil that has high potential for crops. Therefore, a field trial for three years (2013-17) was designed to monitor the deleterious effects of high RSC water on soil physical properties under rice-mustard (Raya) crop rotation. Treatments included were; T_1: tube well water, T_2: gypsum application on the basis of RSC of water, T_3: H_2SO_4 application on the basis of RSC of water, T_4: green manuring with Guar, T_5: FYM @ 10 t. ha^{-1}. A moderately saline sodic field (pH_{s} = 8.70, EC_e = 4.08 dS m^{-1}, SAR = 20.87 (mmol $L^{-1})^{1/2}$, HC = 0.70 cm hr^{-1} and BD = 1.30 Mg m^{-3}) was selected, prepared and leveled. Experiment was laid out in RCBD with four replications. Tube-well water (RSC 7.85 me L^{-1}, SAR 8.40 (mmol $L^{-1})^{1/2}$ and EC 1.37 dS m^{-1}) was used for irrigation. Data regarding paddy/grain yield of rice and raya crops was recorded at maturity. Soil samples were collected after harvesting of each crop. Pooled data of three years revealed that paddy/grain yield of rice and raya was significantly higher in T_2 (gypsum application on the basis of RSC of water) and T_3 (H_2SO_4 application on the basis of RSC of water) followed by T_5 (FYM @ 10 t. ha^{-1}) and T_4 (green manuring with Guar). The lowest yield was recorded in control T_1 (Tube well water). In case of soil analysis pH_s and SAR were above the safe limits in all the treatments. EC_e was also above the safe limits in T_1 (Tube well water) and. Hydraulic conductivity of soil increased while bulk density in all the treatments as compared to control.

***Keywords*:** RSC, Raya, Salinity, BD, HC

EXAMINING THE EFFICACY OF SILICON IN MITIGATING SALINITY STRESS ON SOYBEAN PLANTS

Beenish Shakeel[1*], Muhammad Anwar-ul-Haq[1], Muhammad Saqib[1], Rehman Ali[1]

[1]Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad 38000, Pakistan

[*]Email: beenishshakeel2000@gmail.com

ABSTRACT

Global food security depends on the complex relation between food production, increasing yields, and increased food demand with the world population expected to reach 9.7 billion by 2050, there's an urgent need for better ways to increase global food production. Climate change adds challenge by reducing the yield of important crops like soybean, maize, and rice. Additionally, saline soils covering about one-third of agricultural lands which seriously affect the growth and productivity of crops in arid and semi-arid regions. The salinity causes nutrient imbalance and nutrient insufficiency, which are detrimental to crop growth. The study aimed to exam soybean development under saline stress. A hydroponic experiment was conducted in the wire house of Institute of Soil and Environmental Sciences, UAF. The experiment followed complete randomized design with two salinity levels and two silicon concentration including a control (T_1 = Control, T_2 = 2 dsm^{-1}, T_3 = 7 dsm^{-1}, T_4 = Si=1.75mM, T_5 = 2 dsm^{-1}, Si=1.75mM, T_6 = 7 dsm^{-1}, Si= 1.75mM) with three replications under Complete Random Design (CRD). The results revealed that the exposure to salinity resulted in a significant reduced in biomass, chlorophyll (Chl) contents and relative water content (RWC) in comparison to the control. Conversely, the application of silicon (Si) had opposite effects on physiological parameter like improvement in RWC, chlorophyll content, and positive changes in membrane stability index (MSI). Sodium (Na^+) concentration in soybean plants increased under salinity and reduced by Si treatment with an increase in the potassium (K^+) content. Moreover, Si application was found to boost silicon accumulation while simultaneously reducing sodium (Na+) uptake, thereby contributing to an overall improvement in morpho-physiological growth of soybean plants. The current experiment concludes that utilization of silicon (Si) at a concentration of 1.75 mM emerges as an effective strategy to mitigate the adverse impacts of salt stress on soybean plants.

Keyword: Soyabean, Silicon, Mitigating and Salinity.

EVALUATING PHYSIOLOGICAL AND BIOCHEMICAL RESPONSES OF COTTON (*GOSSYPIUM HIRSUTUM* L.) TO ORGANIC AMENDMENTS UNDER SALINITY STRESS

Syed Muhammad Mizfar Gohar[1*], Muhammad Anwar-ul-Haq[1], Alisha[1], Muhammad Usama Mustafa [1], Aneela Riaz[1] , Amber Nawaz[1] , Rehman Ali[1]

[1]Saline Agriculture Research Center, Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad 38000, Pakistan

[*] Email: gkshah408@gmail.com

ABSTRACT

Cotton growth, yield and fiber quality are all threatened by salinity. The current study was executed to determine the impact of organic amendments on cotton growth, development, and yield under salinity stress. Application of organic amendments have been shown to positively influence the soil physical, chemical, and biological properties. Organic amendments improve the soil ability to maintain and supply essential nutrients by promoting root penetration into more permeable soil. A pot experiment was conducted in wire house of Saline Agriculture Research Center (SARC) at Institute of Soil & Environmental Sciences (ISES), University of Agriculture Faisalabad (UAF). There were 45 treatment pots and each pot containing 12 kg of sieved soil. Six seeds of cotton variety BS-18 were sown in each pot. There were five treatments (T1= FYM, T2= Poultry manure, T3= Press mud, T4= Compost and T5= Crop residue) with two salinity levels along with control (Control, EC-7d Sm-1 and EC-10d Sm-1). A two-factor completely randomized design (CRD) was used. Each treatment was replicated three times. Before the experiment begins, soil samples were taken and examined for the following parameters: pH, EC, SAR, Ca^{+2}, Mg^{+2}, CO_3^{-1} and HCO_3^{-1}. Plant leaves were collected and analyzed after 60 days of stress for MSI, RWC, SPAD Results showed that application of compost and press mud resulted in higer levels of antioxidant enzymes like SOD, POD, and CAT under salinity stress. Likewise, the addition of poultry manure and compost enhanced the nutritional status of plants (NPK).

Key words: Cotton, Organic Amendments, UAF

INVESTIGATING THE RESPONSE OF SOYBEAN (GLYCINE MAX) GENOTYPES AGAINST SALINITY STRESS

Fazal Maqsood[1*], Muhammad Anwar-ul-Haq[1], Rehman Ali[1] and Muhammad Umair[1]

[1]Saline Agriculture Research Center, Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad 38000, Pakistan.

Email: fazalmaqsood465@gmail.com

ABSTRACT

Salinity stress is the leading cause for the decreased crop growth and production in arid and semi-arid areas. Soybean is a leguminous cash crop enriched with oil and protein that is an essential ingredient in dairy and poultry feed. Soybean is quite sensitive to salinity. Soil salinization has detrimental impact over its productivity and growth pattern. Consequently, Pakistan is spending a huge amount to import soybean every year that affects the overall economy. The current study was planned to screen out the best performing cultivar under specified levels of salinity. Four soyabean genotypes AARI, Faisal Soy, NARC-1 and NARC-21 were tested under saline conditions using two factorial arrangements in a completely randomized design each with three replicates. Results revealed the significant differences in shoot length, with AARI and Faisal soy while NARC-21 showing the least growth. Root development was significantly inhibited in Faisal soy exposed to salt stress, whereas AARI and NARC-1 were found to be the least affected. Based on physiological criteria employed in study, soybean line Faisal soy and AARI were classified as tolerant, NARC-1 was classified as medium tolerant while NARC-21 was categorized as sensitive. Hence, it can be concluded that AARI was resistant and NARC-1 as sensitive against salinity. This screening process facilitates the identification of suitable soybean lines that can be recommended for cultivation in different saline areas.

Keywords: Soybean, Salinity, Genotype, AARI, Faisal, NARC-1, NARC-21

EVALUATION OF MILLET (*PENNISETUM GLAUCUM L.)* GENOTYPES AGAINST NaCl STRESS

Hafiz Hussain Ali[1*], Muhammad Anwar-ul-Haq[1], Tayyaba Naz[1], and Usama Mustfa[1]

[1]Saline Agriculture Research Center, Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad 38000, Pakistan

*Email: hussainaliaari@gmail.com

ABSTRACT

Salt stress causes negative impact on the growth and development of the plant. When plant exposed to the salt stress several changes occurs in the plant mechanism. Evaluation of large number of genotypes in the salt stressed environment may help to identify the salt tolerance genotypes. A hydroponic study was conducted at Institute of Soil and Environmental Sciences (ISES), University of Agriculture, Faisalabad (UAF) with seven millet genotypes (FB-795, FB-803, FB-810, F.S.B-15001, F.S.B-15007, M.B-87, SDG-2011) and five different salt levels (T_1 = Control, T_2 = EC – 4 dSm^{-1}, T_3 = EC - 6 dSm^{-1}, T_4 = EC - 10 dSm^{-1}, and T_5 = EC - 14 dSm^{-1}) to investigate the effects of salinity on growth and development of the plant. Salt stress was given after two weeks of germination and the plants were harvested after the four weeks of treatments. Based on plant height and fresh biomass it was observed that six out of seven millet genotypes performed well in the highest level of salt stress 14- dSm^{-1} but the millet genotype F.S.B-15001 gave the best results. Only the one Genotype SDG-2011 was sensitive. So, results concluded that these millet genotypes have good potential to grow in salt affected area.

***Keyword*:** Soil salinity, Salt Stress, Millet, Hydroponic, Screening, Tolerance

PROSPECTS OF SALINE AGRICULTURE IN FOOD SECURITY UNDER CHANGING CLIMATE

Bhaveesh Chander[1], Fozia Naz Memon[2], Ravi Prakash[3], Muhammad Daniyal Ali Khan[3], Utam Chand[4]and Attiya Muneer[4]

[1]Department of Soil Sciences, Sindh Agriculture University Sub-campus Umerkot
[2]Soil & Environmental Research Institute, ARC Sindh
[3]Department of Soil Sciences, Sindh Agriculture University Tandojam
[4]Department of Soil and Environmental Sciences, MNS-University of Agriculture Multan

*Email: foziamemon345@gmail.com

ABSTRACT

Soil salinity is a globally major issue that impacts agricultural land spanning over 830 million hectares. Approximately 1-2 million hectares per year are experiencing an increase in salinity, with the potential for the problem to spread to unaffected areas. The presence of salinity deteriorates soil health, contaminates water quality, and impairs the physiological systems of crops, ultimately resulting in reduced crop yield and food production. The primary cause of salinity is attributed to climate change, along with various anthropogenic activities such as urbanization, industrialization, deforestation, overgrazing, excessive use of fertilizers and groundwater. The detrimental effects of climate change on agriculture have become increasingly apparent, posing significant threats to global food production. Rising temperatures, prolonged droughts, unpredictable rainfall patterns, and extreme weather events disrupt traditional farming methods, leading to yield losses and food shortages. In light of these circumstances, saline agriculture emerges as a crucial solution to address concerns regarding food security amid a changing climate. Saline agriculture offers a resilient approach, employing strategies such as cultivating salt-resistant genotypes, improving drainage systems, implementing suitable irrigation practices, adopting conservation agricultural practices, and utilizing phytoremediation techniques to successfully mitigate soil salinity issue. The benefits of saline agriculture extend beyond climate adaptation, as it allows for the productive use of previously unproductive saline soils, thus expanding arable land and increasing overall agricultural capacity. Future efforts may focus on developing genetically modified salt-tolerant crop varieties, optimizing irrigation methods, and promoting sustainable soil management techniques to effectively mitigate the impact of salinity. Additionally, research on innovative technologies like hydroponics or aquaponics adapted to saline conditions could play a crucial role in enhancing agricultural productivity in such environments.

Keywords: Saline agriculture, Food security, Climate change

EFFECT OF ORGANIC AMENDMENTS ON MAIZE (*ZEA MAYS* L.) GROWTH IRRIGATED WITH BRACKISH WATER

Saifullah[1*], Hamza Azam[1], Sadia Bibi[1], Sidrah Ashfaq and Muhammed Sabir[1]

[1]Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad-38040
[2]Department of Farm Machinery and Power, University of Agriculture, Faisalabad-38040

*Email**:** swcl@uaf.edu.pk

ABSTRACT

Salinization of agricultural land due to primary and secondary sources, one of the main challenges faced by sustainable agriculture. Saline water irrigation decreases the productivity potential of soils. Organic amendments have the potential to minimize the negative effects of saline water. Present study was conducted to evaluate the ameliorative impact of organic amendments applied at (biochar, compost, farm manure and coconut coir) on soil and maize productivity using saline water. Pre- and post-experimental soil and brackish water used for irrigation was analyzed for various physical and chemical properties following standard analytical procedures. Data showed that the highest plant height, leaf area were recorded with the application of coconut coir. Application of saline water resulted in high levels of Na while lowest levels of K in plant leaves. However, application of organic amendments caused a significant increase in Ca and K even under saline water treatment Plant biomass per pot was also affected with the application of all the treatments. Study showed that that harmful impacts of brackish water could be minimized with the application of organic amendments through direct providing essential nutrition and/or indirect improving water availability, microbial activity, soil properties beneficial effects. when compared to saline water irrigation without amendment treatments.

Keywords: Saline water, maize growth, leaching of salts.

IMPROVING YIELD PERFORMANCE OF WHEAT/MAIZE CROPPING SYSTEM UNDER HEAT, WATER AND SALT STRESSES

Muhammad Saad Bin Zafar[*1], Muhammad Saqib[1], Nauman Sattar[1], Noman Zahid[1], Qandil Shafiq[1], Nain Tara Mushtaq[1], Laraib Noor[1], Amina Abdul Rahim[1], Nain Tara Mushtaq[1], Samra Sattar[1], Ayesha Abid[1] and Zilyad Ul Hassan[1]

[1]Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad.

Email: ibnezafar28@gmail.com

ABSTRACT

Cereal grains are the most common food staples around the world. Wheat, Maize and Rice make up two-thirds of this food consumption. Climate change is an exponentially growing concern with every passing day causing increased temperatures and altering the precipitation patterns causing prolonged droughts resulting in stressed crops and reduced yields. It is contributing to food insecurity and famine in Sub-Saharan regions and even developed countries are facing more frequent droughts and crop damages. To develop resistant plants to tolerate such climatic change will take its course of time. Meanwhile the crop damage at hand also needs to be addressed promptly. For such purpose, an innovative approach is needed to handle with such sudden climatic drift which may also be beneficial in traditional problems ultimately contributing to sustainability. Under abiotic stresses, the activity of acid invertase enzyme may be affected in both wheat and maize. Based on this study, a new approach was introduced in this experiment of applying different chemicals exogenously at different levels of growth stages under abiotic stresses. The results indicated that the exogenous applications at booting stage of wheat and kernel setting of maize under all the abiotic stresses showed better results improving the fresh grain weights. The results give a promising indication that this approach may have a solution in the form of an amendment to cope with the abiotic stress challenges in cereal grains under prevailing climatic shifts.

Keywords: Heat stress, water stress, salt stress, yield, wheat

SULPHUR FERTILIZATION AND *ACIDITHIOBACILLUS THIOOXIDANS* IMPROVED SUNFLOWER GROWTH AND ACHENE YIELD UNDER SALINE AND SALINE SODIC CONDITIONS

Muhammad Ibrar[1]*, Ali Raza Gurmani[1], Ayaz Mehmood[1], Muhammad Jawwad[1], Mazhar Rafique[1], Rasheed Ahmed[1] Ghulam Jilani[2] and Zahoor Ahmed[1]

[1]Department of Soil & Climate Sciences, The University of Haripur, Khyber Pakhtunkhwa, Pakistan
[2]Department of Soil Science, PMAS Arid Agriculture University Rawalpindi Pakistan

*Email**:** ibrar.uoh@hotmail.com

ABSTRACT

Soil salinity is one of the most important abiotic stresses which decline productivity of crops under irrigated agriculture. Greenhouse pot experiment was conducted to investigate the two levels of sulphur (S at 50 and 100 mg kg^{-1}) and Sulphur oxidizing bio-fertilizer (*Acidithiobacillus thiooxidans*) alone and in combination with both levels of Sulphur on sunflower crop under normal, saline and saline sodic conditions. Saline and saline sodic soils collected from saline area were grinded, sieved and filled in a 10 kg soil pots. Sulphur levels, biofertilizer alone and in combinations were applied to the soils prior to sowing. Results showed that shoot & root dry biomass was significantly reduced with saline and saline sodic soils. Soil application of S levels, biofertilizer, and their combined application substantially improved plant dry biomass under saline and saline sodic soils conditions. Sodium and chloride concentrations were significantly declined while K^+ and chlorophyll content were potentially enhanced with the combined application of S and *Acidithiobacillus* thiooxidan*s* under saline and saline sodic conditions. Sunflower Achene yield and yield components as well as seed protein content was highest with combined application of S at 100 mgkg^{-1} with *Acidithiobacillus thiooxidans*. It can be concluded that Sulphur fertilization along with *Acidithiobacillus* thiooxidan*s* biofertilizer can be used for saline and saline sodic soils. However further field studies may be conducted to investigate various levels of Sulphur along with *Acidithiobacillus thiooxidans* on sunflower yield under saline sodic soils.

Keywords: Saline sodic soils, Sulphur fertilization, *Acidithiobacillus thiooxidans*, Helianthus annus

COMBINE APPLICATION OF BIOCHAR WITH GYPSUM, LIME, AND FARM MANURE TO ENHANCE THE RICE PLANT GROWTH BY IMPROVING CHEMICAL PROPERTIES OF SOIL

Talha Saleem[1], Muhammad Zia-ur-Rehman[1], Muhammad Anwar-ul-Haq[1], Muhammad Aamer Maqsood[1], Muhammad Usman[1], Abdullah Maqsood[1], Rubaz Ahmad[1], Ghulam Mohiuddin[1]

1 Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad 38000, Punjab, Pakistan

Email: ziasindhu1399@gmail.com

ABSTRACT

Soil salinization and sodication pose significant environmental challenges, especially in arid and semi-arid regions, causing land degradation. These abiotic factors, soil salinity, and sodicity critically threaten soil fertility and global crop production. Hence, the reclamation and management of degraded soils are crucial for ensuring worldwide food security. To address this, the development of ecofriendly and effective amendment is crucial for salt-affected soil, where biochar emerges as a versatile and promising amendment for the salt-affected soils. In a controlled pot experiment, cotton stick biochar was combined with gypsum, lime, and farm manure (FM) to grow rice (*Oryza sativa* L.) on salt-affected soils. The biochar was mixed with gypsum, lime, and FM at rates of 5 and 6 tons per hectare. The findings revealed substantial improvements in rice biomass, chlorophyll content, plant height, and overall growth attributed to the application of biochar in combination with gypsum. Remarkably, the additive application of biochar and gypsum significantly increased the concentration of Ca+Mg in the soil by 39.82% while concurrently decreasing soil electrical conductivity by up to 37.63%. Additionally, biochar application induced a notable 22.61% decrease in soil pH, with the combination of biochar and gypsum at 10 tons per hectare demonstrating the most significant impact among various treatments. The experiment highlights the effectiveness of cotton stick biochar and gypsum combined in boosting rice growth in salt-affected soils. This combination improved soil properties, raising Ca+Mg levels and lowering soil electrical conductivity and pH. These results suggest a promising method for sustainably reclaiming salt-affected soils, role in improving crop productivity and soil health. Further field research can provide valuable insights for addressing soil salinity and sodicity issues in agriculture.

Keywords: Soil salinization, Environmental challenges, *Oryza sativa*, Gypsum, Cotton stick biochar, Field research

"Soil Health: A Key to Food Security"

20th INTERNATIONAL CONGRESS OF SOIL SCIENCE

20-22 February 2024, Rawalpindi, Pakistan

SOIL, WATER & ENVIRONMENTAL CHEMISTRY

STOICHIOMETRIC CHARACTERISTICS OF C, N, P AND S IN BENCHMARK SOIL SERIES UNDER DIFFERENT CROPPING SYSTEMS OF PUNJAB, PAKISTAN

Munazza Yousra*[1], Qaiser Hussain[2], Khalid Saifullah Khan[2], M. Mahmood-ul-Hassan[1], Sair Sarwar[1], Muhammad Zameer khan[1], Ahsan Ali Anwar[3], Sana Naeem[1]

[1]Land Resources Research Institute, NARC, Islamabad, Pakistan
[2]PMAS Arid Agriculture University, Rawalpindi, Pakistan
[3]Directorate of Soil Conservation, Punjab

Email: munzkhan@parc.gov.pk

ABSTRACT

To evaluate the ecosystem productivity, it is important to understand the spatial changes and stoichiometry of soil organic carbon (SOC), soil nutrients (N, P, S) and their ratios (C:N, C:P, and C:S). In this study, a total of 1440 soil samples of sixteen benchmark soils were collected from rice-wheat, maize-wheat, cotton-wheat and fallow-wheat cropping areas of Punjab. The collected soil samples were fractionated and analyzed for total SOC, N, P, S contents and the degree of spatial dependence and geographical patterns of C, N, P, S concentration and their ratios in the studied cropping systems were assessed. Semivariogram modelling depicted the strong spatial dependency for C, N, P and S concentration while moderate for C:N, C:P and C:S ratios in the order of FW> RW>CW>MW cropping system. High spatial variability was found in FW compared to CW, MW and RW cropping systems. Moreover, a consistent stoichiometric C:N:P:S ratio i.e., 62.2:5.4:1.2:1, was explored across the studied benchmark soil series under different cropping systems of Punjab, Pakistan. Therefore, better understanding of the spatial variability for C, N, P, S concentration and C:N, C:P, C:S ratios, is useful for increasing the carbon storage by managing C:N:P:S stoichiometry and refining agricultural management practices which ultimately improves the soil health and soil fertility.

