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NIFA

ANNUAL REPORT 2022

NUCLEAR INSTITUTE FOR FOOD AND AGRICULTURE (NIFA)
PESHAWAR

NIFA

Annual Report

2022

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NIFA ANNUAL REPORT 2022

PREFACE

Agriculture is linked to biodiversity loss and climate change and the impact of this climate change is creating serious challenges to the future food security of billions of people in Pakistan. The concept of climate-smart agriculture reflects an ambition to improve integration of agriculture development and climate responsiveness. It aims to achieve food security and broader development goals under a changing climate and increasing food demand. Agro-based economy of Pakistan is deeply sensitive to climate change impacts. Evidently, these impacts are causing a decline in agricultural productivity and thus stressing country's food security. Therefore, the need for attuning the existing R & D according to climate compatible development (CCD) is crucial. Nuclear Institute for Food and Agriculture (NIFA) is striving to introduce climate smart agriculture and high yielding crop varieties resilient to climate change through innovative R&D plans. NIFA is committed to achieve food security and ensure food safety through research and development (R&D) by nuclear and other contemporary advanced techniques in the areas of Food and Agriculture. The major achievements of four research divisions during the period under report are summarized as below:

PLANT BREEDING AND GENETICS DIVISION

Two genotypes CTHN-162056 and CTHN-172114 were sent to the 1st & 2nd year mandatory evaluation, respectively in the National Yield Trial (NUYT). As per NUYT pooled analysis, CTHN-172114 stood 1st (4667 kg ha^{-1}). Four genotypes (CT-18048, CT-18062 and CT-18145) were tested at 13 locations of KP, including NIFA, under irrigated conditions. As per results, the genotype CT-18062 stood 2nd (3719 kg ha^{-1}) on KP level in comparison to high yielding check Gulzar-19 (3398 kg ha^{-1}). Proposal for approval of CTHN-162056 as a new high yielding variety NIFA NIJAT was submitted to Verity Evaluation Committee (VEC), Agricultural Research System KP. New candidate rainfed wheat line NRL 1812 showed excellent performance in National Uniform Wheat Yield Trials and produced 5-25% higher grain yield than the check Pakistan 13 on Pakistan and Azad Jammu and Kashmir basis. Under Irrigated conditions it out

yielded the checks by 3-47% at different locations. Based on high yield and disease resistance, 82 wheat genotypes were selected from preliminary, advanced and international wheat nurseries/ trials. With the help of FSC & RD 13400 kg Pre-basic seed was produced and disseminated through KP Agriculture Extension Department for further multiplication. Five rapeseed mutant/recombinants were evaluated in the National Rapeseed Yield Trial, RM-1-9, RR-8-2 and RM-1-2 out yielded check by 2 – 10% in seed yield on overall mean basis of sixteen locations. In zonal trials, five of eight rapeseed recombinants performed better (2098 – 2291 kg ha^{-1}) than check (2080 kg ha^{-1}) on average mean basis of six locations. Seventeen out of thirty four advanced rapeseed/mustard rec./mutants exhibited better seed yield while only one genotype produced significantly higher seed yield (2269 kg ha^{-1}) than check (2082 kg ha^{-1}) in advanced yield trials conducted at NIFA, Peshawar. Different breeding generations (F^1 – F^5/M^1 – M^5) were maintained in quest of creating genetic variability, selection of the desirable variants based on agronomic, quality traits and subsequence advancement of generations to achieve genetic stability leading to development of new variety. Morphological characterization of two lines, one each of rapeseed and mustard was carried out at NIFA with the cooperation FSC&RD, Regional Office, Peshawar. Two hundred (200) kg quality seed of NIFA Sarson-T20 was certified in Basic category. In common bean, 02 varieties 'NIFA Lobia Red-2022 and NIFA Lobia Yellow-2022 were approved by the Provincial Seed Council, Khyber Pakhtunkhwa (KP) on January 20, 2022 for general cultivation in Kurram and other common bean growing areas of the KP. One out of 08 common bean genotypes produced statistically significant average higher seed yield (2587 kg ha^{-1}) against average seed yield of check varieties NIFA Lobia Red-22 (1913 kg ha^{-1}), NIFA Lobia Yellow-22 (1836 kg ha^{-1}) and Himalaya-1 (486 kg ha^{-1}) in spring 2022.In case of Mungbean, 52 advanced green-seeded recombinants and mutants were evaluated for yield and yield related traits in 04 sets of replicated yield trials in kharif 2021. A total of 29 genotypes produced statistically significant average higher seed yield of 1632-2361 kg ha^{-1} against average seed yield of check varieties (Ramzan 1382 kg ha^{-1}), NIFA Mung-19 (1626 kg ha^{-1}) and AZRI Mung-18 (1748 kg ha^{-1}). Two out of 13 black-seeded mungbean genotypes produced statistically significant average higher seed yield (1971 and 1960 kg ha^{-1}) against average seed yield of check varieties NIFA Mung Spinghar-21 (1828 kg ha^{-1}) and NIFA Mung Sikaram-21 (1783 kg ha^{-1}). Mungbean NUYT comprising of 23 entries was evaluated at NIFA in kharif 2021.

In case of chickpea, 20 advanced genotypes were screened for physiological traits related to heat tolerance under field condition at NIFA. 08 genotypes showed better performance for the physiological traits as well as per plant biological and grain yield. Two exotic germplasm i.e., Plawhite-5 & Zincle-4 were evaluated for early blooming, dwarfism and fruit maturity. Flower initiation/sprouting in 06 plants of plawhite-5 were recorded, days to fruit setting range from 9-14 days, maximum number of fruits per plant (30) were noted. The harvesting date was 16 days earlier than the harvest date of early grand. The mutants of Cv Fazli Manani irradiated with (20 and 30 Gy) gamma rays were evaluated in the orchard. Earliest sprouting was recorded in the control plants as compared to irradiated material of 30 Gy treatment. The effect of different concentrations of plant growth regulators on budding success was investigated in plum F. Manani, Santa Rosa and Blasting star. Significantly ($p \leq 0.05$) highest bud sprouting of 66.4 % was recorded in IAA treated bud wood of Santa Rosa plum.

FOOD AND NUTRITION DIVISION

The Food and Nutrition Division (FND) carried out R&D activities of national importance for achieving food security and safety through donor funded as well PAEC funded projects. R&D on astringency removal of persimmon and date fruits was carried out. Persimmon fruit vacuum packed in transparent polyethylene (PE) bags were less astringent as compared to other treatments. Similarly, Dhaki and Tosha Basra varieties dokha were found less astringent when treated in modified atmosphere chamber (MAC), desiccator (CO_2 added) and vacuum packed in PE bags. Pilot scale Zero Energy Cooling Chambers were constructed in Peshawar, Nowshera, Charsadda, Haripur and Swat districts for providing on-field, short-term storage facility for fruits and vegetables. Training workshops were arranged in each district in coordination with Agriculture Extension Department of Khyber Pakhtunkhwa.

Fresh Pine Nuts or Chilgoza dry fruit samples from Waziristan tribal district were studied for surface decontamination and disinfection using Co-60 source of gamma and low energy x-rays. Irradiation dose of 1 kGy showed best results for sensory evaluation. Samples treated with low energy X-rays (150 kV) had no fungal growth.

Food and Nutrition Division is popularizing mushroom cultivation. Mushroom growers from 8 districts (Peshawar, Nowshera, Charsadda, Mardan, Swabi, Buner, Swat and Bajaur) were provided with 103.5 kg of mushroom spawn and they have developed 36 private mushroom farms

that have contributed to increase in their income. Moreover, Grey Oyster (Pleurotus sajor caju) was successfully cultivated in a preliminary trial at NIFA. Ganoderma or Reishi (Ganoderma lucidum) was phytochemically analyzed and its biologically active constituents were confirmed/ quantified. Botanicals extracts (*Melia azedarach*, *Azadirachta indica* and *Withaina coagulans*) showed urediospores germination inhibition properties in laboratory conditions thus showed its potential as antifungal agent.

Characterization of indigenous food bio-preservative known as bacteriocin was carried out wherein quantification of molecular weight SDS-PAGE was performed. It was observed that bacteriocin had a single band of molecular weight of about 8.5 kDa and had strong inhibitory characteristics against food born pathogen. Detection of adulteration in food is an essential requirement for ensuring safety of foods. Rapid test for foreign dyes in red Chilli and turmeric powder was successfully developed and optimized with sensitivity of 0.03%.

Oxidative changes in fats and oils have a detrimental impact on their quality. R&D on the development of an on-spot qualitative Rapid Test Kit (RTK) for the detection of rancidity in fats and oils based on peroxide values (POV) was carried out. The developed kit was optimized and validated by comparing with the AOAC reference method on randomly selected oil samples. The recommended shelf life of the kit was 4 months at $25^{o}C \pm 5\,^{o}C$.

A rapid, economical and easy to use lab method for quantification of added iron in wheat flour was developed and optimized by checking its efficacy on wheat flour samples collected from vicinities of districts Peshawar and Nowshera. Results of the comparative analysis produced excellent correlation between the conventional and rapid method. Furthermore, validation of the rapid method was carried out by means of intra-lab and inter-lab comparisons. Overall sample analysis yielded good percent recovery (82-85%), and precision (91-94%).

SOIL AND ENVIRONMENTAL SCIENCES DIVISION

Research endeavors of Soil and Environmental Sciences Division encompassed cutting-edge issues such as sustainable soil fertility management, efficient utilization of scarce water and vertical farming of high value crops under current scenario of climate change. Conventional and nuclear techniques were used in integration to identify sustainable solutions for farming community of the province. Environment friendly technology packages were optimized and

demonstrated to the end-users. Flagship projects of the division were tunnel farming technology for off-season vegetables production and development of organic fertilizer products (compost and compost tea) for particular use by vegetables and nursery growers. The technologies and products developed were transferred to stakeholders through a training workshop and field scale demonstration at the institute.

Screening of wheat genotypes was conducted to identify zinc efficient genotypes. Optimal dose and timing of fertilizer application were determined through a series of studies to develop recommendations for off-season production of tomatoes and cucumber. Studies on nitrogen and phosphorus enrichment of organic fertilizer products (compost and compost tea) have been initiated to improve their nutritive value so that these may serve as partial substituent of inorganic fertilizers.

To address the issues of declining soil fertility and climate change, a long-term field experiment was established. This study will monitor impact of conversion to organic farming practices in comparison with conventional chemical fertilizer-based farming. Preliminary findings from the trial depicted that that it was possible to maintain soil fertility under organic farming systems without compromising wheat grain yield.

PLANT PROTECTION DIVISION

Plant Protection Division (PPD) is actively engaged in R & D of insect pests and disease control of economically important crops. The main focus of the division is to develop environmentally safer control measures against major economic insect pests and diseases with minimum reliance on pesticides. In this regard, five different research groups in PPD including Bio-control, Termites, Fruit Flies, Plant Pathology and Medical Entomology are actively involved in various R & D activities.

In a laboratory study, maize and oat proved to be the most preferred food and alternatives to wheat for *Sitotroga* rearing while wheat grains were found suitable for the quality production of host eggs (S*itotroga* eggs) and useful for maximum eggs production, high parasitism & adult emergence of *Trichogramma*. Chickpea flour based artificial diet was found very effective rearing medium for fruit worm. Application of *Trichogramma* coupled with microbial pesticide, *Beauveria bassiana* effectively suppressed fruit worm population in tomato crop. Out of several

tested plant extracts, clove and garlic extracts were found most effective both in toxicity and deterrence against subterranean termites. In trials of developing termite bait matrix, sucrose and yeast @ 2% were identified as most effective phagostimulants to enhance the attractiveness of termite bait. Furthermore, Lufenuron was screened as most effective slow acting toxicant to be mixed in bait matrix for termite management. Investigation on day time activities of fruit flies revealed that *Bactrocera* species remained more active during 6:00 to 10:00 hours in the morning. Guava juice smeared inside brown perforated was found to be an effective ovipositional stimulant for fruit flies. Addition of Ammonium acetate significantly enhanced the attractiveness of food baits towards fruit flies. An artificial larval diet was developed for efficient larval rearing of fruit flies comprising of banana fruit, yeast, nipagen and sodium benzoate. Field studies recorded four yellow rust races (i.e. 0E0, 124E255, 124E238 and 4E255) and virulence to several yellow rust resistance genes. Black point and karnal bunt incidence in a set of NIFA grown wheat varieties reached up to 17 and 5% respectively. Parthenium based bio-pesticides were found very effective against larval stage of culicid mosquitoes. The use of insect growth regulators (IGRs) in indoor and outdoor ovitraps resulted in eggs hatching inhibition, mortality (100%) of larval and pupal stages. The first instar larvae of *Ae. aegypti* exposed to heat in water bath determined that strains showed variable sensitivity to heat @ 40^{o}C and 41^{o}C temperature for 5 and 3 hours respectively.

PLANT BREEDING AND GENETICS DIVISION

Wheat Irrigated

Maintenance of NIFA released wheat varieties

NIFA since its establishment has released a number of improved varieties (Fakhr-e-Sarhad NIFA Bathoor-08 and NIFA Aman-17) for the irrigated areas in the province in order to meet the increasing demand of seed from the government organizations, seed companies and farming community. Therefore, continuous efforts are being made at NIFA for maintenance of varietal purity of the released NIFA wheat varieties for irrigated areas of Khyber Pakhtunkhwa (KP). Seventy (70) blocks and 180 progeny rows of NIFA- Aman were planted at experimental farm of the institute. Rows / blocks having off-type plants were discarded and the desired blocks/rows were harvested and threshed for production of quality seeds during the next cropping season (2022-23).

Evaluation of candidate wheat lines in National Uniform Yield Trials (NUYT) under irrigated conditions

Country-wide field evaluation of candidate wheat varieties is a vital link between genetic improvement and the production environment. Based on higher grain yield and disease resistance in Khyber Pakhtunkhwa Wheat Yield Trial (KPWYT) and National Uniform Wheat Yield Trial (NUWYT), two genotypes CTHN-162056 and CTHN-172114 were subjected to the 1st & 2nd year mandatory evaluation, respectively in the National Yield Trial (NUYT). The agronomic data of the trial recorded at NIFA was submitted to the National Wheat Coordinator for necessary compilation at country level. NUYT pooled analysis showed that CTHN-172114 secured 1st position and produced the highest mean grain yield of 4667 kg ha^{-1} over all the candidate lines throughout KPK and stood in the range of top 10 lines on Pakistan level. Proposal for approval of CTHN-162056 as variety NIFA NIJAT has been submitted to VEC, Agricultural Research System KP.

Evaluation of advanced wheat lines in Khyber Pakhtunkhwa Yield Trials (KPWYT) under irrigated conditions of KP

Multi-location testing / zonal trials of advanced wheat lines are pre-requisite for development of new genotypes with wider adaptability and selection of suitable candidate varieties for evaluation in NUYT. Based on the performance in Micro Plot Test (MPT), four promising genotypes (CT-18048, CT-18062, & CT-18145) along with

commercial checks were tested at 13 locations of KP, including NIFA, under irrigated conditions. According to the results communicated by the Director Outreach of the KP Agricultural Research System, the genotype CT-18062 secured 2nd position on KP basis by producing mean grain yield of 3719 kg ha^{-1} with an increase of 9.4% over high yielding check Gulzar-19 (3398 kg ha^{-1}).

Microplot yield trials (MPT) under irrigated conditions of KP

Multilocation testing of elite material is a pre-requisite for genotypes to be considered as candidate variety. Nineteen (19) genotypes including three checks (Fakhr-e-Sarhad, NIFA Aman & Gulzar-19) were evaluated for grain yield and response to diseases. Four of the genotypes (CT-19078, CT-19293 and CTHN-19101) showed resistance to *Yr*, *Lr* & *Sr* and out yielded the check cultivars (3278 to 4167 kg ha^{-1}), by producing grain yield in the range of 4022-4233 kg ha^{-1}. These genotypes along with two others (CIBW-2 & CIBW-4) will be further evaluated in KPWYT 2022-23.