Keywords: Benchmark soils, N, P, S, SOC, Stoichiometry, Spatial variability

EXPLORING THE EFFECT OF NANOPARTICULATE IRON OXIDE MINERALS ON CHROMIUM IMMOBILIZATION UNDER VARYING ENVIRONMENTAL CONDITIONS

Hamna Bashir[1], Nabeel Khan Niazi[1], Zulfiqar Ahamd Saqib[1], Khalid Hussain[2], Muhammad Mahroz Hussain[1,3,4]

[1] Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad, Faisalabad, Pakistan
[2] Department of Agronomy, University of Agriculture Faisalabad, Faisalabad, Pakistan
[3] School of Emergency Management, School of Environment and Safety Engineering, Jiangsu Province Engineering Research Center of Green Technology and Contingency Management for Emerging Pollutants, Jiangsu University, Zhenjiang, 212013, People's Republic of China
[4] HAM Organics (PVT) Limited, Punjab, Pakistan

Email: nabeelkniazi@gmail.com

ABSTRACT

Almost all the tanneries around the world use chrome-tanning technology to produce high quality leather with uniform texture. In tannery industry wastewater, chromium (Cr) exists in trivalent (Cr(III)) and hexavalent (Cr(VI)) forms, of which Cr(VI) is highly mobile and toxic in nature. Chromium speciation depends on redox potential, pH, and redox coupling agents that governs the redox changes in the aqueous environment. The current study was planned to: (i) synthesize and characterize nanoparticulate iron oxide (NP-FeOx) minerals (nano-magnetite (n-Mg), nano-goethite (n-Gh), nano-ferrihydrite (n-Fh) and nano-hematite (n-Ht)), (ii) explore their potential for Cr removal from water under different pH, initial Cr concentration and contact time scenarios. The results showed that n-Mg and n-Fh removed 99% of Cr while n-Ht and n-Gh removed 90% of the Cr from the Cr-contaminated solution. Dramatically, all three NP-FeOx (n-Fh, n-Mg, n-Gh) performed promisingly under neutral pH (pH=7) however n-Ht showed promising results at pH 3 (acidic range). Isothermal modelling showed that Langmuir and Freundlich were best fitted models upto 99% with n-Fh and n-Mg while the pseudo second order was best fit for all NP-FeOx. The application of pseudo first order was also best fitted for the n-Mg (R^2 = 90%). Fourier transformed infrared spectroscopy spectra for the both solution phase and solid phase of sorption experiment was analyzed using FTIR which showed sharp peaks at 2350 and 1036 cm^{-1} that supported sorption mechanism showing that NP-FeOx were stable at neutral pH except n-Ht. The desorption study showed that in first cycle of all NP-FeOx reproducibility of n-Fh was maximum followed by n-Mg while in 2nd and 3rd NP-FeOx were stabilized at equilibrium with almost similar results. Overall, results showed that NP-FeOx has high potential to remediate Cr from the wastewater particularly n-Mg and n-Fh under different pH and initial concentrations. While rate of reaction also showed a promising increase in sorption efficiency with increasing time.

Keywords: Chromium contamination; iron minerals; nanoparticles; batch sorption experiment

ENVIRONMENTAL ASSESSMENT OF GROUNDWATER CONTAMINATION WITH TOXIC METALS AND MICROPLASTICS DUE TO LEACHATES AROUND WASTE DISPOSAL SITE IN FAISALABAD

Ghulam Murtaza[1], Hafsah Iqbal Meo[1], Muhammad Abdullah[1*], Misbah Abbas[1], Tajammal Hussain[1C]

[1]Institue of Soil and Environmental Sciences UAF.

***Email:** ag66009@gmail.com

ABSTRACT

Groundwater contamination with metals and micro-plastics from landfill leachates is an alarming situation. Many toxic metals and micro-plastics are dangerous for human health and other components of the environment. So, this research work was carried-out at landfill and waste disposal sites of Faisalabad Waste Management Company (FWMC) in Faisalabad city. The sampling sites were: Chak 216 GB Basti Ahmadabad on Jaranwala raod (which is the landfill site of FWMC), Narwala bypass, Liaqat Town and Millat Road named as site 1, site 2, site 3 and site 4, respectively. The objectives of the current research were: (i) to assess the presence of micro-plastics and other metals in MSW disposal site, and (ii) to assess the groundwater contamination levels with micro-plastics and other toxic metals around the landfill site and associated risk to human health. Random groundwater sampling from landfill site was carried-out for toxic metals and micro-plastic concentrations determination along with different physico-chemical parameters like color, taste, odor, turbidity, electrical conductivity (EC), pH, total dissolved solids (TDS), cations like calcium (Ca+), sodium (Na+), and magnesium (Mg+), and anions like carbonate (CO3-2), bicarbonate (HCO3-), sulphate (SO4-2), chlorides (Cl-), total hardness (CaCO3) and Dissolved Oxygen (DO). The risk assessment of health impacts due to consumption of toxic metals contaminated water was done using average daily intake (ADI), hazard quotient (HQ) and cancer risk (CR) equations. The result of this survey study showed that drinking water near the municipal solid waste (MSW) disposal sites of the Faisalabad Waste Management Company (FWMC) has been contaminating with heavy metals i.e. Cu, Cd and Pb and micro-plastics. Among HMs Pb and Cd have crossed the permissible limits of PSQCA and WHO i.e. 0.01 mg L-1 and 0.003 mg L-1, respectively, making the situation alarming. Moreover, nylon (polyamide) micro-plastics were also detected in water. The average daily intake (ADI), hazard quotient (HQ) and cancer risk (CR) showed that the consumption of this water poses health risks in humans. So, landfill sites in Faisalabad city need regular monitoring to avoid the contamination of nearby drinking water resources.

Keywords: Micro-Plastics, Landfill, Average daily intake (ADI), Hazard quotient (HQ), Cancer risk (CR), Nylon

Examining the Impact of Industrial Sewage Sludge and Municipal Compost Application on Soil Health in the Rice-Wheat Cropping System of Punjab, Pakistan

Umair Riaz[1]*, Ghulam Murtaza[2], Saifullah[2], Humera Aziz[3], Abid Hussain[1], Tanveer-ul-Haq[1]

[1]Department of Soil and Environmental Sciences, Muhammad Nawaz Shareef University of Agriculture, Multan-60000 Pakistan.
[2]Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad-38040, Pakistan.
[3]Department of Environmental Sciences and Engineering, Government College University, Faisalabad 38040, Pakistan.

Email: umair.riaz@mnsuam.edu.pk

ABSTRACT

Industrial and municipal waste can be managed via their use and application as soil amendments. Soil health and crop productivity may increase through their application, but the rate of application depends upon the characteristics of amendments. Moreover, the trace elements dynamics in arid- and semi-arid environment could be different to other regions and environments. Therefore, this study was conducted comprising two weather seasons under rice and wheat cropping. Except control (chemical fertilizers application at recommended doses), agriculture waste (AWC), and municipal solid waste composts (MSWC), industrial sewage sludge (ISS), and municipal sewage sludge (MSS) were added as soil amendments at 5 and 10 t ha^{-1} rates. The results indicated that AWC application at 5 t ha^{-1} yielded the most grain yield with 33% more than controls in both crops. Electrolyte leakage was maximum (45%) in both crops due to 10 t ha^{-1} MSWC application. Post-harvest soil analysis indicated organic matter (OM), nitrogen (N), phosphorus (P), and potassium (K) increase up to 1.23, 0.099, 421, and 568 mg kg^{-1} after the addition of AWC at 10 t ha^{-1}. The treatment with MSWC added the trace elements (Zn, Cu, Fe, Mn, Cr, Cd, Pb) more as compared to other treatments. Comparison of this study results with Soil health classification-based USDA criteria concluded that soil under AWC at 10 t ha^{-1} was proved to be 'good' compared to all other treated soils with other wastes and rates. These results recommend usage of AWC in the improvement of soil health and restoration of lands.

Keywords: Soil Fertility, Soil Organic Matter, Trace Elements, Plant Productivity, Food Grains, Macronutrients.

WHEAT YIELD AS INFLUENCED BY VARIOUS APPLICATION METHODS AND DOSES OF PHOSPHORUS FERTILIZER UNDER ARID CONDITIONS

Hafiz Imran Iqbal[1]*, Matiullah Khan[1], Rizwan Ahmad[1], Shoaib Ahmad[1], Muhammad Mohsin Raza[1], Muhammad Arshad[2], Muhammad Ibrar Ahmad[3]

[1]Land Resources Research Institute, National Agricultural Research Center, Islamabad, Pakistan.
[2]Pesticide Quality Control Laboratory, Bahawalpur, Punjab, Pakistan
[3]Soil and Water Testing Laboratory, Sargodha, Punjab, Pakistan

*Email: imran.agro@yahoo.com

ABSTRACT

An appropriate phosphorus (P) fertilizers application method is important from economic and environmental point of view and for the conservation of the world's phosphoric reserves. A field experiment was conducted during rabi season 2018-19 at Regional Agricultural Research Institute, Bahawalpur to determine the most efficient application method and optimum dose of phosphorus fertilizer on wheat. Three methods of P application i.e. line sowing with P as broadcasted (M1), line sowing with P application as bands (M2), Ridging after P and wheat seed as broadcasted (M3) were adopted at the time of sowing. The experiment was laid out following split plot design replicated thrice. Mean values were compared by interaction method. Results indicated increase in the number of fertile tiller, spike length, 1000 grain weight and ultimately wheat yield by using the M3 method. Maximum fertile tillers (305 m^{-2}) were achieved in treatment where M3 method was applied. Maximum plant height and spike length were observed in M3 method. The M2 and M3 treatments appeared to be improved method with the higher number of spikelet. Interaction among these two factors was found non-significant showing increased number of spikelet per spike and ultimately yield of the crop. A maximum increase of 44 grains per spike was observed by M3 method. Significant difference among various methods showed that the heavier grains were recorded with the M3 method. Findings of this study also indicate that application of the highest dose of phosphorus contributed maximum toward all parameters and ultimately wheat yield. More field studies are suggested to determine the suitability of efficient fertilizer application method with best climatic conditions and other management practices to maximize the grain yield with least fertilizer to increase farmer's profitability.

Keywords: Wheat, Yield, Phosphorus, Application Methods, Arid

ZINC AVAILABILITY TO WHEAT AS EVALUATED BY DIFFERENT FRACTIONS OF ZINC IN SALINE-SODIC SOIL

Sadia Sultana[*1, 2], Ayesha Amin[1], Muhammad Sabir[1], Saifullah[1], Ghulam Murtaza[1], Sadia Bibi[1]

[1]Institute of Soil and Environmental Sciences, UAF
[2]Institute of Soil Chemistry and Environmental Sciences, AARI

*Email: ssadiaiqtidar@gmail.com

ABSTRACT

Zinc deficiency is common in Pakistan due to alkaline calcareous nature of soils and salt affected soils further aggravate it. Zinc is an essential element for plants and plays a crucial role in mediating the activities of many enzymes. To investigate the effect of Zn application on its uptake by wheat and fractionation of Zn in salt affected soil, a pot experiment was conducted in the department of Soil and Environmental Sciences, University of Agriculture, Faisalabad, Punjab, Pakistan. Different Zn concentrations (Zn_0: control, Zn_1: 5, Zn_2: 10, Zn_3: 20 and Zn_4 40 mg kg^{-1}) were applied on the soils having different salinity levels (S_0: Control, S_1: 6, S_2: 8, S_3: 10, S_4: 12 and S_5: 14 dsm^{-1}) to find their combined impact on wheat growth and plant Zn concentration under two factors, complete randomized design. Salinity and sodicity was developed in soil using sodium sulphate, calcium chloride, magnesium sulphate and sodium bicarbonate. Zn fractionation in soil was also assessed. The findings demonstrated that higher applied Zn concentrations increased tillering in wheat under typical soil conditions (control), however higher Zn applications significantly decreased tillering at high salinity levels. Similar to the control, the amount of administered Zn increased the grain's Zn concentration, however the amount of salinity had no influence on grain Zn concentration as salinity levels increased. In Zn fractionation, it was determined that treatment Zn_4S_2 had the highest plant-available Zn concentration (0.91 mg kg^{-1}) while Zn_0S_5 had the lowest Zn concentration. The level of exchangeable Zn in the soil was significantly influenced by salinity.

***Keywords*:** Zinc, Wheat, Zinc fractionation

ROLE OF ALTERNATE WETTING AND DRYING ON ARSENIC BIOACCUMULATION BY RICE AND ASSOCIATED HEALTH RISK

Muhammad Mahroz Hussain[1,2,4]*, Hamna Bashir[1], Hamza Yousaf[1], Nabeel Khan Niazi[1], Irshad Bibi[1], Khalid Hussain[3]

[1] Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad, Faisalabad, Pakistan
[2] School of Emergency Management, School of Environment and Safety Engineering, Jiangsu Province Engineering Research Center of Green Technology and Contingency
[3] Department of Agronomy, Faculty of Agriculture, University of Agriculture Faisalabad, Faisalabad 38040, Pakistan
Management for Emerging Pollutants, Jiangsu University, Zhenjiang, 212013, People's Republic of China
[4] HAM Organics (PVT) Limited, Punjab, Pakistan

Email*: hmahroz@gmail.com

ABSTRACT

Rice ia a staple food for more than three billion people. Geogenic arsenic (As) contamination has been reported globally over 115 countries and have shown more mobility and bioavailability under paddy (reduced) soil conditions due to conversion of arsenate to arsenite. This study was conducted to evaluate As accumulation by rice under alternate wetting and drying cycles (varying irrigation) in a pot experiment. Seedbed was prepared for nursery and after 25 days nursery was transplanted in pots in the wire house. The alternate wetting and drying cycle were maintained as 30, 50, 70 and 100% (IW-30, IW-50, IW-70 and IW-100) irrigation water levels. Morphological parameters including number of tillers/plant was relatively higher in IW-100 and IW-50 compared other IW levels. Plant height, shoot and root height was also found higher in IW-50 (117 and 35cm) compared to other IW levels. Shoot and root dry biomass comparatively greater in IW-50 (8.8 and 4 g) compared to control and other IW levels, number of spikelet and dry weight of grains were also higher in IW-50 (4.81g) compared to control and other IW level (3.55, 3.50, 3.66 g). SPAD values were found maximum in IW-50 compared to other levels. Arsenic concentration in root, shoot result indicated that there was significant ($p < 0.05$) difference of As concentration was relatively higher in IW-100 (108, 40 mg kg^{-1} DW) compared to other and minimum As concentration was calculate in 50 % IW level (25, 10 mg kg^{-1}). Arsenic concentration in rice grains and husk was not detected. Hazard Quotients (HQ) were calculated, and significant ($p < 0.05$) difference was observed in grain with IW-100 (0.94 mg kg^{-1} day^{-1}) compared to IW-50 (0.15 mg kg^{-1} day^{-1}).

Keywords: Rice, Arsenic, Availability

INFLUENCE OF SULPHER (BENTONITE) ON THE GROWTH AND YIELD OF COTTON CROP

Naseer Ahmed Deho[1], Sohail Ahmed Qureshi[1], Fozia Naz Memon[1], Nazia Rais*[1], Nasir Ahemd Katyar[1], Masood Babar[1], Inzmam-ul-haq Khanzada[1]

[1]Soil & Environment Research Institute, Agriculture Research Center Tandojam, Pakistan

*Email: naziarais81@gmail.com

ABSTRACT

Sulphur (S) deficiency in soils and plants has become widespread. Despite the numerous studies reporting on the effects of sulphur application on growth, yield components, and quality parameters in various plant species, very little research has been done on cotton in this regard. A field experiment was conducted in 2019 at the Soil & Environment Research Institute, Tandojam to examine the impact of the Sulphur on the growth and yield of cotton (Gossypium hirsutum L.) at varying rates (00, 1250, 1550, and 1850) and four replications under Randomized Complete Block Design (RCBD) layout. The study utilized sulphur bentonite sources for application. The results demonstrated that the highest Sulphur increased the yield to 1965 kg/ha, much more than the lower rates. Also, using the highest Sulphur rate led to a big 20% increase in fiber yield compared to the lowest rate of 1250 kg/ha. This study highlights the positive connection between cotton and Sulphur yield, suggesting it could be a useful practice for farmers. Further research is needed to understand exactly how Sulphur helps cotton grow better.

Keywords: Cotton, Sulphur, Yield, Soil Health, Sulphur Bentonite

PESTICIDE RESIDUES ANALYSIS OF MAIZE (*ZEA MAYS* L.) SAMPLES FROM SAHIWAL DISTRICT USING MASS SPECTROMETRY TECHNIQUES

Haseeb-Ur-Rehman[1*], Umair Riaz[1*], Abid Hussain[1], M. Asif Farooq[2], Abdullah Niaz[3], Rehman Gul[3], Muhammad Tariq[1], Qurrat-ul-Ain[1]

[1]Department of Soil & Environmental Sciences, MNS- University of Agriculture, Multan, Pakistan.
[2]Institute of Plant Protection, Department of Entomology, MNS- University of Agriculture, Multan, Pakistan.
[3]Pesticide Residue Laboratory, Kala Shah Kaku, Institute of Soil Chemistry and Environmental Sciences, Ayub Agricultural Research Institute, Faisalabad, Pakistan.

*Email: 2018-uam-464@mnsuam.edu.pk

ABSTRACT

Maize (*Zea mays* L.) is a staple crop in Pakistan, and the over use of agrochemicals in maize-growing regions causes result in the pervasive presence of pesticide residues in various parts of the maize plant and topsoil. A survey study was planned to monitor the pesticide residues in post-harvest soil, flag leaves, and in maize grains. The twenty (20) samples from all three sites of maize growing areas in Sahiwal district were extracted in the laboratory using QuEChERS (Quick, Easy, Cheap, Effective, Rugged and Safe) method, followed by cleaning step involving dispersive centrifugation and filtration prior to chromatographic analysis on Liquid Chromatography-Mass Spectrometer (LC-MS) and Gas Chromatography-Mass Spectrometer(GC-MS). At location 1, pendimethalin (weedicide) was identified in the range of 0.22-0.48 ppm in flag leaf and 0.93-1.92 ppm in post-harvest soil, fipronil (insecticide) ranges 0.196-4.39 ppm in flag leaf and 0.145 ppm in grains and 0.65 ppm of carbofuran (insecticide) was found in grains of one sample. At location 2, atrazine (weedicide) was found as 0.69 ppm in flag leaf of one sample and 0.24 ppm in grains of the same sample, while post-harvest soil of this site contained residues of atrazine in the range of 0.95-1.40 ppm. Other pesticides detected from this location were; fipronil as 0.172 ppm in flag leaf and 0.09 ppm in grains and 1.02 ppm of carbofuran in flag leaf. At location 3, only carbofuran was found in the range of 0.65-1.58 ppm in flag leaf, while acetochlor (weedicide) was identified in the range 0.78-1.36 ppm in post-harvest soil. The results showed that only few of the samples were containing pesticide residues. Insecticide residues were detected in edible portion (grains), while only atrazine herbicide could translocate into grains, and pendimethalin herbicide did also showed its residues but in the top leaf only and grains were free of its traces. Similarly, the third herbicide, acetochlor was detected in post-harvest soil samples only but analysis of plant parts; leaf and grains, did not show any of its residues. This information could be important regarding scenario of pesticide residues in maize areas and also on translocation of different pesticides within maize plant.

Keywords: Pesticide residues, Maize (*Zea mays* L.), Soil contamination, Agricultural sustainability

ADSORPTION POTENTIAL OF CASSIA FISTULA SEED ACTIVATED CARBON FOR THE TREATMENT OF LAUNDRY WASTEWATER

Hadia Tassadaq*

[1]Institute of Soil and Environment Science, PMAS-AAUR

*Email: hadiatassadaq@gmail.com

ABSTRACT

The gap between water supply and water demands is increasing day by day. With rapid increase in global population, the utilization of water is also increased which also result into wastewater generation. Among others, domestic wastewater contribute majorly in this waste generation. Grey water in domestic wastewater can be a potential source of water pollution if it will not be treated. Source of grey water is usually residential zone areas which includes laundry effluents, kitchen wastes etc. It was estimated that in a day if laundry industry washes 1 kg clothes it will consume 15 L water and will produce 400m^3 of wastewater. In the present study adsorption potential of *Cassia fistula* seeds will be checked for treating laundry wastewater. Different physicochemical parameters i.e Colour, COD, BOD, and SS of laundry wastewater will be measured before and after treatment at different pH and dosage levels. This study will be helpful in developing adsorbent using adsorption technique by utilizing *Cassia fistula* seed waste.

Keywords: *Cassia fistula;* Laundry wastewater; Adsorption

MITIGATING DROUGHT STRESS THROUGH BIOCHAR AND GIBBERELLIC ACID IN RICE (*Oryza sativa L.)*

Imran Ullah[1], Muhammad Arif[1] , Shakeel Ahmad[1], Kashif Razzaq[1], Ahmad Mahmood[1] , Hafsa Maqsood[1] , Dad Muhammad[1], Muhammad kamran[1], Gul Marjan[1]

[1]Department of Soil and Environmental Sciences, MNS-University of Agriculture, Multan.