Agronomic evaluation of elite wheat genotypes in advanced yield trials (AYTs)

Based on higher yield and response to *Yr*, *Lr*, *Sr* and *BYD* in preliminary yield trials, evaluation of desirable genotypes in advanced yield trials (AYTs) is a prerequisite for further evaluation in MPT and KPWYT. The selected genotypes are being tested in AYTs conducted at NIFA.

A total of 66 genotypes including 04 checks (NIFA Aman, Gulzar-19, Zincol & F. Sarhad) were evaluated in three sets of advanced yield trials (AYTs). In all, 25 genotypes out-yielded the check cultivars (NIFA Aman, Gulzar-19 and F. Sarhad) by producing grain yield in the range of 4444-5733 kg ha^{-1}. Grain yield of the check cultivars was recorded in the range of 5500-3944 kg ha^{-1}.

Agronomic evaluation of genotypes in preliminary yield trials (PYTs) under irrigated conditions

Sixty (60) genotypes were evaluated in 3 sets of preliminary yield trials. Based on higher grain yield and disease resistance, 23 genotypes out-yielded both the check cultivars (NIFA Aman and Gulzar-19). The selected genotypes produced grain yield in the range of 4445– 5778 kg ha^{-1} as compared to the check cultivars NIFA Aman (Ave. 5988 kg ha^{-1}) and Gulzar-19 (Average. 4584 kg ha^{-1}). The selected genotypes will be subjected for further evaluation in ASYTs during the next cropping season (2022-2023).

Field evaluation of exotic wheat germplasm

Global exchange of wheat germplasm, in particular CIMMYT through provision of observation nurseries and trials to cooperating institutions plays a pivotal role for having desirable ideotypes for wheat breeders.

54th IBWSN (International Bread Wheat Screening Nursery) consisting of **256** genotypes received from CIMMYT, Mexico, was evaluated with local checks NIFA-Aman. Based on plant type, yield performance and disease reaction (*Yr* and *Lr*), a total of **37** genotypes were selected for further evaluation. The selected genotypes out yielded the check cultivar NIFA-Aman by producing grain yield in the range of 7067 - 9200 kg ha^{-1}.

32nd HRWSN (High Rainfall Wheat Screening Nursery) consisting of 116 genotypes received from CIMMYT, Mexico, was evaluated for plant type, yield and disease reaction (*Yr*), a total of 05 genotypes were selected for further evaluation. The selected genotypes revealed statistically significant yield over the check varieties by producing grain yield in the range of 7733 - 8267 kg ha^{-1}.

NIFA Disease Screening Nursery (NDSN) consisting of 143 genotypes included in station trials from NUWYT, KPWYT, MPT, AYTs and PYTs (2021-22) was evaluated for disease reaction against yellow rust (*Yr*), leaf rust (*Lr*) and loose smut (*Ls*) using standard checks Morocco as disease spreader.

42nd ESWYT (Elite Spring Wheat Yield Trial) consisting of 50 genotypes was evaluated for yield and resistance against diseases (*Yr*) with local check NIFA AMAN. Nine genotypes were selected for further evaluation. The selected genotypes revealed statistically significant yield over the check variety NIFA AMAN (5167 kg ha^{-1}) by producing grain yield in the range of 5433 – 6167 kg ha^{-1}.

09th WYCYT (Wheat Yield Consortium Yield Trial) consisting of 33 genotypes was evaluated for yield and resistance against diseases (*Yr*) with local check NIFA AMAN (5100 kg ha^{-1}). Two genotypes with statistically significant yield in the rage of 5300-5667 kg ha^{-1} and desirable disease response were selected for further evaluation.

Pak-China Project (Pak-China PYT) consisting of 04 genotypes was evaluated for yield and resistance against diseases (*Yr,)* with two local checks NIFA AMAN and Gulzhar-19. Three genotypes with higher

yield and desirable disease response were selected for further evaluation in KPWYT (CIBW-2 & CIBW-4) and MPT (CIBW-4, 5). Quality analysis of CIBW-4 were carried out in NIFA having Zinc (Zn) 37 ppm and Iron (Fe) 59 ppm & in PINSTEC, Islamabad with results Zn 40 ppm and Fe 64 ppm.

Creation of new genetic variability and raising of segregating populations

Raising and maintenance of different segregating populations developed through conventional hybridization and induced mutation using gamma irradiation as mutagen is the most important breeding strategy. It is routinely carried out as a part of wheat improvement program at NIFA. The effort may ultimately results in the development of high yielding, disease resistant and widely adaptable homozygous genotypes to be released as genetically improved wheat varieties to cope with changeable climatic condition and maximize wheat production.

Genetic variability through hybridization

Based on higher yield, early maturity and disease resistance, out of 34, 18 F_4 families were selected for further evaluation. The population was resulted from 05 cross combinations. The selected genotypes were included in PYTs for further evaluation in the next cropping season (2022-23).

Fifty seven (57) families out of 98 recombinants were selected from F_3 population resultant from 13 cross combinations and were subjected for further evaluation in observation nursery 2022-23.

Based on disease resistant with high tillering capacity, medium plant height, early maturing and bold seeded trait, 37 desirable recombinants were selected from F_2 population resulted from 3 cross-combinations. The recombinants will be confirmed for their desired traits during cropping season 2022-23.

F_1/M_1 generation resulted from 11 cross combinations (irradiated with 100 Gy of γ rays) was harvested for raising as F_2/M_2 population during the next cropping season (2022-23).

Seventy seven (77) genetically variable genotypes were planted in the field as gene pool on two different dates. Six fresh cross combinations were attempted and seeds from the cross combinations were separately harvested to be raised as F_1 during cropping season 2022-23.

Genetic variability through induced mutation

Based on disease resistance and improved plant type, 26 promising mutants out of 78 were retained from M_3 population resulted from the seed treatment of Fakhr-e- Sarhad

and NIFA Bathoor-8, each with 250 and 350 Gy doses of gamma irradiation

Fifty six (56) desirable mutants were selected from M_2 population resulted from the seed treatment of two varieties (Fakhr-e- Sarhad and NIFA Bathoor-8) each with 200 and 300 Gy doses of gamma rays.

Seed of each of Bakhtawar-92 and Fakhr-e-Sarhad were irradiated with 250 Gy dose of gamma rays for raising as M_1 generation during the cropping season 2022-23.

Demonstration Plots and Seed Multiplication on farmer's field

Demonstration plots on farmer's field always plays an important role in varietal proliferation and it also helps the farming community to have easy access to the quality seed on their door step. In the year 2021-2022, 250 kg of NIFA Aman was provided to 5 farmers of District Peshawar, Bannu, Lakki Marwat and Nowshera free of cost with an undertaking that the produced seed will be provided to the neighboring farmers. The reports from the farmers revealed that 15.75 tons of seed was produced from 5 plots in these districts and this will be available for cultivation during 2022-23. DDA Bunir was provided 200 kg seed of NIFA Aman on cash payment. They have reported a total of 01 ton production of NIFA-Aman on farmer's field which was distributed to the farmers as certified seed for cropping season 2022-23. Pre-basic seed of NIFA Aman (1.6 metric tons) was recently supplied to DDA, Bunir for the production of certified seed on farmers' fields during 2022-23.

NIFA New Candidate Wheat Line (CTHN-162056) for Irrigated Areas of Khyber Pakhtunkhwa

Wheat Rainfed

Early Generation Seed production

Consistent efforts are being made by NIFA rainfed wheat breeders to develop improved cultivars coupled with potential wheat germplasm helping in boosting farm productivity and ensuring food security in the country. The research activities along with the desired goals are summarized as under:

Seed Production

A total of 13400 kg quality seed (Pre-basic) of NIFA rainfed wheat varieties NIFA Awaz 2019, NIFA Lalma 2013, NIFA Insaf 2015 and Tatara was produced and certified by

FSC&RD for fast proliferation through active involvement of public/private entrepreneurs in Khyber Pakhtunkhwa

NIFA wheat varieties popularization / demonstration

Demonstration plots on farmer's field always play an important role in varietal proliferation and helping the farming community of easy access to the quality seed. In the year 2021-22, 250 kg seed of NIFA Awaz was provided to 05 farmers in Districts of Nowshera and Charsadda. The seed was provided free of cost with an undertaking that the produced seed would be provided to the neighboring farmers. The feedback from the farmers revealed that 8100 kg of seed was produced from these 05 demonstration plots that would be available for cultivation during 2022-23.

Involvement of District Director Agriculture Extension Buner in seed production / certification of NIFA rainfed wheat varieties (2021-22)

A total of 2,53,000 kg certified seed of wheat varieties i.e., NIFA Lalma 2013, NIFA Insaf 2015 and NIFA Awaz 2019 was produced by District Director Agriculture Buner with the help of FSC & RD officials. The details are as under:

Grower Name	Field Inspection Report No.	Variety	Class	Yield (kg)
Subhan Ali	48170208015	Lalma	Certified	30000
Abdul Rauf	48170208016	Lalma	Certified	25000
Naik Zada	48170208022	Lalma	Certified	60000
Haji Rahman	48170208025	Lalma	Certified	18000
Hameed	48170208026	Lalma	Certified	15000
Bakht Raj	48170208027	Lalma	Certified	7000
Abdus Samad	48170208028	Lalma	Certified	10000
Hazrat Khan	48170208018	Awaz	Certified	45000
Haleem	48170208019	Awaz	Certified	35000
Ibrar	48170208017	Insaf	Certified	5000
Saeedullah	48170208021	Insaf	Certified	3000
Total				**253000**

Performance of exotic germplasm

During 2021-22, three (03) international wheat yield trials / nurseries i.e., 39th Semi-Arid Wheat Screening Nursery, 11th Stress Adaptive Trial Yield Nursery and 29th Semi-Arid Wheat Yield Trial comprising of 256, 40 and 50 exotic genotypes respectively were evaluated at the institute. Data with regards to yield, yield components and disease was recorded for each genotype at different growth stages. Based on field performance 26 best genotypes were selected from 39th SAWSN, 16 from 11th SATYN, and 16 from 29th SAWYT for further confirmation and evaluation.

Performance of wheat genotypes in various yield trials under rainfed conditions

Sixteen (16) promising genotypes including NIFA Awaz as standard check were assessed for grain yield, yield components, and disease resistance in Advanced yield trial at the institute. Based on grain yield and disease resistance 06 promising genotypes were selected. NRL 2001 produced the highest mean grain yield of 4914 kg ha^{-1} and ranked 1st closely followed by NRL 2009. The overall yield in Advanced yield trial was in the range of 3272 kg ha^{-1} to 5276 kg ha^{-1}. The lowest grain yield of 3272 kg ha^{-1} was produced by NRL 2018.

Eighty four (84) newly selected genotypes were tested for grain yield, disease resistance, and other agronomic traits in 07 Preliminary Yield Trials under moisture stress conditions at the institute. Wheat varieties NIFA Awaz was included as standard check in each trial. On the basis of high yield & disease resistance, a total of 18 genotypes were selected from these trials. The grain yield of selected genotypes in these preliminary yield trials ranged from 4578 kg ha^{-1} to 6089 kg ha^{-1}. These selected lines will be further tested in advanced yield trial during the coming growing season.

The relative effects of environment, genotypes and their interaction on grain yield and agronomic attributes were assayed using 42 promising bread wheat genotypes grown in replicated trials in the plains, southern parts and northern part of Khyber Pakhtunkhwa. Wheat variety "PS 19" was used as a grand check. The trails were conducted with standard cultural practices with no irrigation. NIFA five elite wheat lines (NRL 1901, NRL 1903, NRL 1908, NRL 1928 and NRL 1929) were among the contested genotypes. NIFA elite line NRL 1929 secured 5th position among the tested genotypes by producing yield of 3411 kg ha^{-1} with 12% yield increase over PS-19 and 20% over local check NIFA Awaz 2019. This line will be further evaluated in national trials during 2022-23. NIFA candidate varieties, NRL 1812 and NRL 1825 were subjected for 1st year mandatory evaluation in National Uniform Wheat Yield Trials (NUWYT-Rainfed) at different sites in the country. NRL 1812 produced 5%, 9% and 25% higher grain yield than the Check (Pakistan 2013) on Pakistan, Khyber Pakhtunkhwa and Azad Jammu and Kashmir basis under rainfed conditions, respectively. NRL 1812 again showed excellent performance under irrigated conditions and out yielded the checks by 3%, 4%, 40% and 47% on Punjab,

Sind, Gilgit and Baluchistan basis, respectively.

Evaluation of segregating material and creation of genetic variability for desired traits

Continued raising of different segregating populations achieved through gene pyramiding and single gene mutation is the most important breeding strategy that ultimately results in the availability of homozygous genotypes. A crossing block consisting of 15 genotypes was planted on three different dates for acquiring floral synchrony among early and late flowering parents.

Based on transfer of genes for disease resistance and other economically important traits to otherwise well adapted cultivars/genotypes, fresh crosses among different wheat cultivars / genotypes were carried out. F_1 generation comprised of 12 cross combinations were raised. Each cross combination was planted in 02 rows with 2.5m length and having 25 plants per row. Seed of the F_1 population was harvested, bulked and stored after proper labeling. In F_2 generation 02 cross combinations having about 1500-2000 plants per cross were space planted. Based on field performance 30 desirable plants were selected and threshed individually. F_3 generation of 08 cross combinations was raised in the field for isolating desirable plants. Seventy-two (72) best progenies were selected. In F_4 generation (11 cross combinations) 68 progenies were selected. F_5 and F_6 populations comprised of 227 entries were raised in the form of observation nursery (4^{th} NIFA Wheat Observation Nursery) and 18 genotypes were finally selected for further confirmation in preliminary yield trials during Rabi 2022-23.

Breeder Nucleus Seed production of NIFA rainfed varieties

Consistent efforts were made by the NIFA wheat breeders to maintain seed purity and to produce Breeder Nucleus Seed by growing progeny blocks / rows of these varieties on the available land at the institute. In total 262 progeny blocks and 300 progeny rows were grown for these varieties. After regular observations 212 progeny blocks and 210 progeny rows were selected and the rest were discarded. A total of 600 kg breeder nucleus seed of NIFA rainfed wheat varieties NIFA Awaz and NIFA Lalma was produced. These cultivars showed resistance to prevailing yellow and leaf rust races. The BNS seed will be used for the production of Pre-Basic seed in the coming Rabi season.

Socio-Economic Impact

During 2021-22 a total of 13, 400 kg quality seed (Pre-Basic) of NIFA rainfed wheat varieties i.e., NIFA Lalma 2013, NIFA Awaz 2019, NIFA Insaf 2015 and Tatara 96 was produced which is sufficient to plant 265 Acres of land. The institute generated an amount of Pak. Rs. 17,42,000 from seed sale.

Oilseed Brassica

Evaluation of oilseed brassica mutants/ recombinants in various yield trials

Five rapeseed mutants/recombinants viz. RR-1-4, RM-106-1, RM-1-9, RM-1-2 and RR-8-2 were contributed in National Uniform Rapeseed Yield Trial (2021-22) for the second year mandatory evaluation for seed yield performance and stability studies across sixteen diversified locations in the country. Three entries viz. RM-1-9, RR-8-2 and RM-1-2 produced higher seed yields (1638, 1710 and 1772 kg ha^{-1}, respectively) on overall means of sixteen locations compared to national check (1605 kg ha^{-1}).

Based on high seed and oil yields performance of 08 rapeseed recombinant/ mutants advanced lines (RR-016-49, RR-016-62, RR-016-101, RR-016-20, RM-016-28, RR-016-30, RR-016-31 and RR-016-82) were assessed in multi-location adaptation trial at selected sites in the KP & Punjab (NIFA, Peshawar; ARI, Mingora; ARS, Buner; AZRC, D. I. Khan; BARS, Kohat and BARI, Chakwal). The results of the six locations demonstrated that five out of eight rapeseed recombinants performed better (2098 – 2291 kg ha^{-1}) than check-Super Canola (2080 kg ha^{-1}) on average mean basis of six locations. Highest genotypic mean was recorded for RR-016-101 (2291 kg ha^{-1}), followed by RR-016-62 (2242 kg ha^{-1}) and RR-016-30 (2235 kg ha^{-1}). Amongst all, NIFA, Peshawar was the most productive site based on location means (3462 kg ha^{-1}) followed by ARS, Buner (2855 kg ha^{-1}).