*Email: muhammad.arif@mnsuam.edu.pk

ABSTRACT

Drought stress increases the global food insecurity by causing agricultural losses and lowering water availability and quality. Rice is the staple food for nearly half of the world's population and is cultivated in approximately 160 million hectares of land globally. Rice is cultivated in a variety of water regimes and soil types, such as saline, alkaline, and acid–sulphur soils throughout the year in different agro-ecosystems. Drought stress has a serious effect on rice by reducing seed germination, root and shoot length, vegetative growth, and reproductive phase. However, rice is extremely sensitive to water insufficiency during the reproductive phase, which significantly reduces grain production. Biochar primarily improves soil conditions for water retention, gibberellic acid acts at the physiological level within plants to promote growth and resilience. Many existing studies are conducted in controlled environments, and there is a gap in field-scale assessments. Field studies can provide insights into the practical feasibility, long-term effects, and scalability of these interventions in real-world agricultural settings. Research on mitigating drought stress in rice through biochar and gibberellic acid 3 is crucial for developing sustainable agricultural practices, enhancing crop resilience, and ensuring food security under changing climate. So, employing these techniques aims to alleviate the negative effects of water scarcity on rice crop. The study on mitigating drought stress in rice through biochar and gibberellic acid 3 is laying the foundation for a future where farmers can adopt innovative techniques to ensure better yields in the face of changing climate patterns.

Keywords: Agro-ecosystem, Biochar, Drought stress, Rice and Staple food.

NITROUS OXIDE EMISSION FROM SOIL UNDER MAIZE CROP AS INFLUNCED BY THE APPLICATION OF BIOCHAR AND NITRIFICATION INHIBITORS COATED UREA

Aamir Khan[1]*, Muhammad Akmal[1], Khalid Saifullah Khan[1], Ghulam Qadir[1]

1 Institute of Soil and Environmental Sciences, PMAS-AAUR, Rawalpindi

Email: aamir_mkd@yahoo.com

ABSTRACT

Low nitrogen levels in the soil is a major factor which adversly affect the productivity of crops in rainfed areas. Lack of nitrogen, low organic matter, inadequate fertilization, and nitrogen losses in the form of nitrate leaching, ammonia volatilization and nitrous oxide gas emission are some major causes of poor soil N contents. However, improving soil fertility and increasing nitrogen availability are major challenge for improving crop yields. This can be achieved through a variety of methods, including the application of biochar and nitrification inhibitors coated urea. Thus, keeping in mind the importance of both amendments present study was designed to cover the knowledge gap regarding effect of two different types of biochar, NI and their coated urea on maize growth and yield. A field experiment was conducted to evaluate the individual or combined effect of two different sources (plant & animal) of biochar and nitrification inhibitors (nitrpyrin and neem-seed oil) and their coated urea on the production of maize in sandy loam soil under the rain fed condition. The study included 10 treatments: addition of urea alone (non-coated) or combined with biochar coated urea (BCU) and nitrification inhibitor coated urea (NICU) to the soil and a control without the addition of N fertilizer following RCBD. Characterization of both types of biochar and their coated urea by XRD, FTIR, and SEM analysis showed that coating of biochar over urea granules enhanced the N adsorption capcity while urea was adsorbed on the adsorbents in the highest quantity. Therefore, BCU and NICU significantly increased N retention > 75 days. Results showed that CDB+NI coated urea played an imperative role in enhancing maize plant height, number of leaves and number of grains/cob over control, and sole application of amendments. A significant enhancement in grains 4389 kg ha^{-1}, biological 8925 kg ha^{-1} and stover yield 4536 kg ha^{-1} validated the effectivesnes of CDB+NI coated urea over non-coated urea. In conclusion, CDB+NI coated urea is an effective amendment for increasing NUE, growth, and yield attributes of maize. More investigations are recommended to declare CDB+NI coated urea as a best treatment in different soil textures and agroclimates for maize cultivation.

Keywords: Rice Straw Biochar, Cow Dung Biochar, Nitrification inhibitor, Nitrapyrin, Neem Seed Oil, coated urea

"Soil Health: A Key to Food Security"

20th INTERNATIONAL CONGRESS OF SOIL SCIENCE

20-22 February 2024, Rawalpindi, Pakistan

SOIL & ENVIRONMENTAL PHYSICS, SOIL CONSERVATION

Soil quality indicators and growth of Mungbean as influenced by application of compost and dairy manure

Muhammad Iqbal*[1], Areeba Fatima[1], Tooba Mumtaz[1], Liaba Tahir[1], Mussawar Abbas[1]

[1]Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad

*E-mail: iqbal@uaf.edu.pk

ABSTRACT

Mungbean (*Vigna radiate L.*) is an important legume. It is capable of being grown as a cash crop and as an alternative to rice for water conservation. The impact of phosphorus, farmyard manure and compost on growth and soil quality indicators was assessed in this study. A pot study was conducted in a greenhouse comprising 12 treatment combinations following CRD with factorial design. Agronomic practices were followed, and the crop was harvested. This enabled us to collect data regarding all physiological and agronomical parameters of the first and second cuttings of Mung bean. This study applied the following treatments: T_1 = Phosphorous @ 50% + Compost @ 2 Mg ha^{-1}, T_2 = Phosphorous @ 50% + Compost @ 4 Mg ha^{-1} , T_3 = Phosphorous @ 50% + Compost @ 6 Mg ha^{-1} , T_4 = Phosphorus @ (100%) + Compost @ 2 Mg ha^{-1} , T_5 = Phosphorus @ (100%) + Compost @ 4 Mg ha^{-1}, T_6 = Phosphorus @ (100%) + Compost @ 6 Mg ha^{-1},T_7 = Phosphorous @ 50% + Dairy Manure @ 2 Mg ha^{-1},T_8 = Phosphorous @ 50% + Dairy Manure @ 4 Mg ha^{-1},T_9 = Phosphorous @ 50% + Dairy Manure @ 6 Mg ha^{-1}, T_{10} = Phosphorus @ (100%) + Dairy Manure @ 2 Mg ha^{-1}, T_{11}= Phosphorus @ (100%) + Dairy Manure @ 4 Mg ha^{-1}, T_{12} = Phosphorus @ (100%) + Dairy Manure @ 6 Mg ha^{-1}.Utilizing analysis of variance (ANOVA), the impact of compost and dairy manure application on mungbean production was examined . In order to compare the means of the treatments, the LSD (Least Significant Difference) test was used. The results of the trial revealed that by addition of organic compost as organic amendment as compared to dairy manure in the soil improved mungbean crop growth, nutrients availability and different soil characteristics. The treatment in which 0.2% compost with 50% phosphorus was used, showed better results in improving mungbean crop growth. Physical characteristics were improved significantly by compost as compared to dairy manure treatments.

Keywords: Mungbean, Compost, Dairy Manure, Soil Quality.

REGENERATIVE WATERSHED MANAGEMENT STRATEGIES: A RESILIENCE TO CLIMATE CHANGE FOR SUSTAINABLE AGRICULTURE IN RAINFED AREA OF PAKISTAN

Obaid-ur Rehman[1]*, Riffat Bibi[1], Safia Naureen Malik[1] and Majid Rahim

[1]Soil and water conservation research institute Chakwal, Pakistan

*Email: drobaidtmn@gmail.com

ABSTRACT

Intensification of hydrological cycles driven by climate change is causing frequent floods and drought. Soil erosion by water and wind leads to further decline in soil fertility, brings on a series of negative impacts of land degradation and other environmental problems, and creates a threat to sustainable agricultural production and environmental quality. In Pothwar area of Pakistan, the dual regulation of flow and biota i.e. ecohydrology approach was adopted based on watershed management technologies such as rooftop rainwater harvesting, micro catchment, gypsum application, green manuring, on farm water control structures, gully plugging and tillage practices to reduce flood intensity and control flood erosion. These techniques cannot be effectively deployed without full awareness among local communities that how such technologies can help to overcome the erosion problem and drought with proper water conservation/storage practices. The rainfall in these areas varies from less than 200 mm to over 1000 mm, 70% of which occurs during the Monsoon season. Due to high intensity, short duration rainfalls and lack of watershed management/awareness and rainwater harvesting activities, this precious water is wasted as surface runoff. There was a dire need to harvest maximum currently lost water (6MAF) as possible either on the surface or underground. Stored water in soil and groundwater can be used as supplemental irrigation to act as a buffer against crop failure during dry seasons through efficient irrigation means. The achievements of these research techniques so far are: On Farm Water / Runoff Control Structures for improvement of rain-fed terraced systems, Gypsum *application doses* for moisture conservation and improved crop productivity, Green manuring for moisture conservation/fertility improvement under different precipitation regimes, *tillage practices* for moisture conservation, profitable use of gullied areas without land leveling, for reducing soil erosion., screening of indigenous and exotic grasses, dissemination of standardized technologies to end users/farmers.

Keywords: Water Erosion, Land Degradation, Soil Fertility, Ecohydrology Approach.

ASSESSMENT OF COMPARATIVE EROSION OF DIFFERENT SOIL ORGANIC CARBON FRACTIONS UNDER CONVENTIONAL AND CONSERVATION PRACTICES AND SUBSEQUENT CHANGES IN SOIL QUALITY, AND CROP YIELD

Mah-Noor Azad*[1], Shahzada Sohail Ijaz[1], Khalid Saifullah Khan[1], Muhammad Ansar[2], Nighat Musa[1]

[1]Institute of Soil and Environmental Sciences, PMAS-AAUR
[2]Department of Agronomy, PMAS-AAUR

*Email: mahnoorazad35@gmail.com

ABSTRACT

Soil erosion is universally recognized as a serious threat to land resources and public health. Worldwide, up to 75 billion tons of top soils are eroded every year by wind and water and 85% of world's agricultural soils are affected by erosion. In mountainous and sub-mountainous areas of Pakistan, land degradation due to water erosion is a common problem attributable to intense summer rainfalls, undulating topography, inappropriate land use practices, and soil type. Conservation agriculture (CA) has been successfully used for soil and water conservation in large-scale commercial agriculture in developed world. This study aimed at quantifying potential of CA practices for erosion control in rainfed agricultural lands of Pakistan. We hypothesize that replacement of moldboard plow with less intensive chisel plow, and providing soil cover in summer season can help to control erosion. The specific objectives are, comparative erosion of different soil organic carbon fractions under conventional and conservation practices and subsequent changes in soil quality, and comparison of conventional and conservation agriculture for crop yield. A two-year field experiment was laid out in split-plot design having three replications with a net plot size of 5m × 7m at University Research Farm. Main plot treatments were tillage systems viz. 1) Moldboard plow (MB), 2) Tine cultivator (TC), 3) Reduced tillage (RT), and 4) Minimum tillage (MT) with subplot treatments a) summer fallowing (SF), and b) green manuring (GM) followed by wheat. Reduced tillage showed minimum runoff (131.67 mmL^{-1} and 87.92 mmL^{-1}) under green manuring and summer fallow whereas the highest runoff losses were recorded under moldboard plow with green manuring (384.17 mmL^{-1}) as well as summer fallowing (337.50 mmL^{-1}). Similarly, reduced tillage showed lowest sediment loss under green manuring (47.16 g kg^{-1}) as well as summer fallow (29.92 g kg^{-1}) while moldboard plow showed the highest sediment loss (168.86 g kg^{-1} and 138.94 g kg^{-1}) for green manuring and summer fallowing, respectively. The results ensured the validity of reduced tillage (chisel with green manuring) as an alternative to conventional tillage practices for soil and water conservation with the assurance of satisfactory crop production.

Keywords: Soil Erosion, Carbon Fractions, Yield, Conservation Agriculture.

EVALUATING THE IMPACT OF SOIL AMENDMENTS ON RAINWATER RUNOFF, SEDIMENT AND NUTRIENT LOSS UNDER DIFFERENT SLOPE GRADIENTS

Ayesha Malik*[1], Obaid-ur-Rehman[2], Rahina Kausar[1], M. Usman Mohsin[1] and Muhammad Rashid[3]

[1] Soil and Water Conservation Research Station, Fateh Jang (Pakistan)
[2] Soil and Water Conservation Research Institute, Chakwal (Pakistan)
[3] Soil Fertility Survey and Soil Testing Institute, Rawalpindi (Pakistan)

*Email: ayeumer@gmail.com

ABSTRACT

To counter the global population, increase and ensure sustainable agricultural production, addressing soil erosion is imperative. A significant challenge in optimizing land use in regions with undulating topography, particularly in Pakistan's sub-mountainous areas, is the substantial runoff caused by intense rains. A four-year field study at the Soil and Water Conservation Research Station, Fateh Jang, from 2014 to 2017, assessed the impact of soil amendments on runoff, sediment, and nutrient loss across different soil slope gradients. Three types of amendments; chemical fertilizer at 29:79:29 NPK kg ha^{-1}, compost at 750 kg ha^{-1}, and gypsum at 1000 kg ha^{-1}; were applied at 1%, 5%, and 10% slopes alongside a control plot for groundnut cultivation. During the monsoon season, post-rainfall events of ≥ 40 mm were recorded, revealing lower soil and water loss in gypsum and compost treatments compared to the control. Chemical fertilizer exhibited higher grain and straw yields, but also more macro and micronutrient losses compared to compost and gypsum. Moreover, at 10% slope gradient, followed by 5% and 1%, all treatments resulted in maximum soil, water, and nutrient losses, highlighting pronounced variations in runoff, sediment, and nutrient losses in similar topographic conditions. Hence, it is concluded that gypsum or compost should be applied along with chemical fertilizer to reduce the runoff, sediment and nutrient losses without compromising the rain and straw yield of groundnut. Therefore, the prioritization of gypsum and compost treatments is recommended as an effective strategy for mitigating soil erosion and ensuring sustainable agricultural practices in regions characterized by undulating topography.

Keywords: Runoff, Soil Amendments, Slope Gradient, Nutrient Loss.

SIMULATION-BASED ASSESSMENT OF THE IMPACT OF CONSERVATION TILLAGE AND STRIP INTERCROPPING ON SOIL MICROBIAL BIOMASS CARBON

Sana ur Rehman*[1,2], Shahzada Sohail Ijaz[1], Muhammad Ali Raza[2], Imran Haider[2], Zafar Iqbal[2]

[1] National Research Center of Intercropping, The Islamia University of Bahawalpur, Pakistan
[2] Institute of Soil & Environmental Sciences, PMAS-Arid Agriculture University, Rawalpindi, Pakistan

*Email: msrehman@iub.edu.pk

ABSTRACT

Conservation tillage is frequently highlighted as a valuable technique for enhancing soil quality within the realm of agriculture. Soil chemical and microbial properties in strip intercropping under conservation tillage, however, have hardly been studied to date. The objective of this research was to determine whether the MBC stocks are increased by a tillage reduction and legume-based strip intercropping system for long-term studies. There were three tillage practices, viz, conventional tillage (CT), minimum tillage (MT), and reduced tillage (RT), and two strip intercropping systems, wheat-chickpea (W-C) and wheat-brassica (W-B) and three sole crop systems sole-wheat (SW), sole-chickpea (SC) and sole-brassica (SB). In this research study, we investigated the effect of various tillage systems and strip intercropping on soil properties in a newly implemented site where conservation tillage practices were adopted. The MBC contents were affected by tillage, cropping systems, and soil depth. A significant increase in MBC concentration occurred in wheat-chickpea and sole-chickpea (197 and 196 µg g^{-1}) under the RT system at 0-15 cm soil depth. Bulk density (BD) and nitrate-nitrogen (NO_3-N) gradually increased with the tillage treatments from CT to RT. Based on the model's findings, it is projected that the implementation of reduced tillage (RT) will result in elevated levels of microbial biomass carbon (MBC) by the year 2100. Ultimately, conservation tillage practices and strip intercropping can contribute to sustainable agricultural systems by protecting soil resources, enhancing soil microbial activity, and supporting long-term productivity.

Keywords: Conservation Tillage, Intercropping, Soil Health, Microbial Biomass, Simulation,

THE URGENCY OF SOIL CONSERVATION FOR SUSTAINABLE FUTURE

Inaba Hawraa*[1], Muhammad Tahir Akram[1], Muhammad Azam Khan[1], Mehwish Liaquat[1]

[1]Department of Horticulture, PMAS-Arid Agriculture University, Rawalpindi 46300, Pakistan

*Email: inabahawraa987@gmail.com

ABSTRACT

Soil is a non-renewable resource that stores carbon, regulates the water cycle, and mitigates climate change, but unsustainable human activities, such as overgrazing, deforestation, excessive pesticides and fertilizers usage, and intensive agriculture, destroy the balance and accelerate this natural degradation process at an alarming threat. Soil degradation due to anthropogenic activities is ten times faster than its replacement. One inch of fertile topsoil takes thousands of years to form, however it is destroyed in minutes by humans. By 2050, about 90% of soil is expected to be degraded and only agriculture will be about 7.5% of the Earth's surface. Multiple consequences of soil degradation include topsoil loss, reduced fertility, and increased vulnerability to drought, biodiversity loss and compromised water quality. However, several soil conservation techniques are implemented to uphold soil health and alleviate the adverse effects of soil degradation. These approaches encompass practices such as minimizing soil disturbance, preserving soil cover, optimizing nutrient management, and fostering biodiversity. Specific sustainable methods include crop rotation, cover cropping, mulching, zero tillage, windbreaks, runoff control, salinity management, biodiversity promotion, and employing modern techniques like precision agriculture, agroforestry, and soil amendments. Consequently, soil conservation emerges as an indispensable element of sustainable land management, addressing the pressing need to safeguard soil resources' availability and productivity for current and future generations.

Keywords: Anthropogenic Activities, Biodiversity, Degradation, Soil Conservation.

RICE QUALITY AND GROWTH INDEX UNDER DIFFERENT COMPOST LEVELS USING SEWAGE SLUDGE

Hifza Jabbar*[1], Muhammad Iqbal[1], Laiba Tahir[1], Tooba Mumtaz[1], Mussawar Abbas[1]

[1]Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad

*Email: hifzajabbar298@gmail.com

ABSTRACT

In order to improve soil fertility and agricultural productivity, sewage sludge is added to the soil. This study aimed to investigate the impact of sewage sludge on rice quality and growth index. To assess the impact of compost on rice growth and quality using sewage sludge, four levels i.e., 2%, 4% 6%, of compost were applied. Direct seeding (DSR) method was used for sowing of rice. Results revealed that substitution with 50% N through sewage sludge significantly increased the yield and biochemical properties. Sewage sludge amendment modified the physico-chemical properties of soil, thus increasing the availability of heavy metals in soil and consequently with higher accumulation in plant parts. Yield of rice increased by 40%, 80%, 100%, 105% and 115% at 4% compost level. Using composts with sewage sludge attaining high organic matter degradation and exhibiting low amounts of heavy metals, a relatively high germination index, and significant reduction of pathogens. Soil quality parameters including root length (20.23 cm), shoot length (95.0 cm) soil bulk density (1.2 gcm^{-3}), root length density (1.53 g cm^{-3}), plant height (20 cm) and LAI (4.3) were increased. It was concluded that sewage sludge with compost amended soils can lead to substantial reduction in heavy metals.

Keywords: Sludge, soil quality, soil fertility

STRAW MANAGEMENT WITH POTASSIUM FERTILIZATION INFLUENCES ORGANIC C POOLS, AGGREGATE-ASSOCIATE C, AND WATER-STABLE AGGREGATES IN RICE-RAPE CROPPING SYSTEM

Kashif Ali Kubar*[1,2], Li Huang[1]*, Bin Xue[1], Xiaokun Li[1], Jianwei Lu[1], Qambar Baloch[2]

[1]Key Laboratory of Arable Land Conservation (Middle and Lower Reaches of Yangtze River), Ministry of Agriculture, College of Resources and Environment, Huazhong Agricultural University, Wuhan 430070, China.
[2]Faculty of Agriculture, Lasbela University of Agriculture, Water and Marine Sciences, Uthal 90150, Pakistan.

*Email: kashifkubar@luawms.edu.pk

ABSTRACT

Aggregate-associate C, Organic C pools and water stable aggregates contribution can be meritoriously affected by straw management practices and potassium (K) fertilization. A field trial was conducted for six years to assess the effect of straw incorporation along with K fertilization on organic C pools, aggregate-associated C and water stable aggregates in rice-rape cropping system of Jingzhou City, China. Four treatments were established: (i) Conventional tillage without potassium fertilization and straw incorporation (CT), (ii) Conventional tillage with potassium fertilization (CTK) (iii) Conventional tillage along with straw incorporation (CTS) (iv) Conventional tillage with potassium fertilization plus straw incorporation (CTKS). Soil samples were selected from 0-20 cm and 20-40 cm soil layers. Straw management practices with K fertilization significantly enhanced the soil organic carbon (SOC), particulate organic carbon (POC), microbial biomass carbon (MBC), easily oxidizable carbon (EOC), dissolved organic carbon (DOC), and carbon management index (CMI) by 10-25%, 20-94%, 12-24%, 9-29%, 5-13%, 10-15%, respectively at 0-20 cm. Although, SOC stocks and DOC were increased from 5-19% and 3-10% under conventional tillage practice, respectively, at 20-40 cm depth. Straw incorporation with K fertilization also promoted the water stable aggregates, mean weight diameter and geometric mean diameter except fractal dimensions. Among all distinct soil aggregates, aggregate-associated C of >5 mm and 5-2 mm soil aggregates were highest as compared to other separated fractions of aggregates. SOC had significant relationship with organic C fractions, soil carbon management index, SOC stocks and aggregate-associated carbon. This present study concluded that straw incorporation combined with potassium fertilization can be an encouraging approach for improving the SOC sequestration, organic carbon pools and macroaggregates in rice-rape cropping system.

Keywords: Straw Incorporation, Potassium Fertilization, Conventional Tillage, SOC Fractions, Soil Water-Stable Aggregates.

RICE CROP RESIDUE MANAGEMENT EFFECT ON SOIL HYDROLOGY AND WHEAT YIELD IN RICE-WHEAT CROPPING SYSTEM

Rukhsana Parveen Jamro*[1], Ijaz Ali[2], Ghulam Murtaza Jamro[1]

[1]Department of Soil Science, Sindh Agriculture University Tandojam, Pakistan
[2]Land Resources Research Institute, National Agricultural Research Center, Islamabad, Pakistan

*Email: rukhsana4001@gmail.com

ABSTRACT

Burning of crop residues has become a common strategy to manage rice residues in rice wheat cropping system which adversely affects soil physio-chemical properties. Adding the crop or incorporation of residues in soil can alter hydrological characteristics. Management of rice residue with Happy Seeder is the ideal solution which can work as mulch and help to retain moisture. In view of this, a study has been conducted involving three treatments including $T_{1:}$ Rice residue removal and sowing of wheat, T_2: Rice residue incorporation and sowing of wheat by Super Seeder, T_3: Rice residue mulching and sowing of wheat by Pak Seeder. The results indicated that rice residue incorporation and sowing by Super Seeder proved better treatment for improving organic carbon in topsoil (0-10 cm), soil moisture content, available water capacity and grain yield, whereas greater bulk density was found in residue removal treatment. Further, rice residue incorporation and sowing of wheat by Super Seeder retained more moisture followed by Rice residue mulching and sowing of wheat by Pak Seeder and rice residue removal treatment. It was concluded from the data that incorporation of rice residue (sowing with Super Seeder) and its mulching (sowing with Pak Seeder) can alter hydrological characteristics and improve wheat yield in rice wheat cropping system.

Keywords: Super Seeder, Wheat, Rice Residue Incorporation, Moisture Conservation

"Soil Health: A Key to Food Security"

20th INTERNATIONAL CONGRESS OF SOIL SCIENCE

20-22 February 2024, Rawalpindi, Pakistan

SOIL SCIENCE SOCIETY OF PAKISTAN -SSSP-

SOIL & ENVIRONMENTAL POLLUTION AND THEIR REMEDIATION

ARSENIC AND ZINC ACCUMULATIONS IN ZINC-BIOFORTIFIED WHEAT UNDER ARSENIC-CONTAMINATED IRRIGATION AND VARIOUS ZINC APPLICATION METHODS

Ammara Basit*[1], Shahid Hussain[1]

[1]Department of Soil Science, Faculty of Agricultural Sciences and Technology, Bahauddin Zakariya University, Multan 60800, Pakistan

*Email: ammarabasit738@gmail.com

ABSTRACT

Arsenic (As) contamination in groundwater deteriorates food quality by accumulating in edible plant parts. Alongside this, low-zinc (Zn) supply from agricultural soils is contributing to global-level Zn malnutrition. A holistic approach is needed to mitigate As accumulation and Zn insufficiency in foodstuffs, especially in wheat grains. This study compared various Zn application methods for decreasing grain As and increasing grain Zn concentration of wheat. For this, two Zn-biofortified wheat (*Triticum aestivum* L.) cultivars, Akbar-2019 and Zincol-2016, were grown in pots and supplied with Zn through various methods [control, seed priming with distilled water and 6 mM $ZnSO_4$ solution, soil application at 0 and 8 mg Zn kg^{-1}, foliar sprays of distilled water and 0.05% Zn (w/v) at booting and heading, and selective combinations of these treatments]. Throughout the growth period, the pots were irrigated with As-contaminated irrigation water (1.0 mg As L^{-1}). Zinc application methods significantly influenced chlorophyll *a*, chlorophyll *b* and carotenoids with a maximum increase with the combined application of Zn through soil, foliar and priming. Compared to control, Zn application by various methods significantly increased dry matter yields of straw, roots and grains. Additionally, there was an increase in Zn and phosphorus (P) concentrations in grains, as well as in the estimated dietary intake (EDI) of Zn. These positive effects were linked with a simultaneous decrease in As concentrations in various plant parts, including grains, and a decrease in EDI of As. The most significant improvements in terms of increased dry matter yields, enhanced grain Zn accumulation, and decreased grain As concentration was observed with the combined application of Zn through seed Zn application, soil Zn fertilization and foliar Zn spraying. However, the sole treatment of seed Zn priming did not produce a significant effect on these parameters when compared to control. In conclusion, the application of Zn to Zn-biofortified wheat serves a dual purpose by decreasing grain As accumulation and increasing grain Zn concentration. This fertilization strategy has the potential to mitigate high EDI of As associated with wheat cultivation under As exposure, while simultaneously enhancing the nutritional quality of wheat grains, making them suitable for human consumption.

Keywords: Arsenic-contamination, Calcareous soils, Fertilization, Irrigation water, Zinc deficiency, Zinc-biofortified wheat

EFFECT OF Fe-Mg BIMETALLIC BIOCHAR ON REMEDIATION OF MULTI-METAL CONTAMINATED SOIL AND THE REDUCTION OF METAL TOXICITY IN SPINACH (*Spinacia oleracea* L.)

Muhammad Kashif Irshad[1, 2], Jong Cheol Lee[2], Muhammad Aqeel[3], Wasim Javed[4], Ali Noman[5], Ali El-Naggar[6], Muhammad Ibrahim[1], Hun Ho Lee[2], Nabeel Khan Niazi[7], Sang Soo Lee[2]

[1]Department of Environmental Sciences, Government College University Faisalabad, Pakistan
[2]Department of Environmental and Energy Engineering, Yonsei University, Wonju 26493, Republic of Korea
[3]State Key Laboratory of Herbage Improvement and Grassland Agro-ecosystems, College of Ecology, Lanzhou University, Lanzhou, 730000. Gansu, P.R. China
[4]Punjab Bioenergy Institute (PBI), University of Agriculture Faisalabad, Pakistan.
[5]Department of Botany, Government College University, Faisalabad, Pakistan
[6]Department of Soil Sciences, Faculty of Agriculture, Ain Shams University, Cairo 11241, Egypt
[7]Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad, Faisalabad 38040, Pakistan

***Email:** kashifirshad@gcuf.edu.pk

ABSTRACT

Soil pollution with heavy metals like cadmium (Cd), lead (Pb), and copper (Cu) has adverse effects on environmental stability. Current study involved the synthesis of iron-magnesium bimetallic biochar (Fe-Mg-BC). Results showed that Fe-Mg-BC (3%) reduced Cd, Pb and Cu mobility in soil solution by 68, 72 and 49%, respectively in comparison to control. The Fe-Mg-BC (3%) treatment increased spinach biomass by raising photosynthesis, transpiration, stomatal conductance, and intercellular CO_2 by 22, 21, 103, and 15.3%, respectively. Plants treated with Fe-Mg-BC (3%) suppressed metal-induced oxidative stress by boosting the levels of super oxide dismutase (SOD), ascorbate peroxidase (APX) and catalase (CAT) in plant roots and shoots by 40.9, 57, 54.8, 55.5, 65.5, and 37.4%, respectively. The results illustrated that Fe-Mg-BC (3%) decreased the levels of Cd, Pb, and Cu in plants roots and shoots by 34.1, 79.2, 47, 56.3, 43.3, and 54.1%, respectively. Soil amendment with Fe-Mg-BC changed the bioavailable fractions of Cd, Pb and Cu into non-bioavailable fractions, limiting their mobility and uptake by plants. This study confirmed that Fe-Mg-BC could be used for reclaiming multi-metal contaminated soils and preventing Cd, Pb and Cu from being absorbed by spinach, thus making spinach safer for consumption.

***Keywords*:** Enzymes, Food safety, Heavy metals, Iron-magnesium bimetallic biochar, Soil remediation.

SOIL HEAVY METALS CONCENTRATION AND HEALTH RISK ASSESSMENT IN PERI-URBAN AREAS OF GUJRANWALA, PAKISTAN

Matiullah Khan[1], Shoaib Ahmad[1], Rizwan Ahmad[1], Muhammad Mohsin Raza[1], Hafiz Imran Iqbal[1]

[1]Land Resources Research Institute, National Agricultural Research Center, Islamabad Pakistan

*Email: matiullah@parc.gov.pk

ABSTRACT

This study was undertaken to quantify pollution of heavy metals in arable soils irrigated with industrial effluent and other sources of waters and assess health risk for adults and children residing in peri-urban area of Gujranwala, Pakistan. Samples were randomly collected from soil irrigated with industrial effluent (SIE), canal water (SIC) and tube-well (SIT) and analyzed for chromium (Cr), Arsenic (As), Lead (Pb), Nickel (Ni), Cadmium (Cd) and Mercury (Hg) content using Atomic Absorption Spectrophotometer. The results showed that the heavy metals concentration in soil samples was as; SIE > SIC > SIT. It was noted that 100%, 60%, 43.3%, 33.3% and 13.3% of the SIE samples were above the permissible limits for Ni, Cr, Cd, Hg and Pb, respectively. Similarly, Ni, Cr, Cd and Hg were found on higher side in 68%, 18.2%, 18% and 13.3% of the SIC samples, respectively. Analysis of SIT samples showed that the content of Ni, Cd, As and Hg was on higher in 23.1%, 11,0%, 7.0% and 3.33% of the samples, respectively. The database developed was used for assessment of health risk in children and adults residing in the area. The result showed that children in all the soil categories were prone to non-carcinogenic risk due to Cr and Pb. In adults, Pb was found to be a major contributor for non-carcinogenic risk for inhabitants of SIE. In all the three soil categories, Ni and Cr showed potential carcinogenic risk both in adults and children. However, Cd showed slight carcinogenic risk for children of SIC. The study concluded that use of untreated industrial effluent has polluted soil and water resources which adversely affected health of the inhabitants.

Keywords: Heavy metals, Soil pollution, Health risk, Hazard quotient, Industrial effluent.

MICROPLASTICS IN SOIL: UNRAVELING IMPACTS ON SOIL HEALTH AND ENVIRONMENTAL QUALITY

Maha Saleem*[1], Neha Naqi[1], Hamna Iftikhar[1], Muhammad Adeel Akram[1], Ahmad Mahmood[1], Shakeel Ahmad[1]

[1]Department of Soil and Environmental Sciences, MNS- University of Agriculture, Multan

***Email:** saleemmaha814@gmail.com

ABSTRACT

Microplastics, particles measuring less than 5.0 millimeters in size, have emerged as a pervasive environmental concern, posing a significant threat to soil health and environmental quality. The presence of these contaminants can alter soil structure, exerting adverse effects on plant growth and health, and potentially acting as carriers for harmful substances such as pesticides or heavy metals. The introduction of microplastics into soil ecosystems also raises apprehensions regarding their impact on vital soil-dwelling organisms, crucial for nutrient cycling and soil fertility. Here, we focus on the bioaccumulation of microplastics in soil-dwelling organisms, particularly earthworms and invertebrates, and examine the potential cascading effects on the entire soil food web. Additionally, microplastics contribute to environmental pollution by leaching into water bodies, thereby affecting aquatic ecosystems. The long-term consequences of such contamination on biodiversity and environmental quality remain subjects of active research. Addressing the challenges posed by microplastics necessitates a comprehensive understanding of their sources, transport mechanisms, and ecological impacts. This prospective explores effective mitigation strategies, with a particular emphasis on the innovative approach of creating bricks from plastic waste. While this technique holds promise, it is acknowledged as part of a broader strategy to tackle plastic pollution. Comprehensive efforts, including reducing plastic consumption, enhancing recycling infrastructure, and promoting sustainable alternatives, are integral components of a holistic approach to mitigating the impact of microplastics on soil health and environmental quality.

***Keywords**:* Microplastics, Soil health, Environmental quality, Soil-dwelling organisms, Bioaccumulation, Mitigation strategies

DIFFERENTIAL INFLUENCE OF ZINC AND COPPER CONTAMINATED SIMULATED WASTEWATER ON GROWTH AND MINERAL QUALITY OF LETTUCE

Sanaullah[1], Dovile Motiejauskaite[1], Karolina Barcauskaite[1]

[1]Institute of Agriculture, Lithuanian Research, Centre for Agriculture and Forestry, Instituto al. 1, Akademija LT-58344 Kėdainiai, Lithuania

*Email: Sana.ullah@lammc.lt

ABSTRACT

Wastewater (WW) contains various heavy metals (HM) including copper (Cu) and zinc (Zn). Shortage of freshwater for irrigation compels farmers to use WW to overcome the shortage of freshwater. In addition, WW enriched with different nutrients necessary for plant growth and development, organic matter, and ease of disposal in sense of its use in agriculture. Copper and Zn are considered as essential micronutrients for plants at lower concentrations but become toxic at higher concentrations. Therefore, this experiment was aimed to assess the impact of higher levels of Cu and Zn contaminated simulated WW (SWW) on growth and mineral quality of lettuce. Total of four treatments were applied (i) control or uncontaminated SWW, (ii) Cu contaminated SWW (Cu 20 mg L^{-1}), (iii) Zn contaminated SWW (Cu 20 mg L^{-1}), and (iv) Cu+Zn contaminated SWW (Cu 20 mg L^{-1} + Zn 100 mg L^{-1}) to grown in pots filled with field soil. All four treatments were replicated thrice following completely randomized design and were allowed to grow in controlled condition of growth chambers. At maturity plants were harvested and analyzed for different growth and quality attributes. In results, Cu contaminated SWW significantly reduced the root dry weight, shoot dry weight, total dry weight and root length in comparison to un-contaminated control plants. Likewise, Cu contaminated SWW substantially diminished the mineral concentration in lettuce shoot in comparison to un-contaminated control. In contrast, addition of Zn to Cu contaminated SWW retrieved Cu toxicity, hence, improved growth attributes and mineral concentration (Mg, P, Ca, Mn, Fe) in lettuce shoot. Thus, Zn has potential to ameliorate the negative effects of Cu in crop plants when grown in highly Cu and Zn contaminated WW.

Keywords: Copper, Lettuce, Simulated wastewater, Zinc

HARNESSING BIOCHAR FOR SUSTAINABLE AGRICULTURE: A NOVEL APPROACH TO MITIGATE SMOG FROM RICE STRAW

Sajeela Sehar[1], Muhammad Arif[1], Mehwish Sana Ullah[1], Ayesha Ali[1], Najma Majeed[1], Minahil Athar[1], Nauman Hanif[1], Ahmad Mahmood[1]

[1]Department of Soil and Environmental Sciences, MNS-University of Agriculture, Multan

*Email: muhammad.arif@mnsuam.edu.pk

ABSTRACT

Smog, a pervasive form of air pollution, poses significant threats to both the environment and human health, with open burning of rice straw after harvest being a prominent contributor in regions like Southeast Asia. This practice releases harmful chemicals, including carbon monoxide, nitrogen oxides, and particulate matter, into the atmosphere, adversely impacting air quality and exacerbating climate change through the release of substantial amounts of carbon dioxide. To address this dual challenge, researchers are exploring the potential of biochar as an environmentally friendly solution. Biochar, a carbon-rich material produced through biomass pyrolysis, presents a promising alternative to traditional rice straw disposal methods. Unlike open burning, biochar production is an eco-friendly process that does not release harmful chemicals into the air. Moreover, biochar has demonstrated benefits beyond air quality improvement, including enhanced soil quality and carbon sequestration, contributing to climate change mitigation. This study investigates the viability of biochar as an innovative approach to reducing smog caused by rice straw burning. By exploring biochar's potential in lieu of conventional disposal methods, researchers aim to develop strategies that not only alleviate air pollution but also contribute to sustainable agriculture. The utilization of biochar presents an opportunity to tackle the intertwined issues of smog reduction and sustainable agricultural practices, leading to cleaner air, healthier communities, and a more resilient environment.

Keywords: Biochar, Rice straw, Smog, Air pollution, Sustainable agriculture.

IMPACT OF MICROPLASTICS ON SOIL PHYSIOCHEMICAL AND BIOLOGICAL PROPERTIES

Muhammad Nauman Hanif[1*], Tanveer-ul-Haq[1], Najma Majeed[1], Ayesha Ali[1], Muhammad Naeem Akhtar[2], Minahil Ather[1], Sajeela Sehar[1]

[1]Department of Soil & Environmental Sciences, Muhammad Nawaz Shareef University of Agriculture, Multan
[2]Pesticide Quality Control Laboratory, Multan, Institute of Soil Chemistry & Environmental Sciences, Kala Shah Kaku

*Email: muhammadnomihanif@gmail.com

ABSTRACT

Microplastics (MPs) have become a prevalent environmental pollutant, causing growing concerns regarding their effects on terrestrial ecosystems. MPs impact the characteristics of soil, the organisms living in the soil, and the plants. It also affects the intricate relationships within these crucial elements of terrestrial habitats. Plastics of various sizes, including macroplastics, mesoplastics, microplastics, and nanoplastics, have been observed to have a substantial impact on soil properties. They can modify several physical characteristics of soils, such as texture, structure, bulk density, water aggregate stability, water holding capacity, and rainwater infiltration. MPs can impact the chemical properties of soil by altering pH levels, electrical conductivity (EC), nutrient cycling, and enzyme activity. Additionally, they can induce the buildup of heavy metals in plants. The changes in soil properties have significant consequences for the overall well-being of ecosystems and the productivity of agriculture. Moreover, MPs significantly impact soil organisms, specifically earthworms, collembolans, and microbial communities of bacteria and fungi. These organisms have vital roles in the process of nitrogen cycling and the maintenance of soil health. Microplastics can disturb the natural habitats of organisms, influence their actions, and potentially cause alterations in the composition of soil organisms, resulting in far-reaching consequences across the terrestrial food chain. MPs impact the growth and development of plants, as they can be absorbed and transported inside the tissues of plants. These effects have an impact on both food safety and ecological dynamics. Efforts must be made to comprehend the urgency of the intricate interplay between MPs and terrestrial ecosystems. Additional investigation is required to evaluate MPs pollution's scope/fate thoroughly and its consequences in different soil types across varied environmental circumstances and regarding distinct plastic properties. Established protocols for investigating these interactions are crucial to enable meaningful study comparisons.

Keywords: Microplastics, Soil, Physical and biological properties

COMPARISON OF DIFFERENT VARIETIES OF MAIZE FOR HYPER ACCUMULATION AND TOLERANCE OF LEAD (Pb)

Ifra Saleem*[1], Qudsia Nazir[1], Nisa Mukhtar[1], Muhammad Nasim[1], Muhammad Aftab[1], Amina Kalsom[1], Farah Rasheed[1], Raheela Naz, Sarfraz Hussain[1]

[1]Soil Chemistry Section, Ayub Agricultural Research Institute, Faisalabad

*Email: ifrasaleem17@gmail.com

ABSTRACT

Heavy metal contamination is a serious environmental problem that limits crop production and threatens human health through the food chain. Lead (Pb) is the second most toxic heavy metal which causes a range of damage to plants from germination to yield formation. Phytoremediation is an *in situ* nondestructive technique, characterized by the utilization of hyper-accumulator plant species to remove the heavy metals from soil. This study was conducted at the Soil Chemistry Section, Institute of Soil Chemistry and Environmental Sciences, Ayub Agricultural Research Institute Faisalabad to evaluate the response of hybrid varieties against various levels of Pb. The five treatments viz. recommended dose (RD) of NPK, RD of NPK + 6 kg ha^{-1} Pb, RD of NPK + 12 kg ha^{-1} Pb, RD of NPK + 18 kg ha^{-1} Pb and RD of NPK + 24 kg ha^{-1} Pb in three replications were tested. Two different maize varieties (4040 and 30y87) were tested in RCBD factorial arrangement. The results clearly depicted that with the increase of Pb stress, grain yield decreased in both varieties. The results showed that minimum grain yield was observed in 30y87 (2.31 t ha^{-1}) compared to 4040 (2.61 t ha^{-1}) where RD of NPK + 24 kg ha^{-1} Pb was applied. The results showed that the Pb application significantly increased the Pb concentration and uptake in maize crop. The variety 30y87 showed more Pb concentration (7.0 µg g^{-1}) compared to 4040 (6.81 µg g^{-1}) in treatment RD of NPK + 24 kg ha^{-1} Pb. It is concluded from the results that different varieties of maize have different hyper-accumulation and tolerance potential towards Pb contamination. The variety (4040) showed more tolerance compared to variety (30y87).

Keywords: Heavy metals, Hyper-accumulation, Environmental pollution, Lead contamination.