At station; in four sets of advanced yield trials; thirty four (34) rapeseed mutants / recombinant inclusive of seven mustard advanced recombinants were tested for seed yield performance against Super Canola (rapeseed) and Super Raya (mustard). Seventeen (04 mustard and 13 rapeseed) out of thirty four (34) rapeseed/mustard recombinants / mutants exhibited better seed yield (2130 – 3704 kg ha^{-1}) in respective trials, while only one genotype (RM-10-24) produced significantly higher seed yield (2269 kg ha^{-1}) than check (2082 kg ha^{-1}).

Forty one (41) rapeseed and mustard advanced lines tested in the replicated trials at NIFA, Peshawar were also evaluated for quality parameters through non-destructive analysis. On mean basis, twenty five (25)

entries presented high oil contents (44.1 – 51.7%); twenty one (21) had low GSL contents (22.6 – 45 µmol/g) and seven (7) exhibited low erucic acid (1.3 – 1.4%) against their checks in the respective trials.

Selection and advancement of breeding materials

One hundred sixty three (163) out of two hundred eighty eight (288) plant to progeny rows were selected based seed yield performance and phenotypic stability in F_3/M_3 to F_5/M_5 for advancing to next generations. F_2 and M_2 generations were developed from 06 crosses combination and through irradiating Super Canola at 1.2 kGy respectively. One hundred thirty five (135) single plant selections were made in line with purpose of raising recombinant & mutant specifically centering on more branches, grains per pod, low ramification, early maturity, disease tolerance and high seed yield. F_1 generation of four cross combinations and M_1 of single gamma radiation dose were raised and bulk harvested separately. To create genetic variability and to transfer the desired quality and agronomic characters in a variety of interest; four hundred eighty (480) stigma were pollinated in thirteen different combinations.

NIFA New Candidate Wheat Line (NRL-1664) for Rainfed Areas of Khyber Pakhtunkhwa

Oilseed Brassica - varietal maintenance program

Quality seed production is the key to high seed yield. Therefore, a varietal purity conservation cycle was maintained through raising progenies rows and progeny blocks to produce Breeder Nucleus Seed (BNS). True to type progeny blocks were selected on the basis of varietal characteristics. A total of 200 kg basic seed (B.S.) of NIFA Sarson-T20 was produced at NIFA and certified by FSC&RD. Tarnab Seeds owned by Sher Ali & Sons produced 970 kg seeds of NIFA Sarson-T20 at Akora Khattak Seed Farm and tagged with certified class.

Distinctive, Uniformity & Stability Studies (DUS)

Second year DUS of rapeseed candidate line (RR-8-1) was executed and the proposal to the Technical Committee of the Provincial Seed Council (KP) was submitted for variety recommendation. First year DUS study of a

mustard mutant (MM-31-5) was carried out at NIFA with the cooperation FSC&RD, Regional Office- Peshawar.

Socio-economic Impact

The new mutant varieties when adopted by the farmers produce greater crop yields, growers' areas and quality. This year the Oilseed Group apart from achieving its R&D goals as per research programme, has been able to generate an income of Rs. 283,397/- through the sale of quality seeds, grains and seeds quality analysis.

Field View of NIFA Sarson-T22 (RR-8-1), a new high seed yielding rapeseed candidate variety

Pulses

Mungbean

Evaluation of mungbean advanced lines in various yield trials

Thirteen green-seeded recombinants and mutants along with 02 check varieties Ramzan and NIFA Mung-19 were evaluated for yield and yield components in Advanced Lines Yield Trial (ALYT) in kharif 2021 at NIFA. Eight genotypes produced statistically significant ($p \leq 0.05$) higher seed yield of 1632 to 2028 kg ha^{-1} against average seed yield of NIFA Mung-19 (1479 kg ha^{-1}) and Ramzan (1382 kg ha^{-1}). Thirty-nine green-seeded recombinants from 05 different cross-combinations (6601 x Ramzan, NFM-5-36-24 x NFM-5-63-18, NM98 x NFM-5-36-24, V2802 x Ramzan, and Sona mungx NM-2011) were evaluated in 03 sets of Preliminary Yield Trials (PYTs) along with two check varieties i.e. NIFA Mung-2019 and AZRI Mung-18 in kharif 2021 for yield and yield related traits. Of these, 21 recombinants produced statistically significant ($p \leq 0.05$) higher seed yield of 1955 to 2361 kg ha^{-1} as compared to average seed yield of NIFA Mung-19 (1774 kg ha^{-1}) and AZRI Mung-18 (1748 kg ha^{-1}).

In case of breeding black-seeded mungbean, 13 recombinants from a cross-combination KBM x NBM along with 02 black-seeded check varieties NIFA Mung Spinghar-21 and NIFA Mung Sikaram-21 were evaluated for yield and related traits in Preliminary Yield Trial at NIFA in kharif 2021. Two recombinants produced statistically significant ($p \leq 0.05$) higher seed yield of 1971 and 1960 kg ha^{-1} against seed yield of NIFA Mung Spinghar-21 (1828 kg ha^{-1}) and NIFA Mung Sikaram-21 (1783 kg ha^{-1}).

Adaptability yield trial comprising of 06 green-seeded recombinant lines derived from a cross-combinations i.e. NFM-5-36-24 × NFM-5-63-18, NM-98 × NFM-5-36-24 and V2802 × Ramzan along with 02 checks NIFA Mung-19 and AZRI Mung-18 was planted at ARS, Karak in kharif 2021 for wider adaptability of yield and related traits of these lines. Of these, 03 genotypes produced statistically significant ($p \leq 0.05$) higher yield of 1686 – 1743 kg ha^{-1} as compared to check varieties AZRI Mung-18 (1598 kg ha^{-1}) and NIFA Mung-19 (1527 kg ha^{-1}). Similarly, the same genotypes were evaluated in adaptability yield trial planted at AZRC D.I. Khan. The same 03 genotypes produced statistically significant ($p \leq 0.05$) higher yield of 1745 to 1845 kg ha^{-1} as compared to check varieties AZRI Mung-18 (1623 kg $ha^{-1)}$ and NIFA Mung-19 (1602 kg ha^{-1}).

National Uniform Yield Trial comprising of 23 green-seeded test entries was planted at NIFA in kharif 2021, and the results were sent to National Coordinator (Food Legumes), PARC, Islamabad.

Evaluation of mungbean segregating material

Early generation segregating material (F_2/M_2 generation) comprising of 04 different cross-combinations i.e. Ramzan × NBM-2-14-4-6 (11 single plants), NBM-2-14-4-6 × Ramzan (09 single plants), NBM-2-14-4-6 × NFM-19 (21 single plants), NBM-2-14-4-6 × V2817 (29 single plants) were evaluated for yield and related traits at NIFA in kharif 2021. Based on seed colour, better plant type, MYMV resistance and high per plant grain yield, a total of 241 single plants were selected for evaluation in next season. Similarly, 09 single plants from 05 cross-combinations (NFM-5-63-3 x KBM, NIFA Mung-2017 x KBM, AZRI Mung-06 x KBM, Ramzan x KBM and NM-2016 x KBM) were evaluated in F_3/M_3 generation. All plants were bulk harvested cross-combination wise.

In case of quality seed production, 410 kg of pre-basic seeds of NIFA mungbean green and black-seeded varieties i.e. Ramzan, NIFA Mung-17, NIFA Mung-19, NIFA Mung Spinghar-21 and NIFA Mung Sikaram-21 was produced in 2021-22.

Common bean

Evaluation of common bean genotypes in adaptation yield trials

Two common bean varieties ‘NIFA Lobia Red-2022 and NIFA Lobia Yellow-2022 were approved by the Provincial Seed Council, Khyber Pakhtunkhwa (KP) on 20 January, 2022 for general cultivation in Kurram and other common bean growing areas of the KP.

Common bean adaptability trial comprising of 06 entries along with check variety Himalaya-1 was planted on farmers' fields at 03 different locations in Kurram in kharif-2021 for testing wider adaptability of the test entries for seed yield and yield components. Of these, 03 genotypes 'NCB-Tajaki, NCB-Watani and NCB-Kenya produced statistically significant ($p \leq 0.05$) higher average seed yield of 1892 to 2149 kg ha^{-1} as compared to check variety Himalaya-1 (1849 kg ha^{-1}). In spring-2022, eight common bean genotypes along with 03 checks were evaluated in replicated yield trial. One genotype produced statistically significant ($p \leq 0.05$) higher seed yield of 2587 kg ha^{-1} as compared to check varieties NIFA Lobia Red-22 (1913 kg ha^{-1}), NIFA Lobia Yellow (1836 kg ha^{-1}) and Himalaya-1 (486 kg ha^{-1}).

Field view and seed colour of NIFA Lobia Red-22 released in 2022

Field view and seed colour of NIFA Lobia Yellow-22 released in 2022

Evaluation of common bean segregating material

F_1/M_1 generation derived from 03 cross-combinations i.e. NIFA Lobia Red-22 × NCB-G-4729, Himalaya-1 × NCB-Kenya and NIFA Lobia yellow-22 × NIFA Lobia Red-22 were evaluated in spring 2021. Fifty-four single plant recombinants-cum-mutants were separately picked, and pods from each recombinant-cum-mutant were bagged individually and cross-combination wise. M_1 generation of NCB-Afghani (25 & 50 Gy), NIFA Lobia Red-22 (75 Gy), and NIFA Lobia Yellow-22 (100 & 125 Gy) was planted at NIFA in spring 2022. All M_1 plants were picked, threshed and bagged individually dose wise. In order to create new genetic variability for semi erect type, seed colour and high yield, 04 new cross-combinations (Baffa line 2 x NCB-Kurram Local, Baffa line 2 x NIFA Lobia Red-22, NIFA Lobia Red-22 x Baffa line 2 and NIFA Lobia Yellow-22 x NCB-G4495) were successfully attempted at NIFA in spring 2022. All crossed pods were picked cross-combination wise.

Evaluation of common bean germplasm

Thirty two genotypes as germplasm were evaluated for semi erect type plant growth, seed colour and high yield, out of which 05

genotypes were selected for use in induced mutation and hybridization for creation of genetic variability for the traits mentioned above. Similarly, 09 exotic genotypes as germplasm were evaluated for heat tolerance at NIFA and 03 genotypes were performed better for desired traits.

In case of quality seed production, 85 kg of pre-basic seeds of NIFA Lobia Red-22 and NIFA Lobia Yellow-22 was produced in 2021-22.

Chickpea

Screening of chickpea genotypes for physiological traits related to heat tolerance

20 advanced chickpea genotypes were screened for physiological traits i.e. net photosynthesis rate, membrane injury index and canopy temperature depression at flowering, pod formation and grain-filling stages in Rabi 2021-22 under PSF Project at NIFA. Eight genotypes performed better for average percent membrane relative injury ranging from 26.1 to 45.9% compared with other genotypes (58.6 to 70.8%), average higher net photosynthesis values of 17.8 to 21.3 µmol m^{-2} s^{-1} in comparison with other genotypes (11.1 – 13.4 µmol m^{-2} s^{-1}), higher CTD ranging from 3.9 to 5.6 °C compared with other genotypes (0.8 to 1.4 °C). The same eight genotypes also produced higher per plant grain yield ranging from 15.2 to 18.8 g $plant^{-1}$ compared with other genotypes (6.7 to 11.8 g $plant^{-1}$).

Socio-economic impact

244 kg of quality pre-basic seed of NIFA green and black-seeded mungbean varieties "Ramzan, NIFA Mung-2019, NIFA Mung Spinghar-21 and NIFA Mung Sikaram-21" and 60 Kg of quality pre-basic seed of NIFA common bean varieties "NIFA Lobia Red-22 and NIFA Lobia Yellow-22" was sold to KP Agricultural Extension Department through PSDP Pulses Project for further multiplication in kharif 2022.

Horticulture

Evaluation of Exotic/ local peach germplasm/ mutants in orchard for higher yield and quality

Two exotic germplasm i.e., Plawhite-5 & Zincle-4 were evaluated for early blooming, dwarfism and fruit maturity. Flower initiation/sprouting in 06 plants of plawhite-5 were recorded, were days to fruit setting range from 9-14 days and maximum number of fruits per plant (30) were noted. Fruit maturity was 16 days earlier than early grand. Maximum average fruit weight was 96.66 g, fruit shape was slightly flat with fruit size 60.56/56.80 mm. The colour of fruit was red on white ground and TSS 8.75 ° brix were recorded. Similarly, different parameters were studied in 06 plants of zincle-4 were

days to fruit setting ranged from 10-12 days, maximum number of fruits per plant (68) were noted. The fruit maturity was 10 days earlier than early grand. Maximum average fruit weight of 81.99 g with round shaped fruit having of size 51.60/55.40 mm with red colour and TSS 9.50 ° brix were recorded as compared to early grand check variety where maximum number of fruits per plant (19), maximum average fruit weight 83.78 g, fruit shape is oval, fruit size 57.10/64.20 mm, fruit colour yellowish with red blushes and TSS 9.0 ° brix.

Local germplasm 18 plants selected from farmer orchard of Charsadda were studied for desirable characters/evaluation. Flower initiation in 18 plants and fruit setting in fifteen plants were noted as compared to check variety early grand. Mutants plants from each variety i.e., early grand & florida king were studied for further evaluation in NIFA peach orchard. Data on flower initiation, full bloom, fruit setting, days to fruit setting and number of fruits of individual mutant plants were recorded. Number of fruits ranged from (1-11) in early grand mutant plants as compared to control (1-9). Similarly, number of fruits ranged from (1-16) in florida king mutant plants as compared to control (1-4).

Evaluation of plum germplasm/mutants for yield, fruit quality and other agronomic parameters

Local germplasm of Santa Rosa, Red Beauty, Blisting Star and Fazli Manani are under evaluation for morphological characteristics like number of branches, plant height (cm) and inter node length for individual plants. The mutants of Cv Fazli Manani irradiated with (20 and 30 Gy) gamma rays shifted to orchard for evaluation. Earliest sprouting was recorded in the control plants as compared to irradiated material of 30 Gy treatment. Similarly the lowest plant height of 150 cm the lowest internode length of 1.6 cm was recorded in 30 Gy mutant plants as compared to control (150 cm and 2.0 cm). Internode length and seedling diameter were not much effected by 20 and 30 Gy doses and were at par with control. The effect of different concentrations of plant growth regulators on budding success was investigated in plum F. Manani, Santa Rosa and Blasting star. Significantly ($p \leq 0.05$) highest bud sprouting of 66.4 % was recorded in IAA treated bud wood of Santa Rosa plum.

Tangible Achievements of PBGD during 2021-22

A total of 15 ton Pre-Basic seed of rainfed wheat varieties NIFA Awaz 2019, NIFA Lalma 2013, NIFA Insaf 2015, NIFA Aman and Tatara was produced at the Institute. The

seed was provided to KP Agriculture Extension Department, Tri-Star Seed Corporation and Progressive Farmers and generated Rs. 17,42,000 for the Institute.

A total of 250000 kg certified seed of NIFA rainfed wheat varieties NIFA Awaz 2019, NIFA Lalma 2013 and NIFA Insaf 2015 was produced by District Director Buner which will cover approximately 5000 Acres.

Due to high yield performance in provincial and national trails, the proposal of NIFA rainfed and irrigated candidate lines NRL 1664 and CTHN-201656 was presented in the Technical Committee of Provincial Seed Council which was recommended to KP Provincial Seed Council for the approval and general cultivation.

DUS studies of 05 candidate rainfed and irrigated wheat lines are being carried out with the help of Federal Seed Certification & Registration Department.

Two common bean varieties 'NIFA Lobia Red-2022 and NIFA Lobia Yellow-2022 were approved by Provincial Seed Council, KP on 20 January, 2022 for general cultivation in Kurram and other common bean growing areas of the KP. The potential yield of the varieties are 2000 kg ha^{-1} with yellowish and spotted red seed colour.

Four green-seeded mungbean candidate lines i.e. NFM-98-119, NFM-99-2, NFM-103-16 and NFM-103-30 contributed to Kharif NUYT 2022.

First year DUS of 04 green-seeded mungbean candidate lines have been carried-out by FSC&RD.

NIFA Sarson-T22 (RR-8-1) was presented in the Technical Committee Meeting of the 42nd meeting of the KP Provincial Seed Council. The committee unanimously recommended the candidate variety to the PSC for approval

Second year DUS of rapeseed candidate line (RR-8-1) was executed and the proposal to the Technical Committee of the Provincial Seed Council (KP) was submitted for variety approval. First year DUS study of a mustard mutant (MM-31-5) was executed at NIFA with the cooperation FSC&RD, Regional Office- Peshawar.

FOOD AND NUTRITION DIVISION

Food Engineering and Irradiation Group

Development of simple and low cost technology for the removal of astringency from persimmon fruit

Persimmon fruits were packed in 3 different types of plastic bags (green, black and transparent) and stored at room temperature to determine their storage stability and astringency level through sensory evaluation and biochemical analysis. Persimmon fruit vacuum packed in the bags of all three colours had high scores on organoleptic parameters. Vacuum packing in the transparent bags is recommended for further studies.

Vacuum packaging of persimmon fruit for astringency removal

Mitigation of post-harvest losses and value addition of fruits and vegetables

R&D on astringency removal of dates was carried out. Four varieties of fresh Dhoka (dates) were exposed to three type of treatments including modified atmosphere chamber (MAC), desiccator (CO_2 added) and vacuum packing with P.E packing. Total phenol contents (TPC), texture analysis and organoleptic analysis was carried out. Based on the parameters evaluated Dhaki and Tosha Basra varieties dokha was found less astringent.

Astringency removal treatments of Dhoka dates

Adaptation of low energy machine generated radiation sources for surface decontamination and disinfection of food in Pakistan

Fresh Pine Nuts or Chilgoza dry fruit samples of Waziristan origin were purchased from local market at the beginning of the season.

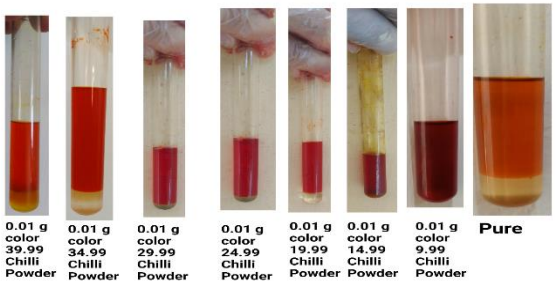
Grading of the samples were made by physical inspection and enclosed in polyethylene bags of thickness 0.1 mm approximately. Research samples of Pine nuts were irradiated with target doses of 1, 3, 5 and 7 kGy using Co-60 source of gamma and low energy x-rays (150 kV) from RS-2400 irradiator source respectively to study the effects of both the technologies for a storage period of six months at ambient temperature. Irradiation dose of 1 kGy showed best results for sensory evaluation of Pine Nuts samples treated with low energy X-rays (150 kV). No fungal counts were found for the irradiation doses of 1, 3, 5 and 7 kGy respectively in the treated Pine Nuts samples. FTIR spectra of the Pine Nuts samples showed, that the functional groups were not significantly affected with irradiation of low energy X-rays and Cobalt-60 source.

Cobalt-60 Gamma Irradiation of Pine Nuts Samples

Low energy X-rays (160 kV) Irradiation of Pine Nuts Samples

Development and optimization of Rapid tests for foreign adulterants in food

Food adulteration is the act of intentionally debasing the quality of food offered for sale either by the admixture or substitution of inferior substances or by the removal of some valuable ingredient. Food adulteration occurs globally and, in many facets, and affects almost all food commodities. Adulteration not only constitutes a considerable economic problem but also may lead to serious health issues for consumers. Detection of adulteration in food is an essential requirement for ensuring safety of foods, we consume. Adulteration of Chilli and turmeric powder (known for hot cuisine) is a matter of serious concern as the spice is widely used in whole country. In the current study, rapid tests for foreign dyes in red Chilli and turmeric powder was successfully developed and optimized. Limit of detection (sensitivity) of developed method was found to be 0.03%.



Adulteration test of red Chilli powder

Food and Environmental Safety Group

Popularization, cultivation optimization, phytochemical analysis of edible mushroom and botanical extract efficacy testing as bio pesticide

Farmers (26) from 8 districts (Peshawar, Nowshera, Charsadda, Mardan, Swabi, Buner, Swat and Bajaur) were provided with 103.5 kg of mushroom spawn and they have developed 36 private mushroom farms. Similarly, Ganoderma, a medicinal mushroom successfully produced at NIFA was introduced to local pharmaceutical industries for its health benefits and potential products. Furthermore, NIFA Ganoderma or Reishi (*Ganoderma lucidum*) was phytochemically analyzed and confirmed/ quantified biologically active constituents i.e. Triterpenoids saponin, Polyphenols, Crude proteins, Minerals (Folic Acid, Ca, Mg, Cu, Fe, Zn, P) and Vitamins (A, D (287.61 IU/100g), C, B6, B2,) at PCSIR Laboratories complex, Lahore under collaboration with Pristine Pharmaceutical Pvt. Ltd. which has established sound foundation for future Ganoderma based product development and possible commercialization.

Different composts (bagasse, wheat straw, paddy straw and saw dust) were tested for Ganoderma mushroom cultivation (fruit production) alone and in combination with each other (1:1 ratio), where wheat straw was found as best compost. Moreover, Grey Oyster (Pleurotus sajor caju) was successfully cultivated in a preliminary trial at NIFA. Detailed compost optimization will be carried out in the coming season.

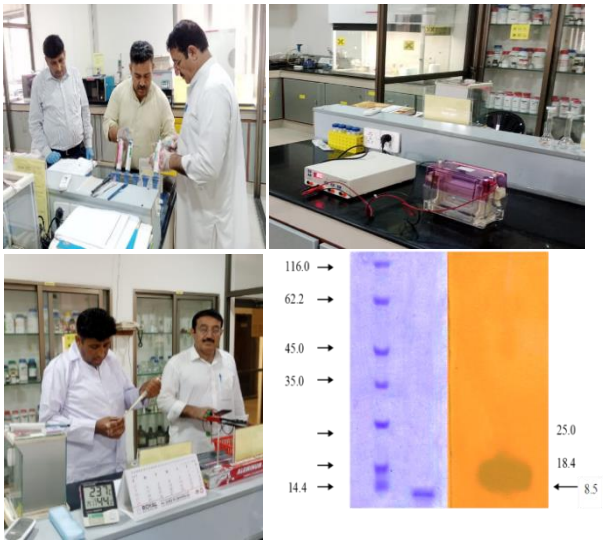
Presentation on NIFA Ganoderma medicinal mushroom to Cidex Lab, a private local pharmaceutical industry at Peshawar

Grey Oyster (*Pleurotus sajor caju*) cultivated in a preliminary trial at NIFA

Botanicals extracts (*Melia azedarach*, *Azadirachta indica* and *Withaina coagulans*) showed urediospores germination inhibition properties in laboratory conditions thus showed its potential as antifungal agent. Highest % field efficacy (95.2%) was exhibited by emulsified forms of both *Azadirachta indica* @ 50 g/L and Melia azedarach @ 50 g/L followed by (90.5%) emulsified form of Oil @ 5 ml/ 2 Ltrs of water.

Development of bio-preserved Food/ Bio-preservative development

Characterization of indigenous food bio-preservative known as bacteriocin was carried out wherein quantification of molecular weight SDS-PAGE was performed. It was observed that bacteriocin had a single band of molecular weight of about 8.5 kDa. That has strong inhibitory characteristics against food born pathogen. Similarly SDS-PAGE of S-layer cell wall protein analysis of bacteriocin producing culture was also carried out. All strains have seven prominent bands along with some minor bands. The molecular weights of these prominent bands were 27, 34, 37, 40, 45, and 60 kDa.



Molecular characterization of bacteriocin

Food Nutrition Group

Development of low cost zero-energy cooling chambers for field heat removal and storage of fruits and vegetables and its transfer to small farmers

The Zero Energy Cooling Chamber (ZECC) was able to maintain low temperature and high humidity inside the chamber irrespective of the external atmospheric temperature and humidity conditions. It maintained about 8-10 ^{o}C lower temperature and 50-60% higher relative humidity inside the chamber compared to atmospheric conditions. Shelf life of spinach and plum fruit were studied in ZECC. Results revealed that spinach had shelf life of 04 days as compared to 01 day outside ZECC. Similarly, the shelf life of plum fruit was 07 days inside the ZECC. In order to disseminate this technology to farmers and small landholders in nearby regions. Pilot scale ZECC were

constructed in Peshawar, Nowshera, Charsadda, Haripur and Swat districts. On-field training workshops were arranged in each district in consultation with Agriculture Extension Department, Khyber Pakhtunkhwa.

Zero Energy Cooling Chamber (ZECC) Technology Dissemination to Farmers of Swat

Zero Energy Cooling Chamber (ZECC) Technology Dissemination to Farmers of Haripur

Spinach stored inside and outside ZECC at Day-04

Development of Rapid Test Kit (RTK) for qualitative determination of peroxide value (POV) in Oil/ Fats and its dissemination to end users

The current study was designed to develop an on-spot qualitative Rapid Test Kit (RTK) for the detection of rancidity in fats and oils based on peroxide values (POV). During 1st phase, three different treatments (T1, T2, and T3) were prepared from a combination of reagents and tested against fresh and used oil samples for 28 days and the best performing treatment (T1) was screened out for further kit development. Storage stability study of the carried out at three different conditions i.e. under uncontrolled atmospheric conditions (KA), inside lab (KL) and in refrigerator (KR). It was observed that the kits were stable for 3 months under KA, 4 months at KL (25 ℃ ± 2 ℃), and 6 months in KR (2-4 ℃ ± 2 ℃). The optimized kit (KR) was validated by comparing with the AOAC reference method on randomly selected oil samples. As a result, a semi-quantitative colour chart was developed to assess the level

of rancidity in oils and fats. A technical workshop was organized for dissemination of developed kit and attended by around eighty multi-sector participants including officials from the KP Food Safety and Halal Food Authority (FS&HFA), R&D organizations, Nutrition International, academia, and representatives of oil and ghee mills, sweets, bakery and, restaurant associations.

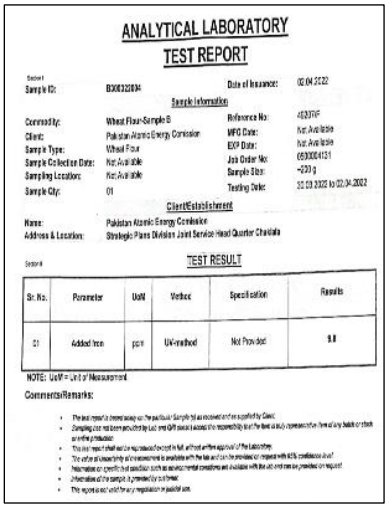
Newly developed NIFA POV Spot Test Kit

Group Photo of participants of the training workshop

Method optimization and assessment of fortified iron in wheat flour samples collected from local markets of district Peshawar and Nowshera

The conventional methods which are utilized for the determination of iron in wheat flour are time-consuming and costly. Therefore, a rapid, economical and easy to use lab method was developed and optimized by checking its efficacy on wheat flour samples collected from vicinities of districts Peshawar and Nowshera. Results of the comparative analysis produced excellent correlation between the conventional and rapid method. Furthermore, validation of the rapid method was carried out by means of intra-lab and inter-lab comparisons. Intra-lab comparative analysis was conducted by analyzing the samples in Food Nutrition, Food Chemistry and Food Processing labs within FND while inter-lab comparison was carried out by comparing the results of sample analysis between PCSIR-Karachi, Qarshi Industries Hattar and NIFA Iron Analysis lab. Overall sample analysis yielded good percent recovery (82-85%), and precision (91-94%).

Intra-Lab comparison of fortified wheat flour samples to quantify Iron (Fe^{+3})



ANALYTICAL LABORATORY

TEST REPORT

Sample Id: B30032694 Date of Issuance: 02.04.2022

Sample Information

Commodity: Wheat Flour-Sample B
Client: Pakistan Atomic Energy Comission
Sample Type: Wheat Flour
Sample Collection Date: Not Available
Sampling Location: Not Available
Sample Qty: 01

Reference No: 4037/F
MFG Date: Not Available
EXP Date: Not Available
Job Order No: 6930004131
Sample Size: ~200 g
Testing Date: 30.03.2022 to 02.04.2022

Client/Establishment

Name: Pakistan Atomic Energy Comission
Address & Location: Strategic Plans Division Joint Service Head Quarter Chaklala

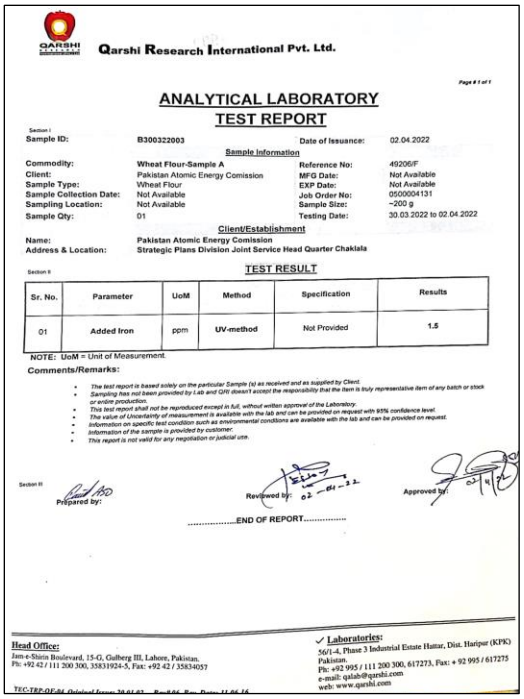
TEST RESULT

Sr. No.	Parameter	UoM	Method	Specification	Results
01	Added Iron	ppm	UV-method	Not Provided	9.8

NOTE: UoM = Unit of Measurement

Comments/Remarks:

- The test report is issued solely on the particular Sample(s) as received and as specified by Client.
- Sampling does not form part of testing and QAR cannot accept the responsibility for the fraud or duly representative form of any batch or stock on selling / production.
- This test report shall not be reproduced except in full, without written approval of the Laboratory.
- The value of Uncertainty of measurement is available with the lab and can be provided on request with 95% confidence level.
- Instruction on specific test condition such as environmental conditions are available with the lab and can be provided on request.
- Information of the sample is provided by customer.
- This report is not valid for any negotiation or judicial use.



Qarshi Research International Pvt. Ltd.

ANALYTICAL LABORATORY
TEST REPORT

Sample ID: B300322003 Date of Issuance: 02.04.2022

Sample Information

Commodity:	Wheat Flour-Sample A	Reference No:	49206/F
Client:	Pakistan Atomic Energy Comission	MFG Date:	Not Available
Sample Type:	Wheat Flour	EXP Date:	Not Available
Sample Collection Date:	Not Available	Job Order No:	0500004131
Sampling Location:	Not Available	Sample Size:	~200 g
Sample Qty:	01	Testing Date:	30.03.2022 to 02.04.2022

Client/Establishment

Name: Pakistan Atomic Energy Comission
Address & Location: Strategic Plans Division Joint Service Head Quarter Chaklala

TEST RESULT

Sr. No.	Parameter	UoM	Method	Specification	Results
01	Added Iron	ppm	UV-method	Not Provided	1.5

NOTE: UoM = Unit of Measurement.

Comments/Remarks:

- The test report is based solely on the particular Sample (s) as received and as supplied by Client.
- Sampling has not been provided by Lab and QHI doesn't accept the responsibility that the item is truly representative item of any batch or stock or entire production.
- This test report shall not be reproduced except in full, without written approval of the Laboratory.
- The value of Uncertainty of measurement is available with the lab and can be provided on request with 95% confidence level.
- Information on specific test condition such as environmental conditions are available with the lab and can be provided on request.
- Information of the sample is provided by customer.
- This report is not valid for any negotiation or judicial use.

Prepared by: Reviewed by: Approved by:

.....END OF REPORT.....