MONITORING LAND DEGRADATION HOTSPOTS FOR MITIGATING SMOG IN PUNJAB USING MODERN GEOSPATIAL TECHNIQUES

Muhammad Danish Majeed[1*], Sultan Ahmad Rizvi[1], Obaid-ur-Rehman[1], Muhammad Adnan Shahid[3,4], Waqas Naseem[1], Sikandar Ali[3,4], Muhammad Usman Mohsin[2], Muhammad Safdar[3,4], Hifza Mariam[5]

1Soil and Water Conservation Research Institute, Chakwal- Punjab Pakistan
2Soil and Water Conservation Research Station, Fateh Jhang- Punjab Pakistan
3Department of Irrigation & Drainage, University of Agriculture Faisalabad- Punjab Pakistan
4Agricultural Remote Sensing Lab- NCGSA, University of Agriculture Faisalabad- Punjab Pakistan
5Smart Agriculture Department, Nanjing Agricultural University- Jiangsu China

*Email: kambohdanish@gmail.com

ABSTRACT

Erratic anthropogenic activities and severe climate change are damaging agriculture resources (i.e. soil, water & crops) and causing uncertainty in the world's weather patterns. Quick and accurate mapping of land degradation footprints is crucial for tracking agricultural emissions and promoting the development of sustainable agriculture. Pakistan is largely unexplored in assessing the amount and frequency of burning agricultural residue, despite its influence on the climate and ecosystem. Due to this untapped gap, Punjab province in Pakistan is facing a persistent smoggy climate due to extensive crop residue burning scenarios (i.e. specially during rice harvest). These burning events not only destroy soil productivity but also threaten the livable environment of soil microbes. Therefore, there is an urgent need to track out these non-climate friendly footprints using modern climate smart technologies such as EOs. In the adaptation of climate smart agriculture practices, Earth Observations (EOs) are pivotal in assessing the dynamics of agro-ecosystems. Assessment of land degradation parcels is accompanied in this study using multi-spectral and multi-temporal satellite data i.e. Sentinel, Landsat & MODIS. Detection methodology undertakes the virtual sampling from novel satellite data by acquiring burned/ degraded and unburned training sample. These training samples are then modeled in geospatial computational platforms (i.e. Google Earth Engine, GIS) to accurately estimate the degraded land parcels from others. Derived monthly agriculture burned hotspots (ABHs) will then be compared to existing global burned area products. As a preliminary assessment of possible emissions from ABHs in Punjab Pakistan, the obtained ABHs will be further used to calculate associated emissions from burning agricultural residue. Overall, the research indicates the potential of geospatial techniques to assess and quantify ABHs which can be undertaken for effective monitoring and mitigation of climate changing practices and to ensure healthy productivity of agroecosystems for sustainable agriculture development. Hence this study employs EOs to precisely trace out the land degradation events and have concluding suggestions for a resilient and climate smart agriculture in Punjab, Pakistan.

Keywords: Smog, Climate Change, Hotspots, Crop Residue, Land Degradation

UPTAKE OF CADMIUM AND LEAD BY WHEAT (*Triticum aestivum*) IN RESPONSE TO BIOCHAR IN DIFFERENT GROWING MEDIUM

Muhammad Moinudin[1], Muhammad Ahmar Amin[1], Muhammad Farooq Qayyum[1*]

[1]Department of Soil Science, Faculty of Agricultural Sciences & Technology. Bahauddin Zakariya University Multan

[*]Email: farooq.qayyum@bzu.edu.pk

ABSTRACT

Heavy metals, a significant problem in Pakistani soils, hinder nutrient absorption by plants, leading to reduced crop growth, development, and yields, contributing to food scarcity. Soil amendments, including Biochar (BC), derived from rice and wheat straw, offer a solution. This study aimed to assess the efficacy of rice straw biochar (BC) in mitigating the impact of heavy metals (Cd and lead) on wheat crop growth attributes. Two experiments, hydroponics, and pot (soil medium) were conducted to assess wheat growth under biochar application and heavy metal stress (Cd, Pb, or both). In the hydroponics experiment wheat was grown as a test crop while two factors were studied. The first factor was with BC (BC addition in form of hanging bags) and without biochar BC (control), while the second factor was heavy metal application (Cd, Pb, Cd+Pb). In the pot experiment, similar treatments were applied (1% rice straw BC and heavy metal application). In both experiments, agronomic, nutrient and metal uptake, and gas exchange characteristics were determined. The data of the hydroponics trial show that BC application significantly increased shoot length and plant biomass, with the maximum effect observed in Pb-treated pots. BC positively influenced gas exchange characteristics, enhancing CO_2 assimilation rate, transpiration rate, sub-stomatal CO_2, and stomatal conductance in both hydroponics and pot experiment. Additionally, BC significantly reduced Cd concentration in plant tissues. In the pot experiment, BC increased agronomic parameters such as plant height, number of tillers, spike height, soil electrical conductivity (EC), pH, plant biomass, and grain yield and effectively mitigated the adverse effects of heavy metals on wheat plants. The data further suggests that rice straw BC can mitigate the negative effects of Cd and Pb on plant growth and physiology, but not on metal accumulation in plant tissue.

Keywords: Wheat, Cadmium, Lead, Biochar, Hydroponics, Gas exchange.

COMPARATIVE EFFECTIVENESS OF ORGANIC AMENDMENTS FOR REDUCING LEAD (Pb) UPTAKE AND IMPROVING GROWTH AND YIELD OF LETTUCE (*Lactuca sativa*)

Maham Naeem[1,2*], Tayyaba Naz[1,2], Muhammad Saqib[1,2], Muhammad Anwar-ul-Haq[1,2], Muhammad Qasim[1,2], Muhammad Mazhar Iqbal[3], Iqra Ghafoor[1,2], Muhammad Umair[1,2]

[1]Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad
[2]Saline Agriculture Research Center, University of Agriculture Faisalabad
[3]Department of Soil and Environmental Sciences, University of Sargodha-Pakistan

*Email: mahamali1155@gmail.com

ABSTRACT

Soil heavy metal contamination is the global environmental problem. It is caused due to anthropogenic activities which result in the degradation of land resources and contamination of soil with heavy metals. Heavy metals enter the food chain and show drastic effects on human, animals and plants. These inhibit the growth and reduce the crop yield. Among heavy metals, lead (Pb) is a highly toxic metal that affects plants, animals and human. Lead hinders the crop growth and reduces the crop yield. Lead also lowers the transpiration, chlorophyll contents, water and protein contents and seed germination drastically. Organic amendments are the nourishing components for many crops and have been used to reduce the stress of heavy metals. Biochar, compost, and farmyard manure are used to remediate the Pb contaminated soil. These amendments are used to reduce the mobility of Pb in soil and enhance the productivity of crops. The main objective of this study was to assess the reduction of Pb toxicity and improve the yield of lettuce using organic amendments. A pot experiment was conducted in greenhouse at Institute of Soil and Environmental Sciences (ISES), University of Agriculture Faisalabad (UAF) to evaluate the comparative effect of organic amendments. Each pot was filled with 5 kg soil and was spiked with Pb (control, 50 mg kg^{-1} and 100 mg kg^{-1}). The application of biochar, compost and farmyard manure as treatments at (control and 1% kg^{-1}) into the soil was done. The experiment was conducted following a completely randomized design along with three replicates. To examine the recorded data statistical procedure used. Growth, physiological and ionic parameters were recorded by using the standard methods. The result showed the negative effect of Pb toxicity on the growth and yield of lettuce. Under normal condition, the growth and yield of the lettuce was high. Organic amendments significantly enhanced the growth and yield, and reduced the root and shoot Pb concentration in lettuce. Hence, it is concluded that organic amendments mitigated the effect of Pb toxicity and improved plant growth and yield.

Keywords: *Lactuca sativa,* Biochar, Compost, Farmyard manure, Heavy metal, Lead (Pb), Environment, Toxicity.

MICROEMULSION PRODUCTION AND FATTY ACIDS CHARACTERIZATION USING (*Serratia liquefaciens*) OLEAGINOUS STRAIN AS BIOREFINERY

Hira Abid*[1], Sobia Jabeen[1], Wajiha Naz[1], Syeda Aliza Naqvi[1], Irrum Shahzadi[1]

[1]Institute of Soil and Environmental Sciences, PMAS-Arid Agriculture University, Rawalpindi, Pakistan

*Email: abidhira27@gmail.com

ABSTRACT

Due to energy crisis and huge waste generation, there is a need to find suitable alternative to fossil fuels. Microbial biofuel is a viable option for biofuel production due to its complete independence from food crops and sustainability. However, finding a cheap substrate to lower the capital cost has been noted as one of the major obstacles to the commercialization of biofuel from oleaginous microorganisms. The production of alternate fuel can minimize environmental issues and decrease reliance on fossil fuels. This study will be conducted to evaluate the ability of various fruit wastes as substrate for accumulation of lipid in *Serratia liquefaciens*. In this study, previously isolated *Serratia liquefaciens* oleaginous strain will be used. The pre-treatment of the waste samples will be done with help of microwave at various parameters. The physicochemical properties of wastes will be analyzed such as chemical oxygen demand (COD), volatile solids (VS), total dissolved solids (TDS), electrical conductivity (EC), total solids (TS) and pH. The waste treatment experiment will be set up along with lipid accumulation. To conduct experiment of waste treatment, slurries will be made by mixing water with each pre-treated waste with a ratio of 1:19 (w/v). Lipid content will be identified using Bligh and Dyer method. The extracted lipids will undergo transesterification process. To further extend the study gas chromatography mass spectrophotometry will be used to identify the unknown components present in the produced biodiesel. This study will represent bio-refinery concept for the production of lipid-based biofuels and environmentally friendly waste management.

Keywords: *Serratia liquefaciens*, Oleaginous, Waste, Transesterification.

METHYLENE BLUE DYE ADSORPTION FROM TEXTILE WASTEWATER USING MODIFIED TEA WASTE ACTIVATED CARBON

Nayyab Nadeem*[1], Aniqa Batool[1]

[1]Institute of Soil and Environmental Sciences, Pir Mahar Ali Shah, Arid Agriculture University, Rawalpindi

*Email: nayyabnadeem98@gmail.com

ABSTRACT

In this innovative world of science and technology, wastewater treatment has become one of the biggest concerns. The discharge of industrial wastewater directly into water bodies cause disastrous effects on aquatic ecosystem. Adsorption technique has been recognized as environment friendly approach for the removal of contaminants from wastewater. Methylene Blue (highly irritant and toxic in nature) is a commonly used dye in paper and textile industries. The aim of this study is to produce a competent adsorbent for the maximum removal of Methylene Blue dye from textile wastewater that was collected from Kohinoor Textile Mills, Rawalpindi, Pakistan. The modified tea waste activated carbon was characterized through SEM, FTIR and XRD. Various optimization experiments were conducted to study the rate of adsorption of Methylene Blue dye using tea waste activated carbon. OFAT approach was used to study different parameters for MB dye assimilation. The obtained optimum conditions were applied on real wastewater and dye removal efficiency recorded was 91.5%. Furthermore, the used activated carbon was regenerated through thermal decomposition and used for adsorption experiment with 97.5% maximum dye assimilation under optimum conditions. Adsorption isotherm models were applied to study the favorability and overall performance of the adsorbent.

Keywords: Textile wastewater, Methylene blue dye, Tea waste, Activated carbon, Adsorption.

HEAVY METAL LOADS IN CANAL WATER AND WASTEWATER OF MULTAN CITY

Waleed Ramzan*, Ammara Basit, Shahid Hussain

[1]Department of Soil Science, Faculty of Agricultural Sciences and Technology, Bahauddin Zakariya University, Multan 60800, Pakistan

*Email: waleedramzan2@gmail.com

ABSTRACT

Wastewater, although beneficial for plant growth, may pose significant environmental and agronomic challenges when utilized for irrigation. Canal water is being contaminated with domestic and industrial wastewater that may potentially contain toxic heavy metals. This study aimed to comprehensively characterize and identify the heavy metal loads in two key canals—Nau Bahar and Muzaffarabad flowing through Multan city. For this, a total of 264 water samples from two canals and fourteen wastewater disposal stations were collected. To address temporal variations, the sampling protocol involved three days a week, comprising two weekdays and one weekend. Samples were collected twice a day with a gap of 12 hours to counter peak and off-peak hours. Irrigation water quality parameters, including electrical conductivity, pH, organic matter, and nutrients were determined. Furthermore, heavy metal concentrations were analyzed using an atomic absorption spectrophotometer following the standard methods. Results revealed that most of the heavy metals were close to the Food and Agriculture Organization (FAO) permissible limits. In conclusion, quality control and continuous monitoring of domestic and industrial effluents are imperative as they can raise concerns about human health and ecological stability.

Keywords: Canals, Environmental monitoring, Heavy metals, Wastewater, Water pollution.

EFFECT OF COMPOST AND VERMICOMPOST ON GROWTH AND YIELD OF CHILI (*Capsicum annuum* L.)

Saqib Bashir[1], Ayesha Siraj[2], Allah Bakhsh Gulshan[2], Saadullah Khan[2], Safdar Bashir[1]

[1]Department of Soil and Environmental Science, Ghazi University Dera Ghazi Khan
[2]Department of Botany, Ghazi University, Dera Ghazi Khan

***Email:** sbashir@gudgk.edu.pk

ABSTRACT

The uptake of trace elements from the soil by plants, leading to their accumulation in living organism and the subsequent exaggeration of these metals through food chains, raises concerns for both human being and the ecosystem. Organic soil additives are considered the carbon and nutrient rich source of organic additives that could ameliorate soil for Chili growth in organic matter deficient soils. A pot trial was organized to examine the influence of compost (CP) and vermicompost (VC) on the progress and yield of chili plants subjected to copper stress. Chili was selected as the trial plant and sown in each pot containing various CP and VC dose levels with followings treatments, T1 = control, T2 = 1.5% CP, T3 = 3% CP, T4 = 5% CP, T5 = 1.5% VC, T6 = 3% VC, and T7 = 5% VC. Each treatment was repeated thrice. The findings of the current study demonstrated that all the soil additives effectively enhanced the growth of chili plants, fresh and dry biomass, plant height, elevate chlorophyll content, as well as enhanced the NPK status in both soil and plant tissues, and increased chili fruit biomass and length. The current findings exhibited that soil pH considerably dropped by 0.38 and 0.45 units when CP and VC were applied at 5% rate compared to the control. Moreover, soil additives showed the substantial reduction in Cu mobility in soil by 34% and 53% when CP and VC were incorporated at 5% dose level. Likewise, the uptake of Cu by chili shoots (52% and 62%) and roots (37% and 49%) were decreased respectively when CP and VC were added at 5%. The maximum plant height was estimated by 55 cm when VC was applied at a 5% rate. Furthermore, both CP and VC incorporation exhibited the positive response led to increase levels of NPK in both soil and plant leaves against control.

Keywords: Chili, Compost, Vermicompost, Copper.

COMPARATIVE EFFECT OF ORGANIC AND INORGANIC AMENDMENTS ON GROWTH AND Pb UPTAKE OF SPINACH (*Spinacia oleracea*) GROWN IN Pb CONTAMINATED SOIL

Aqsa Rashid[1,2*], Tayyaba Naz[1,2], Zulfiqar Ahmad Saqib[1,2], Aysha Kiran[4], Maha Rashid[5], Muhammad Mazhar Iqbal[3], Iqra Ghafoor[1,2]

[1]Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad
[2]Saline Agriculture Research Center, University of Agriculture Faisalabad
[3]Department of Soil and Environmental Sciences, University of Sargodha-Pakistan
[4]Department of Botany, University of Agriculture Faisalabad
[5]Department of Botany, Govt. Murray Graduate College Sialkot

***Email**: aqsarashid325@gmail.com

ABSTRACT

Heavy metal contamination of agricultural lands causes major challenges to the ecosystem and adversely affects the plants. It has an impact on the environment in addition to the quality and productivity of crops, as well as the health of living organisms. The major sources include mineral extraction, excessive use of fertilizers and herbicides, sewage sludge and industrial waste. Among heavy metals, Pb is most hazardous due to its high persistence and toxicity. It lowers transpiration, inhibits enzymatic activities, seed germination, and alters membrane permeability. The uptake of lead from soil to the plants can be decreased using organic and inorganic amendments like biochar (BC), compost, di-ammonium phosphate (DAP) and gypsum. These amendments were applied alone and in combination to compare their efficacy for Pb immobilization. Spinach is among the most important nutritious vegetable crops, cultivated worldwide. The main objective of the study is to assess the reduction in Pb toxicity and improvement in the growth and yield of spinach (*Spinacia oleracea*) by applying organic and inorganic amendments in the presence of varying levels of Pb. A pot experiment was conducted in wire house at ISES, University of Agriculture Faisalabad (UAF) to evaluate the comparative effects of these amendments on Pb uptake in Spinach. It was carried out with 15 treatments and 3-replications. Each pot was filled with 5 kg soil and spiked with different concentrations of Pb (control, 50 mg kg^{-1} and 100 mg kg^{-1}). The application of biochar, compost, gypsum, and DAP as treatments (control, 1% kg^{-1}, 0.1% kg^{-1}) respectively were added separately as well as in combination of Pb into the soil. Completely randomized design was used along with 3-replications. Growth, ionic and physiological parameters were recorded using the standard methods. To analyze the recorded data, statistical software was used. The results depicted significant reduction in the growth and yield of spinach in the treatments where Pb toxicity was present. Under controlled condition, the growth and yield of spinach was high. However, it was concluded that the BC application has liming effect and resulted in improved growth and yield of spinach.

Keywords: *Spinacia oleracea,* Compost, DAP, Biochar, Gypsum, Heavy metal, Lead (Pb), Toxicity, Growth, Environment.

20th International Congress of Soil Science
"Soil Health: A Key to Food Security"

SUSTAINABLE AGRICULTURE: NAVIGATING CLIMATE CHANGE THROUGH SOIL REFORMING STRATEGIES

Rabeel Fatima[1]*, Muhammad Tahir Akram[1], Mehwish Liaquat[1]

[1]Department of Horticulture, PMAS-Arid Agriculture University, Rawalpindi 46300, Pakistan

*Email: rabeelfatima88@gmail.com

ABSTRACT

Globally, land degradation is a widespread occurrence, arising from natural soil erosion, human interventions, and the impacts of climate change. Soil, being a crucial source of sustenance and water, exhibits intricate interactions with climate dynamics. The anticipated global repercussions of climate change encompass shifts in soil fertility, alterations in physical, chemical, and biological soil properties, and changes in factors like soil density, temperature, and rainfall patterns. Elevated concentrations of greenhouse gases further exacerbate these effects. Rising temperatures induce soil salinization, depletion of organic matter, reduced soil porosity, and diminished fertility. Intense rainfall events contribute to soil compaction, soil acidification, and an increased susceptibility to erosion. Mitigating the impacts of climate change involves adopting measures to decrease greenhouse gas emissions, with a focus on effective carbon and nitrogen management. Additionally, implementing adaptive strategies is essential, encompassing the maintenance of optimal soil moisture and nutrient levels through practices such as zero tillage, crop rotation, judicious fertilizer application, and pest control adjustments. Implementing these changes can contribute significantly to minimizing the adverse effects of climate change on soil and fostering sustainable agricultural practices.

Keywords: Climate change, Crop rotation, Land degradation, Soil salinization, Zero tillage.

CARBON POOLS IN SURFACE AND SUBSURFACE SOIL LAYERS IN AN AGROECOSYSTEM IN RESPONSE TO POULTRY MANURE AND ITS BIOCHAR

Umm-e-Aiman fiaz[1] and Tanvir Shahzad[1]

[1]Dept. of Environmental Science, GCUF

Email: aimanfiaz58@gmail.com

ABSTRACT

Soil Organic Carbon yields a requisite scale to measure soil health alongside its indispensable impact on biological, physical, and chemical properties that are conducive to a sustainable ecosystem that soil can render. This study was designed to evaluate the impact of poultry manure and biochar extracted from it on a survey area extending up to 75 cm deep soil indicators. It included a panoptic field study and keenly monitored experiments lasting for a prolonged period of two years with an objectifying wheat-maize rotation. Before sowing, each crop was treated with 2 tons/ha of poultry manure and its biochar harboring multiple treatment frameworks. Several treatments were employed, including not-amended non-planted, not-amended but planted, poultry manure added with planted/non-planted, and poultry manure biochar added with planted/non-planted. The above treatment techniques were rigorously surveyed to study carbon sequestration dynamics and their influence on soil health, fertility, and agronomic productivity. The hypothesis was constrained by the assumption that the soil strip exposed to poultry manure and its biochar would indicate the paramount capability of carbon sequestration. Such behavior was evident from exalted values of treatments like Microbial Biomass Carbon (MCB) and SOC parameters in comparison to control groups, entailing poultry manure-extracted biochar e.g. PMB-NP showcased higher MBC (20.19%) and SOC (18.69%) values contrasted to control (NA-NP – MBC 14.41%, SOC 9.8%). To illustrate it further, PM-NP had a higher nitrate value (27%), and coetaneous, lower nitrate levels in NA-NP (12.02%). Conspicuous enzymatic activity of beta-glucosidase and leucine aminopeptidase, comprising a striking depth of 45cm, made them pivotal in the experimental study with PMB-NP (22.16%) and PMB(-NP.P) (20%) values in that order. This research is established on the foreground of quality of soil indicators when tended with poultry manure and biochar extracted from poultry manure, illustrating their aptitude to facilitate carbon sequestration, condition calcareous soil, exalt agro-productivity, and boost agroecosystems enacting CO_2 sink.

Keywords: Soil organic carbon, Poultry manure and its biochar, Wheat-maize crop, Microbial biomass carbon, Agronomic productivity, Soil health.

MICROPLASTIC POLLUTION: AN EMERGING CHALLENGE TO SOIL HEALTH AND AGRICULTURE SUSTAINABILITY

Ahsan Qureshi[1], Shakeel Ahmad[1*], Muhammad Arslan Asir[1], Muhammad Sulaiman[1], Mohammad Wasim[1], Muhammad Yasir[1]

[1]Department of Soil and Environmental Sciences, MNS-University of Agriculture, Multan

*Email: shakeel.ahmad@mnsuam.edu.pk

ABSTRACT

Microplastics, defined as minute plastic particles, often measuring less than five millimeters but extending to the nanoscale, present a new and alarming challenge to the foundational elements of our future – soil health and agricultural sustainability. The infiltration of these insidious particles into agricultural soils stems from various sources, encompassing fragmented agricultural plastics, sludge application, windblown deposition, runoff, river transport, and direct disposal into oceans. Agroecosystems are estimated to receive between 1.15 to 2.41 million metric tons of plastic waste annually, disrupting the delicate equilibrium of the soil ecosystem and affecting its physical, chemical, and biological properties. The presence of microplastics in soil raises significant concerns regarding their impact on agriculture and soil health, as they have the potential to alter soil characteristics, disrupt vital processes, and diminish overall fertility. Microplastics enter soil through diverse pathways, including plastic decomposition, contaminated water irrigation, and the use of plastic mulch, leading to their absorption by plants and accumulation in edible parts. Given that a myriad of essential microorganisms crucial to nutrient cycling and general soil health resides in the soil, potential interactions between these microbes and microplastics may influence their abundance and activity, thereby disturbing critical soil processes. These disturbances result in reduced plant growth, compromised yields, and pose a threat to food security for an expanding global population. Furthermore, microplastics introduce the risk of food chain contamination, potentially infiltrating agricultural produce and posing long-term health risks to consumers. Understanding the multifaceted impacts of microplastic pollution on soil health is imperative for devising effective mitigation strategies and safeguarding the foundations of sustainable agriculture in the face of this emerging challenge. Concerted efforts, encompassing rigorous research, policy implementation, and individual action, are necessary to pave the way for a future where fertile soils and sustainable food production coexist harmoniously with a healthy planet.