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Inter-Lab comparison of fortified wheat flour samples to quantify Iron (Fe^{+3})

Tangible Achievements of FND during 2021-22

Group: Food and Nutrition Division

Product: NIFA Peroxide Value (POV) Spot Test Kit

NIFA Peroxide Value (POV) Spot Test Kit has been developed to qualitatively detect the level of rancidity based on peroxide value in oil and ghee samples. One spot test kit consists of the three different reagents (R1, R2 and R3) in labelled glass bottles. The kit has been optimized and validated against the standard method and provided satisfactory results. During storage stability studies it was found that kit can be used within 4 months when kept at room temperature (25℃ ± 5℃). Approximately 18-20 tests can be performed by using one spot test kit. POV kits have can assist multi-sectorial stakeholders such as regulatory bodies i.e. provincial food authorities to check the quality of oil and ghee samples in the field and monitor & enforce the availability of healthy and standard food products for common consumers. It can also help quality assurance personnel working in oil and ghee industries to ensure the quality of oil and fat products during processing. Potential End Users of the kit are provincial Food Regulatory Authorities, International NGOs (Global Alliance for Improved Nutrition, Nutrition International, World Food Programme etc.) working on nutrition and food safety in Pakistan, fast food restaurants, bakeries and sweets shops/associations and oil & ghee mills of Pakistan.

SOIL & ENVIRONMENTAL SCIENCES DIVISION

Biofortification of zinc in wheat for balanced human nutrition

Zinc (Zn) deficiency caused by inadequate dietary intake is a global nutritional problem in human populations, especially in developing countries. Biofortification of wheat and other staple foods with Zn is, therefore, an important challenge and a high-priority research task. So far, our agricultural system has not been designed to promote human health; instead, it only focuses on increasing grain yield and crop productivity. This approach has resulted in a rapid rise in micronutrient deficiency in food grains, thereby increasing micronutrient malnutrition among consumers. Biofortification is a feasible and cost-effective means of delivering micronutrients to populations that may have limited access to diverse diets and other micronutrient interventions.

Screening of wheat genotypes for Zn efficiency in chelate-buffered nutrient solution

The seeds of ten wheat genotypes were surface sterilized with sodium hypochlorite and germinated on moist filter papers in petri dishes in an incubator at 20±1 °C. Three days after germination, 2 seedlings of each cultivar were transplanted into white thermopore sheet placed in stainless steel containers filled with chelate-buffered nutrient solution having 2, 10 and 40 pM Zn^{2+} activities. The nutrient solutions were replaced with fresh mixtures on days 10, 15, 19, 24, 28 and 32 following transplantation. The pH values of the solutions were adjusted to 6.0±0.01 with 0.1 M HCl or 0.1 M KOH as required. Harvesting of the plants was carried out on day 35 after transplantation. The tissue samples were then air dried on paper towels and later dried in a forced draught oven at 70±1 °C for 48 hours (until constant weight) and were analyzed for micronutrients and P by standard procedures of analysis.

Different levels of Zn^{2+} activity have differential impact on the growth of plants and resulted in vigorous dry matter production at higher Zn^{2+} activity level. The Zn efficiency of these genotypes varied between 20 to 76%, the genotypes NRL-1929 and Zincol-16 being the most efficient ones and NRL-1825 being the least. The genotype NRL-1929 produced maximum dry biomass of 9.27 g at 2 pM whereas CT-18048 produced the minimum (2.45 g). The wheat genotype NRL-1929 accumulated Zn concentration of 23.17 µg/g at 2 pM Zn^{2+} activity that was significantly higher than rest of the genotypes. Due to higher biomass

production and accumulation of Zn at 2 pM, the wheat genotype Zincol-16 had accumulated significantly higher Zn content of 555 µg/g. However, Zn-inefficient wheat genotype (NRL-1928) has taken up highest P content of 6.23 µg/g. The lower P uptake was recorded in CT-18048 (0.6 µg/g).

Integrated nutrient management of young deciduous fruit orchards

The climate of Khyber Pakhtunkhwa (KP) is highly suited for growing deciduous fruits orchards such as peach and plum. The per acre production of fruit is, however, quite low compared to other fruit growing areas of the world. Imbalance, inadequate and improper fruit tree fertilization are among the major factors responsible for low yield and early decline of orchards. Soils in Khyber Pakhtunkhwa are deficient in nutrients particularly N, P, organic matter and Zinc (Zn). This deficiency is the major factor responsible for low fruit yield and poor quality. The wide spread deficiency of important nutrients needs fresh appraisal to develop strategies for its management so that net returns from stone fruits can be increased. Therefore, experiments were conducted with the aim to develop an appropriate combination of organic and inorganic fertilizers for young deciduous fruits orchards. Three field experiments on young deciduous fruit orchards, two on peach orchards having two different varieties i.e. Early Grand and Florida King and one on plum fruit orchard of one-year plants are in progress at NIFA farm. There are total six treatments with three replications in RCB design and one tree per treatment. N, P, K & Zn were applied @ 60, 50, 50 & 20 g tree^{-1} respectively to peach orchards and @ 30, 25, 25 & 10 g tree^{-1} respectively to plum orchard. Treatments are as follows. i) control ii) 100% NPK from mineral fertilizer (MN) iii) 75% MN+ 25%FYM iv) 50% MN+ 50% FYM v) 25% MN+ 75% FYM vi) 100% FYM, all mineral fertilizer and FYM were applied to the periphery of tree canopy. Half N fertilizer and FYM was applied before flowering, while half N and full P, K and Zn were applied in the month of August.

Results of Peach variety Florida King showed that maximum length of branch (286 cm), weight of pruned product (35.13 gm) and leaves N (2.49%) were found in the treatment where 25% MN+ 75% FYM were applied while P (1470 ppm) & K (5650 ppm) in Florida King leaves were found maximum in the treatment where 100% FYM was applied. In Early Grand variety, maximum weight of pruned product (32.5 gm) was found in the treatment where 50% MN+ 50% FYM were applied. While length of branches

(265 cm) and leaves N (2.30%), P (1425 ppm) & K (5384 ppm) were found maximum in the treatment where only FYM was applied. In plum fruit orchards maximum weight of pruned product (2.26 gm) was found in the treatment where 75% MN+ 25% FYM were applied. N (2.18%), P (1825 ppm) and K (2330 ppm) were found maximum in the treatment where 25% MN+ 75% FYM were applied. Soil analysis of the fruit orchards showed that maximum organic matter (1.32%), N (0.066%) and available P (7.60 ppm) were found in the treatment where 100% farmyard manure was applied.

Improving off-season vegetables production under high and walk-in tunnels through integrated management of nutrients and water

Vegetables are becoming an integral part of daily meals due the changing habits of the masses. Off-season vegetables cultivation under high tunnels in Khyber Pakhtunkhwa has a wide scope to generate economic opportunities for small landholders as there is a great demand of vegetables throughout the year. Farmers having small land holdings and scarce water, normally grow traditional crops through traditional methods of irrigation. The vegetables production by traditional farming is always very low. Under this situation tunnel farming is the best option to get maximum production from such scarce sources. The adoption of tunnel farming with high efficiency irrigation system and by using high quality certified seed can fulfill the vegetable demands of the increasing population. Fertilizer application through drip irrigation (fertigation) allows precise timing and uniform distribution of fertilizers. Proper fertigation is based on nutrient status of soil and nutrient requirements at different stages of crops. It has been established that about 50% fertilizer use efficiency can be enhanced through fertigation for horticultural crops. Optimization of fertilizer and water use would reduce production cost of off-season vegetables, which would contribute to economic betterment of farming community. It will also minimize the agro-chemical hazard to human health and pollution of ground water resources and environment. The farmers under tunnel farming are using imbalanced/ excessive fertilizers without any scientific and research-based recommend-ations. However, the excessive use of such chemicals is harmful for soil, plant and ultimately human health. Vegetable crops differ widely in their nutrient requirements and pattern of nutrient uptake over the growing season. Fruiting crops such as tomato, pepper and melon require little

nutrition until flowering as compared to fruit setting.

Drip irrigation is a type of irrigation where water is mixed with proper dose of plant nutrients under low pressure directly or near the plants root zone. The main advantage of drip irrigation is the efficient use of water and thus saving 50-80% water. In Khyber Pakhtunkhwa, 53% of the cultivated area is rain-fed and it needs proper attention. High tunnel farming including efficient irrigation system for growing off-season vegetables are particularly suitable for the farmers of rain-fed areas having scarce water and nutrients sources. The integrated nutrients and water management may be the environment friendly option to improve yield, fertilizer use efficiency and quality of produce.

The critical timings, methods and economical levels of fertilizer and irrigation for tomato and cucumber were identified for growing off-season vegetables in high tunnels with furrow and drip irrigation systems. Time of fertilizer application proved very crucial for achieving higher yield of tomato and cucumber. The maximum tomato fruit yield (1.78 t/10 Marla tunnel) was achieved with soil application of NPK @ 75-75-90 kg ha^{-1} at 30 days interval with flood irrigation system. Similarly, in drip irrigation highest cucumber yield (3.0 t/10 Marla tunnel) was achieved with NPK (10-10-15 kg ha^{-1}) applied at 7 days interval. Foliar application of Zinc @ 0.5 % to cucumber increased yield by 22%. The technology of tunnel farming was demonstrated to the vegetable growers on February 22, 2022 in which more than 60 growers, students, researchers and extension workers participated.

One day training workshop on "Integrated Nutrient Management for Off-season Vegetables Production in Tunnels" held at NIFA on February 22, 2022

Monitoring the long term impact of conversion to organic farming systems

There had been a remarkable increase in per acre wheat yield at national level since the introduction of fertilizer responsive wheat varieties in the post green revolution era. This increment in wheat yield achieved under chemical intensive farming has been associated with rising cost of production, depletion of soil fertility and triggering of climate change. Farming community is

switching over to other high value crops as net returns from wheat production are continually declining. There is a dire need to identify farming systems that can improve yield and soil health while ensuring reasonable net returns from wheat production. Organic farming practices offer sustainable solution towards improving wheat yield and soil fertility without comprising overall long term net profitability.

A long term field trial has been established at the experimental farm of the institute since 2018-2019 to monitor the long term impact of conversion to organic farming system and trial is in progress during 2021-22. Two distinct blocks of land (1 kanal each) were planted under organic and conventional (chemical) farming systems. Wheat was planted under both farming system during winter seasons. During summer, maize and sesbania were planted under chemical and organic farming systems, respectively. Nutritional requirements under organic farming system were met through green manuring of sesbania (2021) and application of farm yard manure (2020). Soils under each farming system were analyzed up to 90 cm with every 30 cm increment for the determination of soil organic matter, organic carbon, nitrogen, phosphorus and potassium contents.

Preliminary findings depicted that it was possible to maintain and slightly improve soil fertility under organic farming systems without compromising wheat grain yield. Significant differences ($P \leq 0.05$) were observed between farming systems for grain yield, water use efficiency, protein contents and nutrient uptake. Wheat grain yield of 4.7 and 3.8 t ha^{-1} were recorded under chemical and organic farming systems, respectively. Water use efficiency was higher under chemical fertilizer based farming system (15 kg ha^{-1} mm^{-1} than under organic farming (12 kg ha^{-1} mm^{-1}). Protein content were slightly higher under chemical farming (10.4%) than under organic farming (9.5%). Wheat crop under chemical farming exhibited better uptake of nitrogen, phosphorus and potassium than organic farming system. Potato tuber yield was slightly higher under chemical based farming (13.6 t ha^{-1}) than under organic farming system (12.3 t ha^{-1}). Maize biomass yield of 95 t ha^{-1} and sesbania biomass yield of 16 t ha^{-1} was also recorded from ongoing trial. Study is expected to provide recommendations for production of organic wheat and potato besides providing data sets generated through systematic

organic farming research that are lacking at the national level.

Enrichment of compost and compost tea for their nutritive value

Use of chemical fertilizers to improve yield and net returns to farmers has introduced problems of environmental pollution and land degradation. The current era emphasizing sustainability does not permit excessive chemical input and focuses on conservation of land & environment. The high costs of chemical fertilizers are making their use beyond the reach of many small farmers. Situation demands to use chemical and organic fertilizers in conjunction to optimize yield and conserve land & environment. Organic fertilizers i.e. compost and compost tea (CT) have multiple benefits on improvement of sustainable soil fertility build up and are particularly useful for small scale production of organic vegetables and nursery raising of field & horticultural crops. However, the nutritive value of existing organic fertilizers is very low and needs improvement through exploitation of available natural sources of plant nutrition.

Compost is a slow release organic fertilizer that can be prepared at farm level using various agro-waste materials. In order to develop enriched agro-waste compost, various organic/ inorganic sources of plant nutrition like animal manure (AM), poultry manure (PM), filter cake (FC), fish bone meal, etc. were analyzed for their nitrogen (N) and phosphorus (P) contents. Results revealed that fish bone meal had the maximum nitrogen (4.95%) and phosphorus (1.2%) contents. The N and P rich materials were mixed with agro-wastes i.e. green plant material (GPM) and dry plant material (DPM) in various formulations for the preparation of enriched compost. Analysis of mature composts revealed that the compost prepared from combination of agro-wastes (GPM+DPM) with poultry manure (PM) had the highest N content of 1.37%, while the highest P content (0.6%) was recorded when the compost was prepared by combining agro-wastes with rock phosphate (RP) and filter cake (FC). The study needs to be repeated next year to find out reliable formulation for the preparation of compost having higher nitrogen & phosphors contents.

Compost tea (CT) is a liquid extract of compost. Its handling is relatively easier compared to compost as its use reduces transportation costs associated with huge amounts of compost. It can improve plant production by decreasing disease incidence, improving plant nutrient status and generally promoting plant growth. Findings from the on-going research work on improving nitrogen content of CT revealed that highest

nitrogen content (0.49%) were found in compost tea that was enriched by using humic acid @ 12.5 g/ L compost tea.

Productivity Enhancement under Climate Smart Agriculture (CSA) through On-Field Demonstration (OFD) Trials

Wheat is staple food crop of Pakistan. Its domestic production is not sufficient to meet the food requirements of rapidly growing population due to multitude of factors, mainly because of lower fertilizer use efficiency. There exists enormous scope to increase domestic production by narrowing the yield gap between achievable and average yields. Food security situation in the country can be improved by enhancing production of wheat. The yield gap can be reduced by adopting the novel production technology developed by national and international institutions. The aim of the project is to compare farmers' existing practices with NIFA and IAEA recommended technologies for enhancing the overall production of wheat in the country and to reduce the gap between achievable and national average yields.

Five sites in different locations of Khyber Pakhtunkhwa were selected for establishing the on-field demonstration (OFD) trials on wheat. Prior to the sowing of the field trials, soil samples were collected and analyzed for various physico-chemical properties. The wheat variety (NIFA Lalma) was sown at normal sowing time using four fertilizer treatments i.e. control (no fertilizer), farmer's practice (80-25-0 kg NPK ha^{-1}), NIFA practice (120-37-0 kg NPK ha^{-1}) and IAEA practice (230-30-50 kg NPK ha^{-1}).

Tangible Achievements

Tunnel/ Vertical Farming

The technology of tunnel/ vertical farming ensures availability of fresh vegetables for the consumers round the year. It has the potential to produce high quality and quantity of vegetables from small amount of land. The critical timings, methods and economical levels of fertilizer and irrigation for growing off-season tomato and cucumber in high tunnels were identified. Fertilizer application

at 7 and 30 days interval produced maximum cucumber and tomato, respectively. More than 60 farmers were trained on off-season

vegetables farming and about 20 farmers have adopted tunnels/ vertical farming

technology for growing off-season tomatoes and cucumber by using NIFA integrated nutrient and water management package and are getting ten to fifteen times more income compared to conventional ones.

Organic Fertilizers (Compost & Compost Tea)

Injudicious use of chemical fertilizers over the years to improve yield and net returns has introduced problems of environmental pollution and land degradation, posing serious threats to sustainable soil productivity. Situation demands to use chemical and organic fertilizers in conjunction to optimize yield and conserve land & environment. Organic fertilizers (compost and compost tea) have multiple benefits on enhancing the sustainable soil productivity and are particularly useful for small scale production of organic vegetables and nursery raising of field & horticultural crops. However, the nutritive value of existing organic fertilizers is very low and needs improvement through exploitation of available natural sources of plant nutrition. Pilot scale production facility for compost and compost tea has been installed at the institute.

PLANT PROTECTION DIVISION

A. Agriculture Entomology and Pathology

Insect pests and pathogens reduce yield and quality of agriculture production. They cause substantial economic losses and reduce food security at household, national and global levels. Main emphasis under this initiative is to conduct basic and applied research for the development of eco-benign technologies for the management of cosmopolitan insect pests including fruit worm, fruit fly, subterranean termites, aphids, stored product pests, and major pathological constraints in vegetables, fruits and arable crops. R & D results achieved during the reported period are as under:

Biological Control of *Helicoverpa armigera* (Hub.) and wheat aphid resistance

Tomato fruit worm (*H. armigera*) can be effectively managed through field releases of egg parasitoid *Trichogramma chilonis* (Ishii) after lab rearing on host eggs of *Sitotroga cerealella (Oliv.)* Results on different aspects of *H. armigera*, *T. chilonis* and *S. cerealella* along with aphid resistance wheat screening are as under:

Monitoring moth population of *H. armigera* (Hub.) through pheromone baited traps

Pheromone baited traps were installed in in high tunnel tomato and field grown chickpea. Maximum moth population (9/trap) of *H. armigera* was recorded during April which was followed by March-May (6/trap), June (3/trap) in high tunnel tomato whereas in chickpea field, maximum moths were recorded during April (15/trap) followed by March (12/trap), May (9/trap), June (6/trap) and no moth was recorded in both crops from January to February. Fruit worm moth population was higher in March-April in chickpea field as compared to high tunnel tomato crop. This information is a pre-requisite for releasing *T. chilonis* and other interventions to control *H. armigera.*

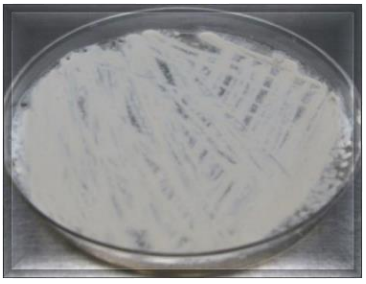
Effect of natural and artificial diets on the biology of *H. armigera* (Hub.)

Results showed that maximum larval period (18 days) was recorded in artificial diet (maize flour) followed by control Okra (17 days) and common bean artificial diet (16 days) while minimum (13 days) was recorded in chickpea flour base artificial diet. Maximum larval mortality (20%) was recorded in control Okra while minimum (4%) in chickpea flour diet. Maximum pupal period (13 days) was recorded in artificial

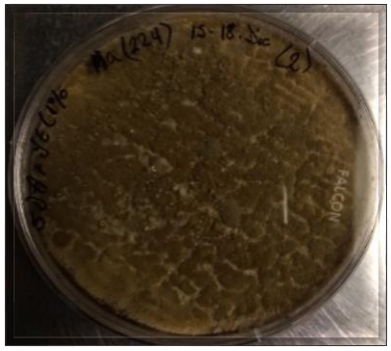
diet (common bean) followed by mungbean (12 days). Maximum adult emergence (86%) was recorded in control (Okra) diet while minimum (68%) was recorded in maize flour-base artificial diet. Adult moth fecundity was found maximum (598 eggs/female) in chickpea flour-based diet. Moreover, the maximum female longevity (13 days) was recorded in soyabean flour-base diet while minimum (10 days) was recorded in maize flour base diet. Chickpea flour base artificial diet was found very effective with minimum larval and pupal period, low mortality rate, high adult emergence and fecundity rate as compared to other diets and can be used for lab rearing of *H. armigera.*

In vitro evaluation of entomopathogenic fungi against *H. armigera* (Hub.)

Different spore concentrations of two entomopathogenic fungi (*Beauveria bassiana* & *Metarhizium anisopliae*) were tested against *H. armigera*. Results reveled that the maximum mortality of *H. armigera* (87%) was recorded in *B. bassiana* when spores' concentration was applied @ $1x10^8$/ml which was followed by *M. anisopliae*, $1x10^8$/ml (73.5%), *B. bassiana*, $5x10^7$ (66.9%), *M. anisopliae*, $5x10^7$/ml (46.8%) and *B. bassiana*, $1x10^7$/ml (40.1%) while minimum mortality (26.8%) was recorded in *M. anisopliae* @ $1x10^7$/ml concentration. Probit analysis showed that the LC_{50} recorded for *B. bassiana* and *M. anisopliae* were 1.721×10^7 and 3.966×10^7 respectively. Lethal time LT_{50} recorded for *B. bassiana* and *M. anisopliae* were 10.23 and 10.49 days. It is concluded that entomopathogenic fungi at higher concentration (1×10^8 spores ml^{-1}) cause maximum mortality of *H. armigera. Beauveria bassiana* took 10.2 days and *M. anisopliae* took 10.5 days to kill 50% population of fruit worm larvae in laboratory.



Beauveria bassiana



Metarhizium anisopliae

Host preference studies on the biological parameters of *S. cerealella*

The experimental results showed that the maximum number of moths emergence was

recorded in oat (132) in free choice test followed by maize (60) and minimum was recorded in split chickpea (18). In no choice test, maximum moth emergence was recorded in oat i.e., 83 followed by wheat (63). In both cases, oat was preferred diet for maximum adult emergence of *Sitotroga* as compared to other cereals. Minimum developmental period, maximum adult longevity and adult weight were recorded in maize i.e. 28 days, 7 days and 0.9 mg, respectively. Moreover, maximum mean fecundity (99 eggs) and fertility (86%) were recorded in wheat which was statistically at par with oat. Maximum infestation (15%) was recorded in chickpea and maximum weight loss was recorded in oat (14%). Oat and maize proved to be the most preferred food and alternative to wheat for mass rearing of *Sitotroga* in the laboratory.

Laboratory evaluation of cereals diets on the fitness of *T. chilonis*

Minimum developmental period of *T. chilonis* was recorded on host eggs of *S. cerealella* reared on millet i.e., 9.9 days followed by oat (10 days) and wheat (11 days). Maximum parasitism was recorded in wheat (86%) followed by millet (78%) and oat (74%). Highest adult emergence (88%) was recorded on wheat followed by millet (83%). Maximum male moths emerged in oat (34%) which was followed by wheat (32%) whereas maximum female moths (68%) emerged in millet followed by wheat (68%). Moreover, *Trichogramma* females were higher in all tested cereals diets. Wheat grains was the most preferred rearing food for *S. cerealella* eggs production and mass scale rearing of *T. chilonis*. However, millet & oat can be used as alternative of wheat for *S. cerealella* rearing & improve the quality of *T. chilonis* in lab condition.

Wheat aphid resistance

Under national wheat improvement program, released, candidate and elite varieties were screened against local aphid population. Out of 1169 wheat genotypes, 24 were found immune, resistant (137), moderately resistant (260), tolerant (251), moderately susceptible (182), susceptible (230) and 85 were found highly susceptible to wheat aphids.

B. Termite management

Subterranean termites are the most serious insect pests of agricultural fields and wooden structures. They are cryptic in nature and prefer concealed habitat which makes their early detection and control difficult. Synthetic pesticides are routinely used for their control which are environmentally hazardous, expensive and undesired. Results

of R&D efforts focusing on the development of eco-friendly indigenous methods for termite control are reported as under:

Candidate plant extracts for termites' management

Different concentrations of Clove (*Syzygium aromaticum*) and Garlic (*Allium sativum*) extracts and their combinations were tested for toxicity and synergistic/antagonistic effects on the mortality of subterranean termites. It was found that clove oil was highly toxic against termites alone as well as in combination with garlic which showed high rate of mortality in exposed termite populations even at very low concentration (0.25%). Whereas garlic became less toxic when its concentration was 5% or less. At higher ratios of 1:10 and 1:20 of clove to garlic; antagonistic impact was observed and the overall toxicity was decreased but at lower ratios like 1:1, 1:2 and 1:4 synergism was observed between clove and garlic which resulted in high termite mortality. Furthermore, all extracts and their concentrations showed deterrent effect against termites. Moreover, residual toxicity of above-mentioned extracts and their concentrations was also recorded by releasing fresh group of termites after gap of 15 up to 2 months in same treated arena and it was observed that treated arena remained toxic for termites and caused quick and high mortalities.

Bait matrix development and toxin delivery stations for termite management

Five different phagostimulants (glucose, fructose, sucrose, urea and yeast) were tested for termite attraction to develop attractive baits matrix. Blotting paper treated with sucrose (3%) and yeast (2%) displayed 60% to 65% attraction of termites as compared to control (untreated blotting paper) 40% and 35%. Developed bait matrix was found more palatable with 35% consumption as compared to poplar wood with 19% consumption in vitro efficacy trials. For selection of toxicant to be added in termite baits, three different toxins were evaluated for their non-repellents and slow action toxicity. Pyriproxyfen showed very quick mortality (LC90, 27.5 PPM, LT90, 4 days) while Coragen found with less mortality event at higher concentrations (LC90, 660 PPM and LT90, 22 days) and termites have showed deterrence response from these both toxins. Lufenuron screened out as slow acting toxicant with LC90, 220 ppm and LT 90, of 9 days and found with almost no repellent response. So, Lufenuron have potential to be mixed in bait matrix as toxicant for sustainable management of subterranean termites.

C. Fruit fly management

Fruit flies (Diptera: Tephritidae) are the deleterious pests of horticultural crops causing tremendous losses to a wide range of fruits and vegetables at farm level as well as in supply chain to traders, retailers and exporters. Farmers mainly rely on the use of toxic chemicals which pose potential health risk, destruction of beneficial insect environmental pollution and development of insect pest resistance. R & D emphasis is on the development and application of alternative control strategies to manage fruit flies and its results are as follows:

Food baits evaluation for fruit fly, *Bactrocera* spp.

Attractiveness of five food baits *viz.* protein hydrolyzate, yeast instant, torula yeast casein and sugar molasses towards fruit fly, *Bactrocera* species was tested in guava orchard located at Malakandher farm of Agricultural university, Peshawar. Yeast instant was found to be the most preferred food bait attracting significantly higher number of *B. zonata* and *B. dorsalis* and hence the highest cumulative population of both species followed by treatment of sugar molasses and protein hydrolyzate. Sex ratio of *B. zonata* and *B. dorsalis* captured in different protein baited traps was found to be slightly inclined towards female flies.

Synergistic effect of ammonium acetate and food baits on trapping of *Bactrocera* spp.

Five food baits (protein hydrolyzate, torula yeast, yeast instant, casein and sugar molasses) in combination with ammonium acetate (3%) were tested for their attraction to the fruit fly *Bactrocera* species in guava orchard located at Malakandher farm of Agricultural University, Peshawar. Results revealed that blends of ammonium acetate with yeast instant, protein hydrolyzate and sugar molasses attracted the highest cumulative population of both species. Similarly, sex ratio of both species captured in traps of all food baits blended with ammonium acetate was found to be highly inclined towards female flies compared to male flies. In terms of percent increase in attraction over simple food baits, blends of ammonium acetate with protein hydrolyzate and yeast instant showed promising results thereby increasing the attraction of these baits for *B. zonata* and *B. dorsalis*.

Effect of botanicals on peach fruit fly, *Bactrocera zonata*

Four botanical extracts *viz.* neem oil (1% and 2%), neem seed extract, eucalyptus leaf extract and bakain seed extract each @ 3 and 4% were evaluated against *B. zonata* in free choice bioassays using treated and untreated

guava fruits in lab. Neem oil 2% and neem seed extract 4% were found to be the most promising repellents and oviposition deterrents against *B. zonata*. Both botanicals also showed the highest percent pupal inhibition and percent adult emergence inhibition. Results suggested that Neem oil 2% and neem seed extract 4% could be used for the management of peach fruit fly *B. zonata*.

Effect of daytime on the activity of *Bactrocera* species

Study with an objective to explore daytime hours during which fruit flies remain more active under two field conditions in Peshawar and generated data could be exploited for its management. Results revealed that at Malakandher farm, maximum numbers of flies were captured between 5:30-9:30 hours in the morning followed by 15:30PM to 19:30PM (evening). In between the activities of flies were decreased and less flies per trap per two hours were captured. Whereas population of *B. dorsalis* was found to be far lower than that of *B. zonata*. At Tarnab farm *Bactrocera* species remained more active during 6:00AM to 10:00AM (morning) and 16:00-18:00 hours in the evening.

Assessment of ovipositional stimulants for egg collection

Three different ovipositional stimulants (mango, peach and guava juices) were assessed in free-choice experiment to identify suitable juice for successful egg collection. Results of *B. dorsalis* indicated that maximum number of eggs (155 nos) was recovered using guava juice, followed by peach juice (112 nos) and mango juice (46 nos). Similarly, maximum number of *B. zonata* eggs (192 nos) were recorded in guava juice followed peach juice (92 nos) and mango juice (52 nos). Hence, guava juice is the most suitable and effective ovipositional stimulant for egg collection of *B. dorsalis* and *B. zonata*.

Assessment of larval diets for fruit flies rearing

Three artificial diets (banana, casein and yeast base) were screened. Results showed that the diet comprising banana fruit, yeast, nipagen and sodium benzoate yielded the highest number of mean pupae 79 and 63 in *B. zonata* and *B. dorsalis* respectively. Similarly, the highest percent adult emergence (82 and 83%) was recorded in *B. zonata* and *B. dorsalis* respectively. Whereas, the shortest larval period (6.5 & 7.0 days) and incubation periods (2.5 days) were observed in banana diet for *B. zonata* and *B. dorsalis* respectively. Thus, it is concluded that the banana diet may be used for successful

laboratory rearing of *B. zonata* and *B. dorsalis* for saving time and resources.

D. Crop pathology

Crop diseases have a serious and wide impact as they can spread readily within season and also from season to season. Costs arise directly from yield losses, chemical control and from maintenance of disease resistance preemptive control program to mitigate the risk of new pathotypes and virulence's. R & D outcomes carried out under crop pathology program during the period are reported below.

Status and seasonal progress of airborne and vector borne diseases

A set of 347 diversified wheat genotypes were raised as stationary sentinel plot for epidemiological studies of yellow rust, leaf rust, powdery mildew and barley yellow dwarf at NIFA farm, Peshawar. Temporal disease assesments were recorded.Yellow rust trigered as flicking and after completing latent period was prominent during mid-march and disease severity varied between 10-20%. Yellow rust severity overtime was increased and its highest value reached upto 60% during april. Leaf rust was observed in nine genotypes which ranged between 10-70% while powdery mildew was not recorded during the season at NIFA farm. Aphid borne barley yellow dwarf disease of wheat was prevelent in 65 genotypes (19%) and disease severity varied between 20-80%.

Pathogen intelligence, host resistance and chemical control

Availability of information regarding yellow rust pathogen (*Puccinia striiformis f. sp. tritici* (*Pst*) virulence's, durable *Pst* resistance sources and cultivation value of all stage *Pst* resistance genes/sources are the prerequisite for rust management and to foster host resistance development and deployment.

Temporal variability of *Pst* virulence's and all stage resistance genes

Temporal variability in natural *Pst* virulence's and races were investigated and postulated during the season at NIFA. Four different *Pst* races were postulated over season at NIFA farm and included 0E0, 12E255, 126E238 and 6E255 which carried 8 to 14 virulence's. Race 126E255 has the broadest virulence spectrum and carried potential of hitting 14 yellow rust resistance genes. *Pst* virulence's including *v1, v2, v6, v7, v8, v9, v25, v27, v32* were consistently recorded during 2018-2022 wheat growing seasons and were considered fixed in the local pathogen population and the corresponding all stage yellow rust resistance

genes (*Yr1*, *Yr2*, *Yr6*, *Yr7*, *Yr8*, *Yr9*, *Yr25*, *Yr27* and *Yr32*) were inferred to be ineffective. Yellow rust resistance genes including *Yr10*, *Yr21*, *Yr24*, *Yr25*, *Yr28*, *Yr29*, *Yr32*, *Yr35*, *Yr41*, *Yr43*, *Yr44*, *Yr65*, *Yr76* and *YrSp* were found clean and considered effective.