Keywords: Microplastics, Soil pollution, Soil health, Food security, Sustainable agriculture.

EVALUATION OF NITRATE CONTENTS AND ASSOCIATED ENVIRONMENTAL ISSUES IN ENERGY DRINKS AVAILABLE AND CONSUMED IN PAKISTAN

Sadia Bibi[1*], Sana Saud[1], Saifullah[1], Muhammed Sabir[1], Sidrah Ashfaq[2]

[1]Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad-38040
[2]Department of Farm Machinery and Power, University of Agriculture, Faisalabad-38040

*Email: Sadia_15565@yahoo.com

ABSTRACT

Energy drinks are formulated with a variety of substances (such as caffeine, chemicals derived from nitrates, vitamins, calcium, magnesium, and zinc, amino acids etc.) that temporarily boost levels of energy within the body. Despite the fact that these chemicals are well-known, nitrate is one of the main components that may be found in energy drinks. Athletes who take nitrate might expect a boost in both their muscle power and their ability to withstand energetic exercise. Nitrate exposure over an extended period of time has been shown to have negative effects on human health. The ingestion of energy drinks has seen a huge increase among young people over the course of the previous several years, notably among students and athletes. Consuming energy drinks not only speeds up the heart rate and improves the efficiency of the heart, but it also reduces blood flow to the brain. In light of what has been said above, we have conducted an experiment with the purpose of determining the concentration of nitrate ions in a variety of energy drinks that are on the market in Pakistan. The UV-Visible spectrophotometric approach was utilized in order to conduct the analysis in 20brands of energy drinks for the concentration of nitrate and physicochemical properties such as (pH, electrical conductivity (EC), and total dissolved solids (TDS). Results showed that B-7 brand has highest amount of nitrate (71.07 mg/l) followed by < B-3(70.43 mg/l) < B-18 (67.97 mg/l) < B-12 (67.70 mg/l) < B-19 (67.68 mg/l) < B-15 (67.50 mg/l) < B-2 (67.47 mg/l) < B-17 (67.06 mg/l) < B-5 (65.98 mg/l) < B-8 (65.63 mg/l) < B-10 (65.30 mg/l) < B-9 (65.24 mg/l) < B-20 (65.05 mg/l) < B-11 (64.45 mg/l) < B-6 (64.28 mg/l) < B-14 (62.81 mg/l) < B-13 (62.50 mg/l) < B-1 (56.92 mg/l) < B-16 (13.20 mg/l) all were above from WHO limit except B-16. The results revealed that EC in all energy drinks samples were in recommended level except B-3, B-13 and B-19. The pH of every sample taken from the f brands was higher than the WHO's acceptable range, same trend was observed in case of TDS. At different body weights 40, 60 and 80 kg in (0.25 and 0.5 liter) ingestion rate all energy drinks samples showed that HQ are less than 1 and EDI were within the permissible limit at both ingestion rates. At 40 and 60 kg body weight carcinogenic risk were found above 10^{-6} and at 80 kg body weight there is no risk of cancer.

Keywords: Athletes, Total dissolved solids, Hazard quotient, Cancer risk.

SALINITY AND WATER STRESS INTERACTION IN *Acacia ampliceps*

Qandil Shafiq[1], Muhammad Saqib*[1], Muhammad Saad Bin Zafar[1], Tayyaba Naz[1], Muhammad Nauman Sattar[1], Noman Zahid[1], Amina Abdul Rahim[1], Nain Tara Mushtaq[1], Samra Sattar[1], Aysha Abid[1], Laraib Noor[1]

[1]Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad

***Email:** m.saqib@uaf.edu.pk

ABSTRACT

In Pakistan, 6.67 mha of land is salt-affected, which greatly impacts plant productivity and other physiological processes. Currently, 30% of cultivated land is under degradation due to salinity which causes a reduction in the growth, and yield of crops and land use. Besides salinity, drought and waterlogging are also considered the worst abiotic stresses occurring frequently due to the change in climate that adversely affect both the soil and plants. The study aimed to evaluate the interactive effect of abiotic stresses on the growth and physiological parameters of *Acacia ampliceps.* A pot trial was conducted. Two weeks old seedlings of *Acacia ampliceps* were transplanted with two levels of salinity (normal and 30 dS m^{-1}) and three levels of water (normal Irrigation with respect to saturation percentage, half irrigation with respect to saturation percentage, and double irrigation with respect to saturation percentage) with three replications in two-factor completely randomized design. The growth and physiological parameters were recorded after the four months of transplantation. The results were analyzed using the statistical software Statistix 8.1. The results showed that the interactive effect of salinity and water stress affected the plant height, stem diameter, number of leaves, and relative water content. However, chlorophyll content and MSI remained unaffected and showed similar results under all treatments. The Na^{+} concentration was higher under salt stress. *Acacia ampliceps* can be recommended to grow under salt-affected conditions with additional stresses of waterlogging and drought.

Keywords: Acacia ampliceps, Drought, Waterlogging, Salt-affected

ENHANCING CLIMATE-SMART AGRICULTURE AND GLOBAL FOOD SECURITY THROUGH EFFECTIVE SOILMANAGEMENT

Rahila Akhtar[1], Umme Aiman[1], Abdullah Shafi[1], Farhat Ullah Amar Matloob[1], Ahmad Mahmood*[1]

[1]Department of Climate Change, MNS-University of Agriculture, Multan, Pakistan

*Email: ahmad.mahmood@mnsuam.edu.pk

ABSTRACT

In the realm of sustainable agriculture, the pivotal role of soil management is undeniable, particularly within the context of climate-smart practices. As global climates undergo unprecedented changes, the imperative to adopt strategies ensuring both agricultural productivity and resilience to these shifts becomes paramount. This discussion explores the critical nexus between soil management and climate-smart agriculture, examining techniques and principles contributing to environmental sustainability and agricultural viability. Climate change impacts on agriculture emphasize the need for climate-smart practices in soil management. Agricultural activities significantly contribute to greenhouse gas emissions, particularly methane and nitrous oxide. Improved soil management can mitigate these emissions through practices such as cover cropping and reduced tillage. Unsustainable farming practices can degrade soil quality, reducing its ability to support crops. Climate-smart soil management practices aim to reverse land degradation by enhancing soil fertility and structure. Furthermore, climate change can exacerbate water scarcity, impacting agricultural productivity. Soil management practices like conservation tillage and improved irrigation efficiency play a crucial role in water conservation and sustainable agriculture. Increasing frequency and intensity of extreme weather events, such as droughts and floods, pose challenges to agriculture. Climate-smart soil management builds resilience by improving water retention and promoting adaptive crop varieties. Greenhouse gas emissions and climate-related changes can lead to altered temperature and precipitation patterns, impacting crop growth and reducing yields. Changes in temperature and humidity patterns create favorable conditions for the proliferation of pests and diseases, posing additional challenges to crop health. Certain soil management techniques, such as agroforestry and conservation tillage, contribute to carbon sequestration, mitigating climate change by capturing and storing carbon in the soil. Sustainable soil management also preserves biodiversity, fostering a balanced ecosystemthat supports beneficial organisms contributing to soil health. In conclusion, soil management plays a pivotal role in the success of climate-smart agriculture. Adopting sustainable practices such as cover cropping, crop rotation, and organic amendments enhances soil health, increases resilience to climate change, and contributes to carbon sequestration. Implementing precision agriculture technologies further optimizes resource use. A holistic approach to soil management ensures food security while mitigating the impact of agriculture on climate change, promoting a more sustainable and resilient agricultural system for the future.

Keywords: *Soil management, Climate-smart agriculture, Sustainable practices, Resilience, Carbon sequestration, Food security*

ASSESSING MICROPLASTIC CONTAMINATION AWARENESS AND KNOWLEDGE: A COMPARATIVE STUDY BETWEEN URBAN HEALTH PROFESSIONALS AND RURAL FARMERS IN PENANG, MALAYSIA

Vanitha Thurairasu*[1]

[1]Department of Public Health, Perak State Health Department, Perak, Malaysia

*Email: nitha_5@yahoo.com

ABSTRACT

Microplastic contamination in the food supply chain is a pressing global concern, with potential health implications. Understanding the awareness and knowledge levels among different populations is crucial for effective mitigation. This study aimed to assess and compare the awareness and knowledge of microplastic contamination among urban health professionals based in Georgetown and rural farmers from Balik Pulau in Penang, Malaysia. In this cross-sectional comparative study, a total of 100 participants, comprising 50 health professionals and 50 farmers, were enrolled. Data collection involved structured questionnaires and semi-structured interviews. These instruments were designed to gauge participants' awareness and knowledge levels regarding microplastic contamination in food sources. In this study, an unexpected pattern emerged where rural farmers displayed significantly higher levels of knowledge regarding microplastic issues compared to urban health professionals. Specifically, 90% of the farmers were already aware of microplastics, in contrast to only 12.5% of health professionals. Additionally, 80% of the farmers expressed serious concerns about the health effects of microplastics. The thematic analysis revealed an obvious contrast in awareness and knowledge of microplastics between urban health professionals and rural farmers, with the latter group demonstrating a significantly higher understanding of microplastic sources and associated health risks. Urban health professionals' understanding of microplastics was found to be limited, likely due to restricted access to relevant information and a lack of focused education on the subject. These findings underscore the importance of targeted educational efforts for urban health professionals to bridge the knowledge gap and raise awareness about microplastic contamination in food sources.

Keywords: Microplastics Contamination, Awareness, Health Professionals, Farmers, Educational Interventions

OTHERS

PROSPECTS OF HYDROGEL TO IMPROVE WHEAT YIELD IN RAINFED AGRICULTURE

Rahina Kausar[1*], Obaid-ur-Rehman[2], Ayesha Malik[1], M. Usman Mohsin[1] and Muhammad Rashid[3]

[1]Soil and Water Conservation Research Station, Fateh Jang (Pakistan)
[2]Soil and Water Conservation Research Institute, Chakwal (Pakistan)
[3]Soil Fertility Survey and Soil Testing Institute, Rawalpindi (Pakistan)

[*]Email: rahinaawan@gmail.com

ABSTRACT

The application of soil additives to improve soil properties and water productivity has sparked attention, particularly in arid and semi-arid environments. Present study was conducted during 2018-2021 at village Pindsultani tehsil Fateh Jang with objectives to evaluate the impact of soil polymer on soil moisture conservation, wheat yield and physico-chemical characteristics of soil. The treatments were arranged in RCBD design including, No hydrogel application T1(control), Hydrogel application by seed drill T2 (seed drill), Hydrogel application by broadcast T3(broad cast). The finding of this experiment revealed that soil moisture retention increases from 21 to 50 % compared with control and the application of hydrogel increased wheat yield from 2721 to 3825 kg ha^{-1}. Consistent significant increase of moisture conservation during four years of the study revealed that the application of Hydrogel had positive effect on soil moisture conservation, soil properties, growth and yield of wheat which enhance the profitability of the farmers of Pothowar region. Hence use of hydrogel as a soil conditioner will be a productive option for increasing sustainable agricultural production in moisture-stressed environment.

***Keywords*:** Soil polymer; water holding capacity; rainfed area; wheat yield

COMPARATIVE EVALUATION OF BIOGAS ENRICHMENT BY USING DIFFERENT TECHNIQUES

Muhammad Usman Mohsin[*1], Obaid-ur-Rehman[2], Rahina Kausar[1], Ayesha Malik[1] and Muhammad Danish Majeed[2]

[1]Soil and Water Conservation Research Station, Fateh Jang
[2]Soil and Water Conservation Research Institute, Chakwal

* Email: iamshan661@gmail.com

ABSTRACT

Biogas is a renewable fuel source and can be used as an alternative to fossil fuels and natural gas if purified adequately. Biogas is produced by anaerobic digestion (AD) of organic matter and contains methane (35-70%), carbon dioxide (20-65%), water vapors (5-10%), hydrogen sulfide (0.004-2.5%) and some other impurities. After upgrading, it can be stored in cylinders and can be used as vehicle fuel. There are many biogas enrichment techniques. A comparative evaluation of different upgrading techniques has been performed. In this study, pressurized water scrubbing system and chemical method of biogas purification was evaluated. Data collected about different performance parameters at different pressures, flow rates and temperature and at different column heights and diameters. Results were analyzed by statistical methods and compared with other data collected from another biogas plant site. The efficiency levels of H_2S gas removal were 21.5 % in 0.72 m column height and 0.254 m diameter as compared to the other levels of column height. Interaction of H_2S removal efficiency at different column height and diameter with respect to days taken was also significant in this experiment. Maximum H_2S removal was observed when data was recorded after 10 days of applying CaO treatment. According to analysis, maximum CO_2 removal was observed in treatment when data was recorded after 45 minutes. According to analysis, maximum O_2 removal was observed in treatment when data was recorded after 45 minutes. The efficiency levels of gas removal were 86.96 % in 2.44 m column height and 0.6 m diameter as compared to the levels of column height. Results revealed that water scrubbing was less effective as compared to chemicals removal by CaO and NaOH. Chemical enrichment was the best purification technique to get maximum biomethane as compared to pressurized water scrubbing technique.

Keywords: Biogas, biogas enrichment, biogas purification, biomethane, renewable energy

ADVANCING SOIL HEALTH MANAGEMENT THROUGH GIS AND REMOTE SENSING: A SUSTAINABLE APPROACH

Najma Majeed[1], Muhammad Imran[1], Sajeela Sehar[1], Minahil Ather[1], Ayesha Ali[1], Mehwish Sana-ullah[1], Muhammad Sulaiman[1], Muhammad Nauman Hanif[1], Ahmad Mahmood*[1], Tanveer ul Haq[1]

[1]Department of Soil and Environmental Sciences, MNS-University of Agriculture Multan

*Email: ahmad.mahmood@mnsuam.edu.pk

ABSTRACT

Soil, a vital non-renewable resource, plays a crucial role in supporting ecosystems worldwide by providing essential services such as nutrient cycling, water filtration, biodiversity support, and climate regulation. Maintaining soil health is imperative for both human welfare and the well-being of ecosystems. Traditional soil analysis methods are labour-intensive, time-consuming, and costly. To overcome these challenges, Geographic Information System (GIS) and remote sensing have emerged as powerful tools for efficient soil health management. Unsustainable land management practices, including intensive agriculture, deforestation, and pollution, contribute to soil degradation, resulting in fertility loss, increased erosion, and diminished water quality. However, embracing practices that emulate natural ecosystems can regenerate degraded soil, enhance agricultural productivity, improve water quality, bolster climate resilience, and promote biodiversity. We emphasize the utilization of GIS for monitoring and managing soil health, offering valuable insights for land management interventions. GIS facilitates the analysis and monitoring of soil fertility, land assessment, and nutrient availability. Serving as a centralized platform, GIS streamlines the storage, access, and analysis of soil data, enabling the identification of trends and patterns to inform decision-making. Automation of tasks, such as data collection and reporting, through GIS can significantly save time and resources. Moreover, GIS generates clear and concise maps and visualizations of soil health data, enhancing communication and collaboration among stakeholders. The integration of remote sensing further strengthens the monitoring and management of soil health. By combining these technologies, a comprehensive solution for sustainable land use and agriculture can be established. While the potential benefits are significant, it is crucial to recognize that technical expertise is essential for the effective implementation and utilization of GIS.

Keywords: GIS, geographical information systems, soil health, remote sensing,

SOIL HEALTH IN A CHANGING CLIMATE: CHALLENGES AND MITIGATION STRATEGIES FOR SUSTAINABLE AGRICULTURE

Ayesha Ali[1], Shakeel Ahmad[1*], Minahil Athar[1], Sajeela Sehar[1], Najma Majeed[1], Muhammad Nauman Hanif[1], Mehwish Sana Ullah[1], Ahsan Qureshi[1], Ahmad Mahmood[1]

[1]Department of Soil and Environmental Sciences, MNS-University of Agriculture, Multan.

*****Email**:** shakeel.ahmad@mnsuam.edu.pk

ABSTRACT

Soil health, defined as the ongoing capacity of soil to function as a dynamic living system within ecosystem and land use boundaries, is integral to sustaining biological productivity, ensuring air and water quality, and promoting the health of plant, animal, and human communities. This paper addresses the formidable challenges that changing climate conditions pose to soil health and explores innovative mitigation strategies for sustainable agriculture. Climate change threatens soil health and food production through processes such as soil desertification, deforestation, and erosion, altering carbon and nitrogen dynamics, nutrient availability, and soil biodiversity. The escalating global temperatures and shifting precipitation patterns contribute to increased greenhouse gas (GHG) emissions, with China and the US being major global contributors. Projections suggest a potential 2-4°C temperature increase by the end of the century, exacerbating current challenges. Elevated temperatures and precipitation alterations result in the loss of soil organic carbon (SOC), negatively impacting soil health, fertility, and biodiversity. Weather extremes, including wet and drought events, contribute to soil erosion, causing a 10%-20% decrease in agricultural production and compromising soil health. This prospective emphasizes the pivotal role of soil health in sustainable agriculture and underscores the urgency to adopt effective mitigation strategies. Conservation practices, such as no-tillage (NT) and conservation tillage systems (CTS) within the conservation agriculture (CA) framework, offer a pathway to enhance soil health and productivity. Practices like minimal soil disturbance, continuous plant residue cover, extended crop rotations, and cover crops promote soil health indicators, including soil carbon sequestration. Mitigation strategies range from amendments and suitable irrigation practices to cultivating tolerant genotypes and employing phytoremediation, conservation agriculture, and bioremediation techniques. Economic and policy incentives play a crucial role in encouraging farmers to adopt climate-resilient technologies, reducing GHG emissions, and improving soil health for a sustainable agricultural future. This prospective calls for a holistic understanding of soil health and advocates for the implementation of these strategies to build resilience and sustainability in agriculture amid a changing climate. By safeguarding soil health, we ensure not only food security for future generations but also the preservation of vital ecosystem services, promoting a healthier planet.

Keywords: Climate change, soil health, sustainable agriculture, mitigation strategies, soil carbon sequestration, food security, conservation agriculture.

SOIL-ROOTSTOCK INTERACTION- AN IMPORTANT PHENOMENON THAT DETERMINES THE ABOVE-GROUND TREE PERFORMANCE

Naeem Akhtar[*1], Ghulam Muhammad[1], Danish Majeed[1] and Obaid ur Rehman[1]

[1]Soil and Water Conservation Research Institute Chakwal

***Email:** naeemakhtar117@gmail.com

ABSTRACT

Rootstocks play a crucial role in food production by influencing plant growth, nutrient uptake, disease resistance, and adaptability to diverse environmental and soil conditions. They can enhance crop yields, improve water and nutrient efficiency, and provide resistance to soil-borne pests. Like the above-ground environmental interaction of scion stock, the soil and rootstock interaction cause various physiological reactions in plants, which can change the chemical composition of trees and, as a result, the plants behave differently in various soil conditions. Rootstocks affect a scion's generative and vegetative performance, such as productivity, span of nonbearing period, growth vigor, shelf-life, and quality of fruits. It affects tree performance via the development and extent of the root system, determining water and nutrient uptake and adaptability to ecological conditions like tolerance to frost, drought, calcareous soils, soil pH, salt, waterlogging, soil-borne pests, and diseases. The unsuitability of the environment and diverse types of soil are the main factors for fruit orchards; therefore, the adaptability of the rootstock to soil conditions is the main priority. Different rootstocks may have varying abilities to access and assimilate nutrients, influencing the overall health and productivity of the plant. Some rootstocks exhibit preferences for particular pH ranges, and matching them appropriately can enhance plant performance. Certain rootstocks may be better suited to acidic soils, while others thrive in alkaline conditions. It's essential to consider the soil pH of a given planting site and choose a rootstock that is well-matched to that pH range to ensure optimal nutrient availability and overall plant health. Drought-tolerant or disease-resistant rootstocks may also be preferred to mitigate challenges associated with poor soil quality. Additionally, the well-adopted rootstocks to diverse soil types can enhance the plant's ability to thrive in varying and even nutrient-challenged environments.