Partial resistance and fungicides for *Pst* management

Durable resistance

In-order to retard or reduce yellow rust impact in 70% of the wheat landscape of low altitude districts of KP Province, initial inoculum of *Pst* from the source area (i.e. mid and high altitude districts) and exotic territories is essentially required to be reduced. To achieve this goal, a set 195 registered/ approved wheat cultivars were tested under artificially induced *Pst* epidemic to identify allo and auto infection reducing genotypes which were determined using captured temporal data which was transformed to area under disease progress curve (AUDPC). AUDPC values were ranged from 0 to 1080. AUDPC values of 40 genotypes were fall between 201-400 and were considered moderately resistant and potentially durable/slow rusting and are suggested for deployment in the source area for *Pst* management.

Resistance and yield protection

Preliminary investigation was conducted to asses comparative yield reduction and *Pst* development using three each highly resistant (Fatehjang-16, Wardan-17 and Pasina17), moderately resistant (Pakistan-2013, Boroloug-16, Anaj-17) and moderately susceptible (Shafaq-2006, Galaxy-2013, Land race) cultivars along with susceptible check (Morocco). Mean AUDPC values of highly resistant, moderately resistant, moderately susceptible and susceptible check were 15.5, 210, 432 and 739 respectively while corresponding yield/ plot (g) (1239, 1167, 1061 & 622) and thousand kernel weights(g) were (29.6, 29, 27 & 26.5).

Fungicidal efficacy against *Pst* and yield protection

Investigation was conducted to study efficacy of five fungicides (Tilit, Success, Redomil, Topsin-M, Cymoxanil plus Mancozeb) using yellow rust susceptible variety "Morocco". Statistically maximum area under disease progress curve (AUDPC) were recorded in control (624.17) and Cymoxanil+Mancozeb (630) while no rust was recorded in Tilit treated plots. AUDPC in the remaining three treatments varied in the range of 303-560 which were statistically different from each other. Highest yield per plot were recorded in both Tilit (408 g) Cymoxanil plus Mancozeb (375 g) while control yield was 292 g.

Remaining three treatments were statistically at par to each other. Thousand kernel weight (TKW) in Tilit (31 g) was followed by Cymoxanil plus Mancozeb(30 g), Redomil (30 g), Success(30 g), Topsin-M (30 g) and Control (29 g), Further studies are required to confirm current results.

Development of disease resistant germplasm and varieties

NIFA is fostering the development of disease resistant elite wheat germplasm and varieties involving 32 national institutions and other private companies. Three sets of wheat germplasm including 795 elite genotypes in National Wheat Disease Screening Nursery (NWDSN), 70 candidate varieties (National Uniform Wheat Yield Trial-Nursery) and a set of 195 released varieties were received for testing at NIFA under national wheat improvement program, Pakistan Agricultural Research Council (PARC), Islamabad. These three sets of national importance were raised, tested and evaluated for all stage and partial resistance under *Pst* artificial epidemic conditions. Over season critical disease data of each set entries was recorded under local conditions which is published in the final country report by PARC, Islamabad for use by national breeding programs, provincial and federal seed councils for variety release and cultivation.

Wheat seed health risk analyses

Seeds of one hundred and eighty NIFA grown wheat varieties were tested for black point and karnal bunt incidence. One thousand seed of each variety were manually analyzed for black point and karnal bunt incidence using magnifying lens with built in light source. Percent black point incidence reached up to 5 and 18% for karnal bunt and black point respectively. Seed treatment with appropriate fungicides should be carried out to avoid and manage these diseases.

E. Medical entomology

Dengue is a vector borne human disease and has become endemic in Pakistan. As no effective vaccine is available globally for its control, therefore, the control of the culprit vector mosquitoes is the only option on board. Reliance mainly on insecticides for vector control has caused health hazards, entomological problems with environmental constraints. Hence, research efforts are directed to work out environment friendly activities and to develop Integrated Vector Management (IVM) against dengue mosquitoes through integration of conventional & novel techniques.

Assessment of ovitraps for developing adult trapping system

Laboratory findings on the use of low cost ovitraps was further tested under field

conditions at different replicated sites. The follow up population data was based on the number of eggs in the ovitraps placed in the treated block and overall suppression of the gravid females. Results were misleading due to the chemicals used inside the traps which may have resulted in either deterrence of the female mosquitoes or killed the mosquitoes outside the traps. Further study is required to resolve this issue.

Evaluation of Insect Growth Regulators (IGRs) on mosquito and their use in ovitraps

Three types of IGRs (i.e. Pyroproxyfen, Novoluron, and larvicol) were tested on development parameters such as eggs hatching inhibition, development, mortality and emergence to adult stage of mosquitoes. Results indicated that all IGRs affected development of mosquitoes and prevented them to grow to the next stage. When used in ovitraps, none of the IGRs resulted in repellency to the gravid females. Their use in indoor and outdoor ovitraps caused eggs hatching inhibition, mortality (100%) to larval and pupal stages and longevity of adult female *Ae. aegypti* was reduced to 23-days as compared to control (47-days) longevity. In a field trials at three sites in Peshawar including Tarnab Farm, Muslim City and Wapda Colony, application of Pyreproxifen @ 1.5 ppm) was standardized to be used as an eco-friendly larvicide in lieu of other hazardous chemicals.

Efficacy of parthenium based aqueous extract for mosquitos' management

Parthenium based aqueous extract in various formulation comprising of organic based synergizing agent plus sand/sodium bicarbonate as inert matter were found effective against larval stage of culicid mosquitoes under both lab and field conditions. Results indicated that the required mortality (~ 100 %) was achieved using relatively higher concentration as compared with in vitro trials. The field application dose of the effective formulation was found to be 250-300g of the formulation per 1000 Liters ($1m^3$) of the natural aquatic habitat. This dose when tested in mosquito habitats of various nature (sewage, ponds, pools, discarded fountains etc.), the outcome mortality effect was significantly higher and was (~ 100 %) in almost all the trials.

Formulations of bio-pesticides and field tests against culicid mosquitoes at Shahi Bagh, Peshawar.

Evaluation of potential of mass production cages (MPC) for Culicid mosquitoes

Evaluation of rearing and production potential of Aedes mosquitoes was compared

by using mass production cages (MPC) and general rearing cages (GRC). Data on biological parameters; pupae production (400, 250), sex ratio (85, 80), mean longevity (45, 30) showed high production potential in case of MPC as compared with GRC respectively. The overall increase was found to be more than (20%) of these cages over the routine rearing procedures and therefore, should be considered in large scale rearing of Aedes mosquitoes. Trails on the bioassays for resistance status showed various ratio of resistance in the field population of the culicid mosquitoes as compared with the laboratory susceptible strain.

Monitoring of resistance in field population of culicid mosquitoes

Trails on resistance status were carried out on various batches of mosquitoes collected from multiple sites in Peshawar including Tarnab farm, Muslim city, Shahi Bagh and Sarband. Data showed elevated ratio of resistance in field populations as compared to the laboratory strain. The resistant ratio (RR) was above the threshold level i.e. 5 at all locations; Tarnab Farm, Muslim City, Shahi Bagh and Sarband. Resistant ratio values for Deltamethrin and Cypermethrin were in the range of highly resistant (29-144) under trial locations. However, in case of Organophosphate (Temophos) and new insecticides (Aceta group), did not show any indication of resistance.

Hunt for naturally existing tsl mutation in *Aedes aegypti* and *Ae. albopictus* for construction of more robust Genetic Sex Strain (GSS) for SIT

In search of naturally existing temperature sensitive lethal (tsl) mutation in dengue vector mosquitoes under IAEA-CRP (44003) RC-No 24085; new ovitraps were installed for collection of eggs of both dengue vector's species from different climatic and topographic areas of Pakistan. Larvae and eggs were also collected from by surveying potential breeding places and in coordination with district dengue surveillance teams of health department. Four colonies of *Ae. albopictus* from Peshawar, Swabi, Swat and Mardan were established at NIFA mosquito lab and six other colonies were established and up scaled of *Ae. aegypti* collected from different areas of Peshawar, Bhakkar, Charsadda, Rawalpindi. First instar larvae of up scaled colonies were exposed to heat in water bath in search of naturally existing tsl mutation for construction of genetic sexing strains. Initial thermal screening was done on temperatures ranging from 37 to 41^{o}C for time period ranging from 2 to 24 hrs. It was determined that strains showed variable sensitivity to heat @ 40^{o}C and 41^{o}C temperature for 5 and 3 hrs respectively.

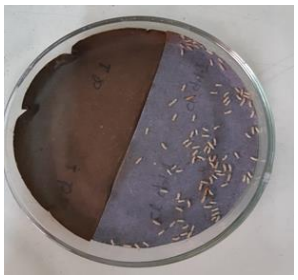
Potential heat resistant and sensitive colonies were again reared for further detailed tsl screening.

Tangible Achievements

NIFA Dengue Guard a mosquito repellent product has been developed for protection against mosquito bites. It is has unique blend of botanical and synthetic compounds with appealing aroma for users and 7-8 hours protection from biting insects especially mosquitoes. The product has been tested extensively at laboratory followed by field evaluation on volunteers with significant consumer satisfaction results. The product has been Trade Marked under reference no. 529340 with Intellectual Property Organization (IPO) Pakistan. Its patent is also under consideration with IPO Pakistan.

Termite Management

Extracts of local plants having insecticidal characteristics were tested for their anti-termiticidal properties. Out of several tested plants clove and garlic were found most toxic and deterrent against subterranean termites. Clove was found toxic even at very low concentration of 1% whereas garlic extracts was effective at 5% concentration. It was concluded that clove have potential to be formulated as organic termiticide for eco-friendly management of termites.



Deterrence of darker portion (treated with clove extract) of the blotting paper towards exposed termites

Different cellulosic materials and phagostimulants were also tested as constituents of solid bait matrix for development of commercial termite bait. Mixture of 70% popular wood, 15% sugarcane powder, 15% methyl cellulose powder having water (300ml per 100 g bait) found attractive for termites alongwith 2% sucrose and Yeast as phagostimulants to enhance bait consumption. Moreover, Lufenuron screened as appropriate non-repellent and slow acting toxicant having potential to be mixed in a bait matrix for sustainable management of termites.

Preference of termites toward prepared bait (on right) in comparison with other cellulosic materials

PLANT BREEDING AND GENETICS DIVISION

The efforts for development of high yielding disease resistant and widely adaptable wheat varieties released to the farmers of irrigated and rainfed areas are responsive to high inputs and are high yielding by 10 to 15% compared to other wheat varieties. This will improve the livelihood of the farming community in the province. During 2021-22 a total of 13,400 kg quality seed (Pre-Basic) of NIFA rainfed wheat varieties i.e., NIFA Lalma 2013, NIFA Awaz 2019, NIFA Insaf 2015, NIFA Aman and Tatara 96 was produced which is sufficient to plant 265 acres of land. The institute will generate an amount of Pak. Rs. 17,42,000/- from seed sale. The new mutant varieties of rapeseed when adopted by the farmers will produce greater crop yields, growers' areas and quality. This year the Oilseed Group apart from achieving its R&D goals as per research programme, has been able to generate an income of Rs. 283,397/- through the sale of quality seeds, grains and seeds quality analysis. 244 kg of quality pre-basic seed of NIFA green and black-seeded mungbean varieties "Ramzan, NIFA Mung-2019, NIFA Mung Spinghar-21 and NIFA Mung Sikaram-21" and 60 kg of quality pre-basic seed of NIFA common bean varieties "NIFA Lobia Red-22 and NIFA Lobia Yellow-22" was sold to KP Agricultural Extension Department through PSDP Pulses Project for further multiplication in kharif 2022. The Division is also actively engaged by providing high yielding, true to type fruit and better fruit quality nurseries for orchards establishment in the country. This will ultimately increase the income of poor farmers by fetching high net returns from their orchards.

FOOD AND NUTRITION DIVISION

Development of technologies for Preservation/ Value addition of fruit and vegetables to mitigate postharvest losses is a strong component of Food and Nutrition Division (FND). Trainings were conducted to transfer technologies to farmers/entrepreneurs to improve their socioeconomic stability. Limited scale production of fruit products for R&D purpose within the institute earned total receipts of around Rs. 0.7 million during year 2021-2022. Irradiation services were provided

to gemstone traders for value addition of gemstones (Topaz, Kunzite, Tourmaline and Quartz etc.). NIFA earned nearly Rs 1.0 million from gemstone irradiation services. However, the gemstone traders are the actual beneficiaries as the value of the gemstones is enhanced 3 to 4 times by irradiation. Radiation services were also provided to R&D and academic organizations that earns a good name for NIFA.

Due to popularization efforts, demand for mushroom spawn has increased and NIFA is providing mushroom spawn and guidance/support to farmers. A total of Rs. 164,000/- was earned from sale of mushroom and mushroom spawn during the year 2021-2022. Moreover, five radio talks have been delivered for Karkeela program broadcast by radio Pakistan Peshawar. Vitamin A and Iron spot kits worth Rs. 1.6 million were supplied to Nutrition International, private mills, regulatory bodies and nutrition programs that are working to eliminate micronutrient deficiency in the country.

SOIL AND ENVIRONMENTAL SCIENCES DIVISION

Soil and Environmental Sciences Division has developed economical and eco-friendly technology packages and products for different field and horticultural corps. Farmers are adopting the technology packages developed by the division to optimize use of inputs and maximize net returns from farming business with the consequences of uplift of socio-economic conditions. The identification and adoption of nutrient efficient genotypes is anticipated to increase wheat yield up to 30% and improved the quality of grain to overcome the mineral malnutrition particularly in marginalized communities. Through the adoption of tunnel farming technology, small vegetable growers are getting up to 10 times more net returns than conventional vegetable production.

PLANT PROTECTION DIVISION

Economic production of crops is directly hampered from yield losses caused by insect pests and diseases such as yellow rust, leaf rust, powdery mildew, barley yellow dwarf and blights which are suspected to have caused 15-30% yield losses in different agro-ecological zones of the country. Effective utilization of pest and disease resistance varieties significantly contribute in reducing production losses and enhance economic benefits of the farming communities. The technologies/products developed at PPD for crop protection and disease management are ultimately transferred to the academia, researchers, agriculture extension specialists, and farmers

as end users which in turn render economic benefits to the end users. Dengue Guard, a mosquito repellent product for protection against mosquitoes, fruit fly traps for fly control and tricho-cards for biological control of lepidopteron pests all have considerable economic impact. The sale of these products on concessional rates generates income to the institute besides its positive effect on environment and economic returns to the farmers.