Keywords: Rootstock, Soil environment, Adaptability, Nutrition, Quality

SUSTAINABLE MANAGEMENT OF AGRICULTURAL BYPRODUCTS: A STRATEGIC APPROACH TO BOLSTER FOOD SECURITY AND MITIGATE CLIMATE CHANGE

Minahil Athar[1], Usman Jamshaid[1], Ayesha Ali[1], Najma Majeed[1], Sajeela Sehar[1], Mehwish Sana Ullah[1], Muhammad Noman Hanif[1], Ahmad Mahmood[1]

[1]Department of Soil and Environmental Sciences, MNS-University of Agriculture, Multan

***Email:** usman.jamshaid@mnsuam.edu.pk

ABSTRACT

The escalating global demand for food, driven by a burgeoning population, has led to intensified agricultural production, resulting in an increased reliance on fertilizers. This heightened agricultural output poses environmental and health risks, with an estimated 70% of plant nutrients globally sourced from fertilizers. The excessive use of fertilizers, coupled with the burning of agricultural waste such as crop residues and organic matter, releases greenhouse gases into the atmosphere, contributing to global warming, air pollution, and other environmental concerns. Here, we address the intricate relationship between agricultural production, waste generation, and climate change, emphasizing the imperative to optimize the management of agricultural byproducts. Inefficient waste disposal not only depletes valuable resources but also significantly increases greenhouse gas emissions. Adopting eco-friendly and sustainable waste management practices emerges as a crucial strategy to mitigate the adverse impacts of climate change. Strategically managing agricultural waste can be a substantial bio-resource for enhancing food security. Various techniques, including composting of crop residues, offer the potential to create nutrient-rich organic matter, improving soil fertility and structure while minimizing reliance on synthetic fertilizers. Additionally, innovative methods such as biochar production, biofertilizers, and bio stimulants derived from waste materials can enhance nutrient uptake and promote plant growth. This prospective underscore the importance of proper agricultural waste management, demonstrating its potential to mitigate climate change impacts. Utilizing waste-derived products in precision agriculture practices not only increases yields to meet food demand but also contributes to sustainable nutrient management, minimizing environmental degradation.

Keywords: food security, global warming, air pollution, crop residues, composting, biochar, biofertilizer, bio stimulants, precision agriculture.

BIODEGRADATION OF AN EMERGING MICROPOLLUTANT, DICLOFENAC FROM WASTEWATER

Farzana Kausar[1] and Irrum Shahzadi*[1]

[1]Institute of Soil and Environmental Science PMAS AAUR

*Email: irrumshahzadi879@gmail.com

ABSTRACT

Diclofenac (DCF) is a polycyclic nonsteroidal and the anti-inflammatory (NSAID) medicine that is extensively identified in the environment due to its excessive usage Diclofenac has been included in the first watch list of European Union of water because it is chemically stable and has low biodegradability. It poisons the surface water and has negative impact on the non- target organism of environment. This pharmaceutical chemical is emitted from hospitals, households, and pharmaceutical businesses. Because diclofenac is chemically stable and resistant to biodegradation, conventional approaches have been ineffective in removing it from water. Excessive discharge of this antibiotic in wastewater is an emerging issue. About 8-10 samples of wastewater will be collected from the twin cities Rawalpindi and Islamabad. These samples will be analyzed for the presence of Diclofenac, pH, Electrical Conductivity (EC), Total dissolved Solvents (TDS), Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD). Bacteria capable of degrading diclofenac will be isolated through enrichment, Mineral Salt Media (MSM). Based on the ability to degrade diclofenac 3-4 most efficient strains will be selected for subsequent studies. Degradation rate will be measured by using Spectrophotometer at wavelength of 260nm. Lab scale bioreactor will be designed. Degradation identification will help to develop the bioremediation strategy for wastewater containing the Diclofenac. Bioremediation of diclofenac by selecting efficient bacterial strains could be used effectively for the removal of harmful emerging micropollutants like diclofenac from wastewater.

Keywords: Diclofenac; Domestic wastewater; Bio treatments; Indigenous bacterial strains

SUBSTRATE MODIFICATION FOR OPTIMAL PRODUCTION OF BIODIESEL BY OLEAGINOUS *SERRATIA* SP.

Sobia Jabeen[*1], Wajiha Naz[1], Hira Abid[2], Syeda Fatima Zainab[3], Irrum Shahzadi[4]

[1]Institute of Soil and Environmental Science PMAS AAUR

*Email: aimaunirfan723@gmail.com

ABSTRACT

The rise in global temperature can be attributed to anthropogenic activities that generate greenhouse gas emissions needed to meet growing energy demands. Global environmental change and the detrimental impacts of air pollution on human health have contributed to a rising awareness of the consequences of modern society's reliance on fossil fuels, creating global concerns about the identification of environmentally sustainable renewable energy sources. The study's aim is to harness the potential of pretreated organic waste materials as a highly efficient substrate for the optimal accumulation and storage of bio-lipids within the cellular biomass of a previously isolated oleaginous bacterial strain. Eggshells and agricultural waste hold enormous potential as a fuel for the generation of biodiesel by using Oleaginous Serratia sp. To achieve the greatest potential lipid accumulation capability, pretreatments (physical and chemical) will be used. The treatment procedure will involve steam explosion of organic wastes combined (5g) with diluted acid at temperature range of 160-260°C and corresponding pressures between 5-50 atm for a short period of time. MW irradiation substrates must first be treated with NaOH and H_2SO_4 at concentrations of 0.5% and 1% (w/v) at 160°C for 10 min. Organic wastes will be hydrolyzed in 5% (v/v) H_2SO_4 at 121 °C for 30, 60, and 90 minutes as part of the chemical pretreatment process. A thorough and complex pathway for biofuel production will be established, by purifying and extracting the bio lipids, followed by an acid-catalyzed transesterification procedure to return the fatty acid methyl esters to their lipid precursor forms and the detection of FAME sample's components through GC-MS.

Keywords: Biodiesel, Oleaginous Serratia, Agriculture waste, lipid accumulation

ASSESSMENT OF HEAVY METALS IN COMMON POLLINATORS IN URBAN & PERI-URBAN AREAS

Syeda Aliza Naqvi*[1], Sobia Jabeen[1], Wajiha Naz[2], Hira Abid[3], Irrum Shahzadi[4]

[1]Institute of Soil and Environmental Sciences, PMAS-AAUR.
[2]Institute of Soil and Environmental Sciences, PMAS-AAUR

*Email: allizanaqvi148@gmail.com

ABSTRACT

The increasing bioaccumulation of harmful heavy metals in pollinators has raised concerns about the threats it poses to both pollinator well-being and ecosystem stability. This study aims to evaluate the escalating bioaccumulation of hazardous heavy metals in pollinators, raising concerns regarding their impact on pollinator health and ecosystem stability. Focused on typical pollinator species in urban and suburban areas of Islamabad, the research endeavours to elucidate the role of these insects as indicators of environmental pollution. Sampling will encompass both urban and peri-urban locations to collect pollinator specimens. These samples will undergo a meticulous digestion process before analysis through Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES) to quantify concentrations of heavy metals. By assessing heavy metal levels in these pollinators, the study seeks to broaden our comprehension of the perils associated with heavy metal contamination. Consequently, this insight will play a pivotal role in formulating conservation strategies aimed at safeguarding pollinator populations and sustaining overall ecosystem health. Ultimately, the findings will contribute significantly to bolstering our knowledge base, facilitating the development of robust measures to counteract the threats posed by heavy metal pollution to pollinators and ecosystem stability.

Keywords: Bioaccumulation; Heavy metals; Pollinators; ICP-OES.

BIOELECTRICITY GENERATION BY BACTERIAL DEGRADATION OF FRUIT PEEL WASTES IN DUAL CHAMBER MICROBIAL FUEL CELL

Wajiha Naz*[1], Sobia Jabeen[1], Hira abid[2], Syeda Aliza Naqvi[1]

[1]Institute of Soil and Environmental Sciences, PMAS-AAUR.
[2]Institute of Soil and Environmental Sciences, PMAS-AAUR

*Email: wajihanaz16@gmail.com

ABSTRACT

Organic waste is an environmental issue throughout the world. Similarly, production of energy using fossil fuels is causing serious environmental problems. Hence in this study, it is proposed to use organic waste as substrate in dual chamber microbial fuel cell to produce bioelectricity. This organic waste poses health effects and pollution load in an ecosystem. Thus, poor organic waste management contributes to climate change and air pollution. Landfills with organic waste produce methane gas. Communities have immediate negative impacts from pollutants that arise from landfilling organic waste, like nitrogen oxides and particulate matter causes lung and heart diseases in human beings. They also trigger asthma, heart attacks, bronchitis, and other respiratory problems. The study will be designed to produce bioelectricity through fruit peel waste which will be collected from the fruit juice shops of Rawalpindi and Islamabad. The peel waste used in MFC will be processed into dried fruit peel powder and fruit peel slurry. The fruit peel slurry will be prepared, and characterization of the substrate will be performed. Previously isolated Serratia liquefaciens and Serratia surfactant strains fresh culture will be prepared along with dried fruit peel powder and fruit peel slurry wastewater will be used as a substrate at anodic biocatalyst. The optimization of factors like pH (5-9), temperature (25-45 oC), fruit peel slurry (40ml/L-80ml/L) and dried fruit peel powder (20g/L-60g/L) will be studied. MFC will be constructed, operated and voltage, electric current will be characterized. Therefore, utilization of organic waste to produce bioelectricity would help to reduce environmental pollution.

Keywords: Bioelectricity; microbial fuel cell; fruit peel wastes; Waste to energy

EVALUATION OF OXYGEN EVOLUTION REACTION (OER) AND HYDROGEN EVOLUTION REACTION (HER) IN ELECTROCATALYTIC TREATMENT OF CONTAMINATED WASTEWATER

Sajida Perveen*, Irrum shahzadi[1], Syeda Fatima Zainab[2], Muzammil Anjum

[1]Institute of Soil and Environmental Science, PMAS-Arid Agriculture University, Rawalpindi, Pakistan

*Email: sajidabasit277@gmail.com

ABSTRACT

Industrial developments in the country have led to serious environmental and human health impacts due to release of endocrine disrupting chemicals (EDCs) in the water bodies. The need for efficient wastewater treatment processes has sparked that incorporate cutting-edge electrochemical technology. Since conventional wastewater treatment method are costly and multistep procedure. Therefore, a wastewater treatment based on the three-electrode system i.e., counter, reference and working electrodes, for Oxygen Evolution Reaction (OER) and Hydrogen Evolution Reaction (HER) will be investigated. About 5–6 wastewater samples will be collected from industrial discharge channel (Nalah Laii) in I-10, Islamabad, and their physico-chemical parameters such as pH, total suspended solids (TSS), Total dissolved Solids (TDS), chemical oxygen demand (COD), biological oxygen demand (BOD). The Pd based material, bi-metallic (NiCo1, CoFe, NiFe) and tri-metallic (NiCo2Fe1, Ni2Co1Fe2) materials will be synthesized for wastewater treatment and characterization of synthesized materials will be carried using different techniques such as Cyclic Voltammetry (CV), Linear Sweep Voltammetry (LSV), Scanning Electron Microscopy (SEM), and X-ray Diffraction (XRD). The electrochemical treatment will be performed at different scan rates and voltages using potantiostate. The study will achieve efficient treatment of EDC containing wastewater and could be used for further applications.

Keywords: Electrocatalyst synthesis; Electrocatalytic treatment of wastewater; Electrochemical reactions, Oxygen evolution reactions, Hydrogen evolution reactions.

OPTIMIZING PECAN-BASED ACTIVATED CARBON ADSORPTION THROUGH RESPONSE SURFACE METHODOLOGY FOR ENHANCED WASTEWATER TREATMENT AND ITS IMPACT ON PEA PLANT GROWTH

Konain Khurshid*[1], Muzammil Anjum[1], Rab Nawaz[2]

1 Environmental Sciences, Institute of Soil and Environmental Sciences, PMAS-Arid Agriculture University, Rawalpindi, Pakistan
2 Department of Earth Sciences and Environment, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600, Bangi, Selangor, Malaysia.

Email: konainsanober511@gmail.com, muzammilanjum@uaar.edu.com

ABSTRACT

Wastewater is produced by a variety of industries, including the pharmaceutical industry, which includes contaminants such as heavy metals, organic contaminants, etc. This study aimed to develop an efficient process of adsorption through a modified pecan shell-based activated carbon to get rid of heavy metals from pharmaceutical wastewater. The modification of the pecan shell-activated carbon was accomplished by using $FeCl_2$ and $FeCl_3$. The modified activated carbon was further characterized using various methods, including Scanning Electron Microscopy (SEM), Elemental Analysis (EDX), X-ray diffraction (XRD), Fourier Transform Infrared Spectrometer (FT-IR), and Vibrating Sample Magnetometer (VSM). A batch experiment was conducted to perform adsorption, and response surface methodology was used to optimize various operating parameters such as absorbent dose (g/L), pH, contact time (min), and temperature (°C). Cadmium (Cd), copper (Cu), and lead (Pb) were selected for removal from pharmaceutical wastewater. To examine the effect of plant growth, the treated wastewater was analyzed in a pot experiment using two types of pea seeds, i.e., P-2009 and Climax. The efficiency of the removal of Cd, Cu, and Pb using iron-modified pecan shell-based activated carbon was 94%, 93%, and 94.3%, respectively, under optimum conditions (Adsorbent dose 0.6g/L, pH 11, contact time 65min, and temperature 35°C). The treated wastewater showed efficient results in plant growth. In a novel approach, this study employed pecan-based activated carbon modified with iron for enhanced metal removal in pharmaceutical wastewater, showcasing a promising eco-friendly solution for sustainable water treatment.

***Keywords*:** Adsorption, Response Surface methodology, Pot experiment.

EFFICIENT REMOVAL OF DIBUTYL PHTHALATE FROM WATER USING SINGLE-LAYERED AND COMPOSITE ELECTROCATALYTIC ELECTRODES DEVELOPED FROM (CO, Fe, Mn) OXIDES AND HYDROGEN PRODUCTION

Shafi Ullah[*1], Rab Nawaz[2], Muzammil Anjum[1], Sammia Khurshid[1], Azeem Khalid[1], Shahid Mahmood[1], Rai Muhammad Amir[3]

[1]Environmental Sciences, Institute of Soil and Environmental Sciences, PMAS-Arid Agriculture University, Rawalpindi, Pakistan
[2]Department of Earth Sciences and Environment, Faculty of Sciences and Technology National University of Malaysia, 43600 Selangor, Malaysia
[3]Institute of Food and Nutritional Sciences, PMAS- AAUR; Pakistan

ABSTRACT

Endocrine disrupting chemicals (EDCs) are the pollutants having serious environmental and human health effects even at low concentrations, they have a major impact on the quality of the water. Dibutyl phthalate (DBP) affects the human endocrine system and is harmful to the environment when present in wastewater systems. The electrocatalysis method has shown to have a high efficiency for degrading a variety of organic substances in wastewater. In the present study, a single-layered electrocatalytic electrode developed from (Co, Fe, Mn) oxides, double-layered composites of (CoFe, CoMn, FeMn) oxides, and CoFeMn nanocomposite were developed as working electrode to removal of DBP in water. Different analytical methods, such as FTIR, UV-Visible, were used to characterized the nanocomposite. The presence of organic bond linkage in the cobalt, iron, and manganese complex is confirmed by peaks at 3442 and 1606 cm^{-1}. Furthermore, at 363–378 nm and 380 nm, respectively, the CoFeMn strong absorption peaks was observed. The samples of wastewater were collected from two plastic industries and analyzed for physicochemical properties, organic constituents including phthalates (GC-MS), and heavy metals (ICP-OES). linear sweep voltammetry (LSV), Cyclic voltammetry (CV), and electrochemical impedance spectroscopy (EIS) were used to investigate the electro oxidation of materials in 0.01M KOH solution in order to look into the catalytic effectiveness of nanoparticles. According to experimental findings, a voltage gradient of 50 v/cm^{-2} was applied to each material for 10 minutes in order to achieve the significant removal effectiveness of DBP. According to the findings, hydroxyl radical (•OH) production in the electrocatalytic electrode, which can be employed as a substitute for an alternative energy source, was also demonstrated to be a key role in the degradation of DBP. When compared to the binary materials, the material CoFeMn had the maximum removal effectiveness of phthalates, according to the electrochemical testing. The electrochemical performance of modified electrodes made of CoFeMn Oxide nanocomposite has been carefully examined and optimized, demonstrating its good catalytic activity for pollutant oxidation.

Keywords: *Electrocatalysis, Nano materials, EDCs, Phthalates, HER, OER*

UTILIZATION OF BENZOPHENONE CONTAMINATED WASTEWATER AS SUBSTRATE FOR MICROALAGE TO PRODUCE BIOLIPIDS

Fatima Zainab*[1], Sobia Jabeen[1], Wajiha Naz[1], Hira Abid[1], Syeda Aliza Naqvi[1], Irrum Shahzadi[1]

[1]Institute of Soil and Environmental Sciences, PMAS-AAUR

*Email: gillanifatimazainab@gmail.com

ABSTRACT

Clean Environmental Conditions are necessary for survival but unfortunately environment is being polluted by many contaminates one of the pollutants are Benzophenone derivatives which are being released from the wastewater of household, paint, food, cosmetics, and synthetic industries. The higher concentration of this pollutant affects the quality of surface and groundwater. This contaminated wastewater should be treated prior to their discharge into water bodies to conserve the life of aquatic organisms and human beings. Present study has been designed with the aim to isolate the algae species having the ability for the degradation of benzophenone derivatives. Algae sample will be collected from freshwater lake (Rawal and Swaik), I-9 treatment plant and Nullah Lai. The wastewater will be analyzed for different physiochemical parameters like Electrical Conductivity (EC), pH, Total Dissolved Solids (TDS), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD). Algae will be isolated by using Bold's Basal medium. Scanning Electron Microscopy and Atomic Force Microscopy. Algae will be screened based on benzophenone degradation, lipid accumulation, and lipid content of these algal strains will be identified through Bligh and Dryer method. Similarly, the effect of various environmental conditions such as pH, Temperature, Nutrient and Aeration will be examined to optimize degradation process. Transesterification of the extracted lipids will be carried out. This study will be helpful in identification of effective algal strains that would assist to develop bioremediation strategy for wastewater containing benzophenone derivatives and it would be a viable option for the treatment of the wastewater and for biofuel production.

Keywords: Benzophenone Degradation; Algae; Transesterification; Biofuel

CONFERRING DROUGHT STRESS TOLERANCE IN MUNG BEAN THROUGH MICROBES: A SUSTAINABLE SOLUTION FOR CLIMATE CHANGE

Hafsa Maqsood[1], Rimsha Sharif[1], Najma Majeed[1], Tehreem Fatima[1], Muhammad Noman Sheeraz[1], Muhammad Arif[1], Muhammad Ahmad Mahmood[1]

[1]Department of Soil and Environmental Science, Muhammad Nawaz Shareef University of Agriculture, Multan

*Email: rimshasharif27@gmail.com

ABSTRACT

Impact of drought stress on mung bean production and the role of microorganisms in conferring drought stress tolerance in mung beans. The importance of mung beans as a high-value nutritive crop and the challenges faced by farmers due to drought stress. It reduces photosynthetic rate and gamete function through oxidative damage and has a profound impact on nutrient uptake by plant root systems along with water due to reduced root growth during drought. The use of plant growth-promoting bacteria (PGPB) to increase mung bean tolerance to drought stress. PGPB can produce beneficial metabolites such as auxin and amino acid 1-aminocyclopropane-1-carboxylate (ACC) deaminase, which can increase plant tolerance to drought stress. PGPB can also alter levels of proline, a protein genic amino acid in plants, derived from the amino acid L-glutamic acid. PGPB can colonize the rhizosphere of plants and promote plant growth by increasing the availability of essential nutrients when used on the plant surface or in the soil and seeds. The use of PGPB can be a sustainable solution for climate change by increasing mung bean yield, quality and ensuring food security in regions where mung bean is commonly grown. They contribute to climate change adaptation, greenhouse gas (GHG) mitigation, and soil carbon sequestration. Microorganisms play an important role in sustainable agriculture and climate change mitigation. Microbial bio stimulants may reduce heat stress in crops by reducing reactive oxygen species (ROS) levels and increasing antioxidant activity. Soil microbes are impacted by climate change, and understanding them is important for maintaining soil health and ecosystem processes. The reintroducing efficient microbial strains into soil is thought to play an important role in restoring soil ecosystems for sustainable agriculture.

***Keywords*:** PGPBs, Mung bean, Microbes, Bio inoculants, Plant-microbe interactions.

PROSPECTS OF BIOCHAR USE IN AGRICULTURE FOR FOOD SECURITY AND ENVIRONMENTAL SUSTAINABILITY

Utam Chand[1], Tanveer Ul haq[1], Muhammad Talha Zubair[1], Syed Bayazeed[1], Mustafa Kamal[1], Attiya Muneer[1], Fizza Batool[1], Hafiz Shahzed Ahmad [1], Najma Majeed[1]and Ayesha Ali[1]

[1]Department of Soil and Environmental Sciences, MNS-University of Agriculture, Multan

*Email: tanveer.ulhaq@mnsuam.edu.pk

ABSTRACT

Biochar is a carbon enriched stable material derived from the pyrolysis of any organic material in absence or limited supply of oxygen at high temperatures (300 - 1000˚C). Biochar is emerged as a key amendment to improve soil health and plant growth. It is reported that the worth of global Biochar market was US$ 261.3 million in 2020 and it will reach to US$ 477.4 million by the end of 2027. The addition of biochar increases soil carbon footprint through carbon sequestration in the face of climate change. Furthermore, biochar improves soil fertility, cation exchange capacity, nutrient holding capacity and nutrient availability, soil water retention, microbial community, buffering capacity, and mitigation of pollution and salinity. The humic substance in biochar plays a crucial role in promoting the aggregate stability and soil hydraulic conductivity. The unique surface properties of biochar make it a desirable nanomaterial, especially for the remediation of heavy metals, polychlorinated biphenyls, polycyclic aromatic hydrocarbons, and herbicides in soils. Similarly, the ability of biochar to immobilize contaminants leads to environmental management and sustainability. Therefore, biochar is an eco-friendly, renewable, and value-added product that not only improves soil quality but also promotes the growth of crops, and beneficial soil microbes, ultimately benefiting humans and ensuring the global food security. Therefore, there is a huge scope and potential for soil and environmental sustainability by promoting the biochar business in the developing countries.

***Keywords*:** Biochar; Soil health; Carbon sequestration; Environmental sustainability; Pollution management

IMPACT OF SOIL EROSION ON AGRICULTURAL SUSTAINABILITY AND FOOD PRODUCTION

Attiya Muneer[1], Muhammad Arif[1], Syeda Rahab Zahra Bukhari[1], Fizza batool[1], Utam Chand[1], Minhal Naveed[1], Iqra zahoor[1], Aliha yaqub[1]and Amna rafique[1]

[1]Department of Soil and Environmental Sciences, MNS-University of Agriculture Multan

***Email:** muhammad.arif@munsum.edu.pk

ABSTRACT

Soil erosion is a significant threat to the sustainability of agriculture and the production of food of the world wide. While the damaging of soil through erosion has been caused by the water wind, other forms of soil degradation are induced by biological, chemical, and physical processes. The erosion process has a detrimental impact on soil health by removing the top fertile layer, disrupting the structure, microbial activity, and reducing the nutrients, erosion disrupts hydrological cycles, impact of soil erosion on crucial aspects of agriculture, causing yield reduction, economic loss and threating food security. In order to address this issue effectively, it is crucial to incorporate sustainable agricultural practices and prioritize the management of soil erosion, like conservation practices, the adoption of innovative technologies, precision farming, the use of cover crops, agroforestry, crop rotation, the establishment of contour plowing, the implementation of mulching, all important strategies in mitigating erosion. Sustainable land management practices play a significant role in mitigating the impacts of erosion. Looking towards the future, The implementation of conservation practices is essential in preserving soil health, sustaining agricultural productivity, and promoting the overall resilience of ecosystems. It is also crucial for ensuring long-term food security in the face of evolving environmental challenges. This abstract examines the negative effects of soil erosion on agricultural sustainability and productivity. Therefore, focusing on the conservational practices that ensure the agricultural sustainability and food security for future generations.

Keywords: Soil erosion; Sustainable agriculture; Food security

EVALUATING INCIDENCE OF ARSENIC CONTAMINATION IN GROUNDWATER USING GIS AND GEOSTATISTICAL NORMS IN MULTAN

Shah Rukh[1]*, Ahmad Khan[2], Ayaz Mehmood[3], Muhammad Imran[4], Humair Ahmed[5], Kouser Majeed Malik[6]

[1]National Centre of Excellence in Geology, University of Peshawar-25130, Peshawar, Pakistan
[2]PARC-National Tea & High Value Crops Research Institute, Shinkiari, Mansehra, Pakistan
[3]Department of Soil and Climate Sciences, The University of Haripur Pakistan
[4]Department of Soil and Environmental Sciences, Muhammad Nawaz Sharif University of Agriculture Multan
[5]Land Resources Research Institute, NARC, Islamabad, Pakistan
[6]Soil and Water Testing Laboratory for Research Rawalpindi, Pakistan

***Email:** shahruk@gmail.com

ABSTRACT

It is estimated that eighty percent of total Pakistani population doesn't have access to safe drinking water. Arsenic contamination in drinking water poses a serious threat to human health. This study was conducted in the 6th most populous city, Multan, of Pakistan to evaluate the arsenic content in the groundwater. One hundred and nine groundwater pumping sites were selected for inspection of their arsenic content. About 51.38 percent of analyzed samples were found unsafe for drinking, when compared with the threshold level of 10 mg/L established by World Health Organization (WHO). Arsenic content in the ground water ranged from 0.00 to 69.81 mg/L with the mean value of 13.61 ±12.48. Semi variogram model indicated that arsenic content in the groundwater were found strongly spatial dependent as the nugget to sill ratio was less than 25%. Ordinary krigingmeanselling also indicated low mean error value and very close root mean square error and average standardized error. Aarithmic maps were prepared to classify the whole city area into differential arsenic contents. Kriged maps indicated that about 50.06 percent of the total area of Multan city has arsenic content higher than 10 µg/L.

Keywords: Ground water contamination, arsenic toxicity, drinking water, Spatial distribution of arsenic.

GREEN BUILDINGS AS A SOLUTION TO CHANGING CLIMATE; A PERSPECTIVE FOR PAKISTAN

Haseeba Bibi[1], Muqarrab Ali[1], Muhammad Imran[1], Ahmad Mahmood*[1], Amar Matloob[1] and Tanveer ul Haq[1]

[1]Department of Climate Change, MNS-University of Agriculture, Multan, Pakistan.

***Email:** ahmad.mahmood@mnsuam.edu.pk

ABSTRACT

Climate change has permeated various facets of life, affecting the atmosphere, lithosphere, hydrosphere, biosphere, and significantly impacting housing and infrastructure. The escalating dependence on artificial cooling, heating, lighting, and air conditioning has given rise to an increased carbon footprint, compromised air quality, inadequate ventilation, and the proliferation of diseases. In response to these challenges, the integration of the green building concept emerges as a crucial solution. Green buildings, constructed with intelligent materials and technologies, not only elevate the quality of life but also contribute to environmental enhancement. By reducing reliance on fossil fuels, these structures play a pivotal role in restoring ecological balance. Anthropogenic activities, deforestation, carbon dioxide emissions, and the trapping of greenhouse gases contribute to climate change. Environmental awareness, coupled with the adoption of green buildings and eco-friendly technologies, can serve as effective mitigation strategies. The repercussions of climate change, such as biodiversity loss, rising sea levels, droughts, and extreme weather events, underscore the urgency of proactive measures. Unregulated construction in peri-urban areas of Pakistan exacerbates climate change through energy-intensive material production, waste generation, increased energy demand, and heightened greenhouse gas emissions. Green building elements, including smart windows, eco-friendly lighting, rainwater harvesting, insulation, air quality sensors, lighting control systems, water sensors, radiant floors, recycling facilities, and solar panels, emerge as critical tools in addressing these environmental challenges. Pakistan is actively promoting green buildings and sustainability through initiatives like the Green Building Council of Pakistan, which provides certification training programs and campaigns. Building codes introduced by Pakistan mandate adherence to specific environmental and energy efficiency standards. The National Energy Conservation Building Code, established in 2017, sets energy standards for new constructions. Presently, Pakistan boasts 17 LEED certified green buildings, with 13 registered with the US Green Building Council and 31 green buildings in total. Deforestation and inadequate waste management contribute to pollution, underscoring the importance of green buildings in improving indoor air quality, reducing energy consumption, minimizing environmental impacts, and lowering greenhouse gas emissions. Sustainable building solutions encompass green roofs and walls, smart water conservation technologies, renewable energy adoption, waste reduction, afforestation, air and water quality enhancement, natural resource restoration, eco-friendly practices, sustainable transportation, and recycling. In conclusion, green buildings are indispensable for eco-friendly management to mitigate environmental effects. Enhancing natural light, indoor air quality, and the overall natural environment fosters healthier relationships between people and the planet.

Keywords: Eco-friendly; Artificial Cooling; Green building and Weather Events.

ASSESSMENT OF SOIL CHARACTERISTICS IN THE VICINITY LANDS OF KHAUR OIL FIELD, ATTOCK, PUNJAB

Tehreem Nawaz[1]*, Aniqa Batool[1], Muzammil Anjum[1], Zia ur Rehman Mashwani[1]

[1]Institute of Soil and Environmental Sciences, PMAS-Arid Agriculture University, Rawalpindi, Pakistan

*Email: tehreemnawaz721@gmail.com

ABSTRACT

Soil is an important part of the environment and plays a vital role in the growth and maintenance of plants and animals. Oil fields could be a major source of soil contamination. Oil and gas production activities can release oil, gas, and other chemicals into the environment. These chemicals can contaminate soil and water resources. In this study, soil characteristics of the vicinity lands of Khaur Oil Fields, Attock, Punjab are being analyzed. A total of 9 composite soil samples were collected from different directions of Oil Field including agricultural fields near oil field storage site and from the barren land near working and non-working oil drilling wells. These samples were analyzed for moisture content and bulk density which showed the variation in the values. The samples were first air dried and then oven dried at 103℃ for 48 h and then subjected to the respective methods to check bulk density and moisture content in the samples. For moisture content, soil was first weighed then oven dried and then again weighed to check the difference and there was a significant difference in the values. While for bulk density, the samples were collected in a metal ring of known length and radius then oven dried, and the values were then observed after putting values into formula. Further analysis of physio-chemical characteristics of soil like Ph, texture, structure, nitrate nitrogen, available phosphorus, TOC, microbial biomass carbon and heavy metals will be performed.

***Keywords**: soil sampling, atomic absorption spectrometry, khaur Oil Field

COMPARATIVE EFFECTIVENESS OF BIOCHAR AND COMPOST IN AMELIORATING DROUGHT STRESS IN *FICUS CARICA* L.

Sehrish Saboor Khan[1], Mazhar Rafique[1], Ali Raza Gurmani[1], Bushra Gul[2], Zahoor Ahmad[1]

[1]Department of Soil & Climate Sciences, Faculty of Physcial and Applied Sciences, The University of Haripur, Haripur, Khyber Pakhtunkhwa, Pakistan
[2]Department of Biosciences, University of Wah, Rawalpindi, Punjab, Pakistan

*Email: sehrishswati@gmail.com

ABSTRACT

Drought negatively impacts the growth and production of fruit crops because it alters a variety of morpho-physiological and biochemical processes. Without harming the climate, organic amendments are crucial for the development of plants under drought stress. In this study, pot experiment was performed in a completely randomized design to evaluate the efficiency of chicken manure biochar (CMB), sawdust biochar (SDB) and vermicompost (VC) to mitigate drought stress in Fig (*Ficus carica* L.). The CMB (0.25% in soil), SDB (0.25% in soil) and VC (2.5% in soil) were applied as different treatments to 5 kg soil in each pot as per treatment plan. Plant growth was monitored for four months, and various physiological parameters were evaluated such as relative water content (RWC), membrane stability index (MSI), rapid test of drought tolerance (DTI), chlorophyll fluorescence (ChlF), relative water deficiency (RWD) and chlorophyll content (SPAD). The RWC were maximum (39%) in CMB treatment under drought stress as compared to SDB that had 34% and 30.67% in VC treatment respectively. Similarly, results showed that MSI for CMB was maximum 85% than other amendments including SDB having MSI 80% and SDB 77%. It was also observed that CMB had relatively high DTI of 0.16% than VC 0.13% while SDB has relatively less DTI 0.10%. Similarly, CMB and SDB had high SPAD values of 6.3% followed by SDB having SPAD values of 4.9%. The ChlF was maximum for CMB 0.84nm and under drought 0.71nm followed by SDB (0.73nm) and under drought (0.64nm). Maximum RWD was observed for Drought Treatment (79.6%) followed by Control (74.6%). Thus, on basis of these results, organic amendments assisted plant to survive and grow under drought stress conditions.

***Keywords*:** Drought, Organic amendments, Fig, Chicken manure biochar (CMB), Sawdust biochar (SDB), Vermicompost (VC)

EFFECT OF FARMYARD MANURE ON SOIL MOISTURE CONTENT GROWTH AND CHEMICAL COMPOSITION OF CHILLI (*CAPSICUM ANNUUM* L.)

Maqsood Ahmed Soomro[1], Khalid Hussain Talpur[1], Ghulam Murtaza Jamro[1], Niaz Hussain Wahocho[2], Rabania Janat[1]*

[1]Department of Soil Science, Sindh Agriculture University Tandojam, Pakista[2]Department of Horticulture, Sindh Agriculture University Tandojam, Pakistan

***Email:** rabaniajannat@gmail.com

ABSTRACT

A significant threat to agricultural productivity is considered drought. To grow crops and increase productivity, maintaining soil quality is important. To maintain the soil health, farmyard manure is a sustainable supply of essential macro- and micronutrients. Additionally, FYM helps to keep soils moist while requiring less water on different crops. In view of the significance of FYM, a pot experiment was conducted at greenhouse department of soil science, to evaluate the effect of farmyard manure on soil moisture content, growth, and the chemical composition of chilli *(Capsicum annuum L.)*. This study involved a two-factorial, completely randomized design, including Factor A, Field Capacity Moisture Levels (FCML), FCML1: 50%, FCML2: 75%, and FCML3: 100%. Factor B is farmyard manure (FYM). Five kilograms of soil from arable land in drought-affected areas of Badin were used in a pot experiment involving the local chilli variety "Kunri chilli.". The moisture levels were maintained every third day until the chillies were harvested. Most growth parameters (plant height, fresh and dry weights of plants, number of leaves, leaf area, and root biomass g) were reduced as field capacity moisture levels decreased. When compared to not having FYM treatments, the effect of FYM was greatest at a 75% moisture level, followed by 100% and 75% similar trends were observed for nutrient contents (N, P, and K) as for growth parameters. However, N, P, and K concentrations were found in adequate range at 75% and 100% moisture levels with FYM in plant tissue, including leaves, stems, roots, and the whole plant. However, in soil N, P, K, and organic matter % in soil was significantly affected by the interaction of farmyard manure application, there was no significant difference between 75% FCML and 100% FCML. In case of 50% FCML with FYM significantly increase P content in soil. The application of FYM increased the amount (%) of saved water as compared to without it; in terms of water savings, 57% more water was saved due to the use of FYM. It is concluded that applying FYM at a moisture level of 75% could help mitigate drought effects on chilli plants.

***Keywords*:** FYM, Field Capacity Moisture, Chilli

LEAF AND PSEUDOSTEM RATIOS ON BANANA WASTE COMPOST EFFECT ON COMPOST QUALITY AND THEIR RESPONSE TO GROWTH AND CHEMICAL COMPOSITION OF MAIZE

Attaullah Ansari[1], Ghulam Murtaza Jamro[1], Zia ul Hassan Shah[1], Ahmed Naqi Shah[2], Durshana Khan Khanzada[1], Zahida Junejo[1*]

[1]Department of Soil Science, Sindh Agriculture University Tandojam, Pakistan
[2]Department of Agronomy, Sindh Agriculture University Tandojam, Pakistan

*Email: junejozahida@gmail.com

ABSTRACT

Bananas generate huge amount of wastes (e.g. leaf and pseudostem) which are typically burnt or discarded on roadsides, and they can cause serious environmental damage. To avoid environmental damage, these wastes could be composted due to high nutrient contents. However, banana wastes (BW) may differ in chemical composition which may also alter compost quality. In view, banana waste based composts were prepared involving different ratios of leaf (L) and pesudostem (Ps) including L100:Ps0, L:75:Ps25, L50:Ps50, L25:Ps75 and L0:Ps100 using handheld method. The results indicated that the ratio of banana leaf and pseudostem in banana waste composts altered nitrogen (N), phosphorus (P) and potassium (K) contents. The N (%) was signficantly greater in leaf (3.19%) as compared to pseudostem (2.98%). With decreasing amount of leaf in ratio of materials for composts, N (%) was signficantly reduced. Generally P content found the lowest in waste these materials. The P was signficantly greater in pseudostem than leaf. The maximum K (5.22%) found in L50:Ps50 BW composts, whereas minimim K (3.99%) was found in L100:Ps0. Leaf had alkaline pH (T1:8.35), whereas pseudostem had slighlty acidic pH (T5: 6.55). At L50:Ps50, pH was 7.5. The maturity test indicated that L50:PS50 matured (86.0°F) before any other compost material. Later on in pot expirement, all measured agronomic parameters highly influenced by ratio of leaf and pseudostem in BW based composts. The maximum growth parameters were found in L50:Ps50 compost than any other compost treatment regardless of recommended chemical fertilizer which showed overall greatest growth parameters as compared to control and compost treatments. The maximum N content found in plant at L50:Ps50 compost and minimum was in control followed by sole pseudostem compost. The P content in maize was non-significantly altered by ratio of leaf and pseudostem composts. The greatest K content found in L0:Ps100 (1.6%) followed by L25:Ps75 (1.4%) and RDF (1.2%). The OM content (%) was significantly influenced by treatments. The highest organic matter content (%) found in treatment having ratio of L50:Ps50 followed by L100:Ps0. It is concluded that alerting ratio of leaf and pseudostem in compost can alter quality of compost and consequently chemical composition and growth of maize.

Keywords: Compost, Banana waste, Nutrients, Maize

EFFECT OF NITRAPYRIN COATED UREA ON NITROGEN USE EFFICIENCY IN MAIZE

Atiya Rajput[1], Ghulam Murtaza Jamro[1], Javaid Ahmed Shah[2], Durshana Khan Khanzada[1], Attaullah Ansari[1] and Hina Panhwar[*1]

[1]Department of Soil Science, Sindh Agriculture University Tandojam, Pakistan
[2]Nuclear Institute of Agriculture Tandojam, Pakistan

***Email:** hina-pervaiz@gmail.com

ABSTRACT

Nitrogen use efficiency (NUE) plays a key role in improving maize production. Considering the significance of NUE, pot experiment was conducted in Completely Randomized Design. Experiment involved two factors including (i) sources of N: 3[S1: urea, S2: calcium ammonium nitrate (CAN) S3: nitrapyrin (NTP)], (ii) level of N inputs, 4 [L1: control, L2: rec, N input: 100%, L3: high N input: RDF +25% extra N input, L4: reduced N input: RDF-25% N]. The N was applied in two splits as per treatment plan. The results indicated that the most of agronomic parameters measured in this study were significantly influenced by source of N, N input and their interaction. The maximum plant height, stem girth, root length, leaf fresh and dry weights, N uptake and soil N loss was observed greater in CAN source followed by NTP and urea sources of N. Further, root fresh and dry weights, shoot fresh and dry weights, chlorophyll content, plant biomass, apparent N recovery (ANR) and physiological N efficiency were found greater in NTP as compared to CAN and urea. In case of N input, plant height, stem girth, root length, root dry weight, chlorophyll content and plant biomass were increased along with increase in N input. Root fresh weight shoot fresh and dry weights, leaf fresh and dry weights, and physiological N efficiency were observed greater in recommended N input than control and extra N inputs. Interestingly, ANR was found greater in reduced N input than recommended and extra N inputs, whereas soil N loss noticed greater in case of extra N input than the rest of N inputs. It was concluded from the results that the NUE measured in terms of ANR, and physiological N efficiency depends on N source and extra N input should be avoided for reducing N loss. Thus, it is recommended that CAN and NTP may be included in N management plan of maize with reduced N input.

***Keywords*:** Nitrogen, maize, Urea, Nitrapyrin, N use efficiency

PLASTIC DEGRADATION POTENTIAL OF BACTERIAL STRAINS RETRIEVED FROM SOIL

Mahrukh Saeed Gillani[1*], Sundas Inayat Alfred[1], Rizwana Kousar[1], Zainab Syed[1], Sadia Latif[1*]

[1]Department of Biology, Allama Iqbal Open University, Islamabad, Pakistan

Email: mahrukhsaeed1998@gmail.com, sadia.latif@aiou.edu.pk

ABSTRACT

The rising concern associated with plastic pollution has necessitated the requirement for novel solutions to eradicate persisting challenges posed by plastic waste. Microbes may rapidly dissolve synthetic chemicals and wastes, which are difficult to degrade. Degradation of these contaminating substances is caused by a wide variety of bacteria, including those belonging to the genera *Alcaligenes, Flavobacterium, Pseudomonas, Bacillus, Moraxella, Arthrobacter, Paracoccus, Aerobacter*, *Burkholderia*, *Sphingomonas* and *Rhodococcus*. Our research focuses on multidisciplinary approach which combines microbiology and environmental science for the investigation of microbial PE degradation. The soil samples were collected, analyzed and subjected to bacterial isolation and characterization. Pure bacterial colonies were isolated on nutrient agar, and their morphology was determined using macroscopy and microscopy. Identification to the genus level was achieved through biochemical tests, including catalase, indole, citrate, methyl red, VP, urease, triple iron sugar, and motility tests. Of a total of 11 isolates obtained, 10 were gram-positive (36% cocci, 64% rods), and one was gram-negative. Biochemical testing revealed the presence of *Bacillus cereus* (3), *Bacillus species* (2), *Staphylococcus aureus* (2), *Staphylococcus epidermidis*, *Streptococcus pyogenes*, *Proteus species* and *Lactobacillus*. A minimal salt medium (MSM) broth, comprising only inorganic salts and plastic as the sole carbon source, was used to grow all the 11 bacterial strains. Plastic degradation was monitored by weighing the plastic before immersing it in MSM broth, then removing, drying, and weighing it at intervals of 10 days over a month. The decrease in plastic weight indicated the plastic degrading potential of the retrieved bacterial strains. Further exploration revealed that *Bacillus spp*. (65%) and *Staphylococcus aureus* (56.4%) exhibited superior plastic degradation, while *Bacillus cereus* (38%) showed the least degradation. These findings offer the potential of specific bacterial strains for efficient plastic degradation, emphasizing the need for further exploration in addressing diverse pollutant challenges.

Keywords: Plastic pollution. Bacterial strains, Soil, Alcaligenes

PARTNERS

20th INTERNATIONAL CONGRESS OF SOIL SCIENCE

SOIL SCIENCE SOCIETY OF PAKISTAN

Secretariat: Land Resources Research Institute,
NARC, Park Road, Islamabad
www.sss-pakistan.org