PUBLICATIONS

1. Ahmed, H.M. and K. Ahmad. 2022. Development of a new oilseed rape variety NIFA Sarson-T20 through physical mutagenesis. Pak. J. Agri., Agri. Engg., Vet. Sci., 38(1): 24-30.
2. Augustinos, A.A., K. Nikolouli, L. Duran De La Fuente, M. Misbah-ul-Haq, D.O. Carvalho and K. Bourtzis. 2022. Introgression of the Aedes aegypti Red-Eye Genetic Sexing Strains into Different Genomic Backgrounds for Sterile Insect Technique Applications. Front. Bioeng. Biotechnol. 10:821428. https://doi:10.3389/fbioe.2022.821428
3. Feng J., J.L. Sun, S.J.A. Shah, F. Wang, Q. Yao, Q. Guo, R. Lin and S. Xu. 2022. Identification of a stripe rust resistance gene *YrSF* in Chinese wheat (*Triticum aestivum*) landrace Sifangmai. Plant Breeding First published: 05 May 2022 https://doi.org/10.1111/pbr.13025
4. Khalique, U., M. Zahid, N. Fatima and S.J.A. Shah. 2021. Evaluation of Pakistani wheat against aphid, *Schizaphis graminum* (Rondani) under favourable weather conditions in Peshawar, Pakistan. Journal of Innovative Sciences, 7(2): 215-221.
5. Khan, A., M.Z. Shah, Z. Mehmood, M.A. Irshad, M. Khan and F. Ahmad. 2022. Effects of ionizing radiation sources and dose levels on quality characteristics of meal ready to eat (Minced cow meat). Pure and Applied Biology, 12(2): 181-188. http://dx.doi.org/10.19045/bspab.2023.120019
6. Khattak, G.S.S., I. Saeed, S. Ahmad, and M. Ibrar. 2022. World's first black-seeded high yielding mungbean [*Vigna radiata* (L) Wilczek] varieties "NIFA Mung Sikaram-21 and NIFA Mung Spinghar-21. International Journal of Applied and Experimental Biology, 1(2): 67-73.
7. Misbah-ul-Haq, M., D.O. Carvalho, L. Duran De La Fuente, A.A. Augustinos and K. Bourtzis. 2022. Genetic Stability and Fitness of Aedes aegypti Red-Eye Genetic Sexing Strains with Pakistani Genomic Background for Sterile Insect Technique Applications. Front. Bioeng. Biotechnol., 10, doi:10.3389/fbioe.2022.871703.
8. Naveed, H., K. Sohail, G.Z. Khan and Y. Zhang. 2021. Oriental leafhopper (Hemiptera: Cicadellidae: Parallygus) first report from North West Pakistan with Redescription of Parallygus rameshi Viraktamath and Webb. Sarhad Journal of Agriculture, 37(3): 954-956.
9. Salman, M., M.H. Khan, M. Zahid, G.Z. Khan, F. Rahim and U. Khalique. 2022. Comparative Ovipositional Preference of the Peach Fruit Fly, *Bactrocera zonata*

(Saunders) (Diptera: Tephritidae) for Selected Fruits under Free-Choice Laboratory Setting. Sarhad Journal of Agriculture, 38(2): 572-577.

10. Tariq M., B. Ahmad, M. Adnan, I.A. Mian, S. Khan, S. Fahad, M.H. Saleem and M. Ali. 2022. Improving boron use efficiency via different application techniques for optimum production of good quality potato (*Solanum tuberosum* L.) in alkaline soil. PLOS ONE, 17(1): e0259403. https://doi.org/10.1371/journal.pone.0259403

FUNDED RESEARCH PROJECTS

Sr. #	Project Title	Project Duration	Total Funds	Principal Investigator	Funding Agency
1.	Promoting research for productivity enhancement in pulses	2019-2024	Rs. 24.446 M	Dr. Gul Sanat Shah	PARC-PSDP
2.	Breeding heat tolerant and high yielding chickpea (*Cicer arietinum* L.) genotypes	2020-2023	Rs. 2.147 M	Dr. Iqbal Saeed	PSF
3.	Wheat Productivity Enhancement Program	2021-2022	$ 2,500	Dr. Fazli Subhan	CIMMYT-Pak
4.	Cooperative agreement for mutual trial planting of wheat varieties between CIB, CAS, China and NIFA, Pakistan	2021-2025	$ 5,000	Dr. Syed Tariq Shah	CIB, CAS, China
5.	Sustainable approaches for effective control of peach stone replant disorders	2022-2025	Rs. 2.8 M	Mr. Shahid Akbar Khalil	PSF
6.	Adaptation of Low Energy Machine Generated Radiation Sources for Surface Decontamination and Disinfestation of Food in Pakistan	2021-2026	€ 30,000	Mr. Alamgeer Khan	IAEA
7.	Improving the Quality Management Practices in Radiation Processing Facilities for Better Performance and Applications	2022-2026	-	Mr. Alamgeer Khan	IAEA
8.	Development of Rapid Test Kit (RTK) for Qualitative Determination of Peroxide Value (POV) to Check Rancidity in Fat/Oils and its Dissemination to End-Users	2021-2022	Rs. 1.0 M	Mr. Ali Raza	PAEC R&D Fund for Member Science Setup
9.	Strengthening National Capabilities to Mitigate Vitamin A Deficiency in the Pakistani Vulnerable Population Using Stable Isotope Techniques	2020-2022	€ 378,295	Dr. Zahid Mehmood	IAEA

Sr. #	Project Title	Project Duration	Total Funds	Principal Investigator	Funding Agency
10.	Strengthening and Enhancing National Capabilities for the Development of Climate Smart Crops, Improvement in Animal Productivity and Management of Soil, Water and Nutrient Resources Using Nuclear and Related Techniques	2022-2025	€ 364,840	Dr. Muhammad Imtiaz (NIFA counterpart)	IAEA
11.	Strengthening Climate Smart Rice Production towards Sustainability and Regional Food Security through Nuclear and Modern Techniques	2022-2025	-	Mr. Parvez Khan	IAEA
12.	Environment friendly management of tomato fruit worm, *Helicoverpa armigera* through bio-control, *Trichogramma chilonis* coupled with SIT in tomato/ okra in greenhouse and field conditions	2017-2023	€ 30,000	Mr. Muhammad Zahid	IAEA
13.	Hunt for naturally existing tsl mutation in *Aedes aegypti* and *Ae. albopictus* for construction of more robust Genetic Sex Strain (GSS) for SIT	2020-2024	€ 24,000	Dr. Misbah Ul Haq	IAEA
14.	Investigating the effect of gamma irradiation in the production of pest free commodities for trade promotion in Pakistan and elsewhere	2022-2026	€ 40,000	Dr. Inamullah Khan	IAEA
15.	Enhancing the Capacity and the Utilization of the Sterile Insect Technique for Aedes Mosquito Control	2022-2026	Technical Cooperation	Dr. Gul Zamin Khan	IAEA

DETAILED LIST OF OFFICERS

Name	Designation
Dr. Gul Sanat Shah, Ph.D. Botany	Director / DCS
Dr. Muhammad Amin, Ph.D. Statistics	PS
I. PLANT BREEDNG & GENETICS DIVISION	
Dr. Roshan Zamir, Ph.D. Horticulture	Head / DCS
Mr. Hafiz Munir Ahmad, M.Sc. (Hons.) Genetics & Breeding	PS
Dr. Muhammad Irfaq Khan, Ph.D. Biology	PS
Mr. Shahid Akbar, M.Sc. (Hons.) Horticulture	PS
Dr. Farooq-i-Azam, Ph.D. Genetics & Breeding	PS
Dr. Syed Tariq Shah, Ph.D. Crop Genetics & Breeding	PS
Dr. Iqbal Saeed, Ph.D. Crop Genetics & Breeding	PS
Dr. Salman Ahmad, Ph.D. Genetics & Breeding	SS
Dr. Akhtar Ali, Ph.D. Breeding & Genetics	SS
Mr. Khurshid Ahmad, M.Phil. Chemistry	SS
Mr. Shehzad Ahmad, M.Sc. (Hons.) Plant Breeding & Genetics	JS
II. FOOD & NUTRITION DIVISION	
Dr. Maazullah, Ph.D. Agricultural Food Engineering	Head / DCE
Dr. Zahid Mehmood, Ph.D. Food Science and Technology	PS
Dr. Muhammad Ibrahim, Ph.D. Plant Pathology	PS
Mr. Alamgeer Khan, M.S. Medical Physics	PS
Dr. Talat Mahmood, Ph.D. Food Science and Technology	SS

Name	Designation
Mr. Ali Raza, M.Sc. (Hons.) Food Science and Technology	SS
Mr. Tauqeer Ahmad, M.Sc. (Hons.) Food Science and Technology	JS
Mr. Asim Irshad, M.Sc. (Hons.) Food Science and Technology	JS
Mr. Muhammad Nisar, M.Sc. Chemistry	ARO
III. SOIL AND ENVIRONMENTAL SCIENCES DIVISION	
Dr. Muhammad Imtiaz, Ph.D. Soil Science	Head / DCS
Mr. Mukhtiar Ali, M.Sc. (Hons.) Soil Science	PS
Dr. Syed Azam Shah, Ph.D. Agronomy	PS
Dr. Amir Raza, Ph.D. Natural Resources & Life Sciences	PS
Mr. Parvez Khan, M.Sc. (Hons.) Soil Science	PS
Mr. Zahid Ali, M.Sc. (Hons.) Soil Science	PS
Mr. Shahzada Asif Ali, M.Sc. (Hons.) Agronomy	JS
IV. PLANT PROTECTION DIVISION	
Dr. Syed Jawad Ahmad Shah, Ph.D. Plant Pathology	Head / DCS
Mr. Muhammad Zahid, M.Sc. (Hons.) Entomology	DCS
Dr. Inamullah Khan, Ph.D. Entomology	DCS
Dr. Gul Zamin Khan, Ph.D. Entomology	PS
Dr. M. Misbah ul Haq, Ph.D. Entomology	PS
Dr. Muhammad Hamayoon Khan, Ph.D. Entomology	SS
Mr. Muhammad Salman, M.Sc. (Hons.) Entomology	SS
Mr. Muhammad Arfan, M.Sc. (Hons.) Entomology	SS
Mr. Usman Khaliq, M.Sc. (Hons.) Entomology	JS
Mrs. Noor Fatima, M.Sc. (Hons.) Entomology	JS

Name	Designation
V. TECHNICAL SERVICE DIVISION	
Mr. Muhammad Zubair Shah, M.S. Chemical Engineering	Head/PE
Mr. Abdul Khaliq, M.Sc. Computer Science	PS
Mr. Asif Murad, B.Sc. Engineering	PE
Mr. Jahangir Khan, M.S. Engineering	SE
VI. ADMINISTRATION & ACCOUNTS	
Mr. Muhammad Shakeel Khan, M.A (Political Science), M.A (Persian) & MBA	Pr. Admin Officer
Mr. Raufullah, M.L.I.Sc.	Pr. Librarian
Mr. Sardar Khalid Khan, MBA	Sr. Admin Officer
Mr. Yasir Muhib, MBA Finance	Sr. Accounts Officer
Mr. Muhammad Islam, B.Com	Accounts Officer

PROMOTIONS/TRANSFERS/ RETIREMENTS/ APPOINTMENTS

Promotions:

S. No.	Name	From	To	On
1.	Mr. Muhammad Zahid	Pr. Scientist	Dy. Chief Scientist	01.12.2022
2.	Dr. Inamullah Khan	Pr. Scientist	Dy. Chief Scientist	01.12.2022
3.	Mr. Alamgeer Khan	Sr. Scientist	Pr. Scientist	01.12.2022
4.	Mr. Muhammad Arfan	Jr. Scientist	Sr. Scientist	01.12.2022
5.	Mr. Muhammad Islam	Accountant	Accounts Officer	01.12.2022
6.	Mr. Ghaffar Ali	Pr. Scientific Assistant	Research Associate	28.05.2022
7.	Mr. Sultan Muhammad	Computer Operator	Sr. Computer Operator	28.05.2022
8.	Mr. Muhammad Zeeshan Khan	Jr. Assistant-I (A/Cs)	Assistant (Accounts)	28.05.2022
9.	Mr. Shahid ud Din	Tech-II	Tech-I	28.05.2022
10.	Mr. Hassan Khan	Fire Leader	Sr. Fire Leader	28.05.2022
11.	Mr. Muhammad Sheraz	Data Entry Operator	Jr. Computer Operator	28.05.2022
12.	Mr. Iqbal Gill	Sanitary Attendant-I	Sr. Sanitary Attendant	28.05.2022
13.	Mr. Mustaqeem Shah	General Attendant-II	General Attendant-I	28.05.2022
14.	Mr. Nazar Ali Khan	General Attendant-II	General Attendant-I	28.05.2022
15.	Mr. Abdul Zaman	General Attendant-II	General Attendant-I	28.05.2022
16.	Mr. Inayatullah	General Attendant-II	General Attendant-I	28.05.2022
17.	Mr. Jaffar Khan	General Attendant-II	General Attendant-I	28.05.2022
18.	Mr. Ahmad Ali Shah	General Attendant-II	General Attendant-I	28.05.2022
19.	Mr. Muqeem Jan	General Attendant-II	General Attendant-I	28.05.2022
20.	Mr. Haider Ali	Mali-II	Mali-I	28.05.2022
21.	Mr. Fayaz Ahmad	Cook-III Helper	Cook-II	28.05.2022
22.	Mr. Jamil Masih	Sanitary Attendant-II	Sanitary Attendant-I	28.05.2022

Transfers / Postings:

S. No.	Name	From	To	On
1.	Mr. Muhammad Imran, Driver-III	PAEC HQs, Islamabad	NIFA, Peshawar	03.01.2022
2.	Mr. Shah Zubair, Mali-II	PAEC HQs, Islamabad	NIFA, Peshawar	17.01.2022
3.	Mr. Haseeb ur Rehman, Sr. Tech	C-I, Chashma	NIFA, Peshawar	04.02.2022
4.	Mr. Amjad Abbass, Gen Attendant-II	BINOR, Bannu	NIFA, Peshawar	14.03.2022
5.	Mr. Taj Ali Khan, SA-II	NIFA, Peshawar	BINOR, Bannu	31.05.2022
6.	Mr. Amjad Khan, Gen Attendant-II	NIA, Tandojam	NIFA, Peshawar	15.06.2022
7.	Syed Raza Asad Shah, Supdt	PAEC HQs, Islamabad	NIFA, Peshawar	27.06.2022
8.	Sardar Khalid Khan, Sr. Admin Officer	PAEC HQs, Islamabad	NIFA, Peshawar	21.09.2022

Retirements:

S. No.	Name	Date
1.	Mr. Sher Zaman, Driver-I	02.01.2022
2.	Mr. Shah Abul Khair Badshah, Supdt.	10.02.2022
3.	Mr. Fazli Nabi, Assistant (Admin)	08.03.2022
4.	Mr. Muhammad Tahir, Stenographer	04.04.2022
5.	Mr. Noor-ul-Basar, ARO	18.04.2022
6.	Dr. Fazli Subhan, PS	15.06.2022
7.	Mr. Riysat Ali, Driver-I	01.07.2022
8.	Mr. Fiaz-ud-Din, DCE	10.08.2022
9.	Mr. Fazli Rabbi, PSA	02.11.2022
10.	Mr. Muhammad Saeed, SA-I	10.11.2022

Appointment:

S. No.	Name	Date
1.	Mr. Muhammad Younas, Telecom Operator-II	19.01.2022
2.	Mr. Imran Khan, Tech-IV Mason	19.01.2022
3.	Mr. Saifullah, General Attendant	14.11.2022

Obituaries:

S. No	Name	Designation	Service Length		Date of Death
			From	To	
1.	Mr. Inayat Ullah	Mali-I (Rtd)	04.09.1986	01.07.2018	23.03.2022
2.	Dr. Muhammad Anwar	PS (Rtd)	02.07.1979	23.05.2012	08.12.2022

Dr. Muhammad Anwar (Late)

Mr. Inayat Ullah (Late)

PICTORIAL VIEW OF SCIENTIFIC EVENTS / DEVELOPED TECHNOLOGIES

NIFA Lobia Red: A common bean variety evolved in 2022 with potential yield of 2000 kg/ha. It is local selection. Kuram and other growing areas of common bean are the potential growing areas of this variety in KP.

NIFA Lobia Yellow: A common bean variety evolved in 2022 with potential yield of 2000 kg/ha. It is local selection. Kuram as sole crop and Charsadda as inter crop with tobacco are the potential growing areas of this variety in KP.

Officials from CNPGS Chashma visited NIFA on January 3, 2022

PAF Officials training on Food and Agriculture held on January 3-7, 2022

Youth Assembly Visit to NIFA on January 27, 2022

Training workshop on "Development of low cost zero-energy cooling chambers (ZECC) for field heat removal and storage of fruits and vegetables and its transfer to small farmers" held on February 25, 2022 at farmer's field in Haripur.

Workshop on "Integrated nutrient management for off-season vegetables production in tunnels" held on February 22, 2022

Mr. Afaq Ahmad DG FSC&RD is briefed about Quality wheat seed production at NIFA during his visit on NIFA Farmer's Day held on March 8, 2022

NIFA POV Spot Test Kit: Kit was developed by Food Nutrition Section in 2022. It is used for on-spot qualitative analysis of peroxide value (POV) as indicator of rancidity in ghee and oil samples.

Dr. Thakur Prasad Tiwari (Country Liaison Officer; CIMMYT), stationed at CIMMYT office NARC, Islamabad visited NIFA on 3rd of March, 2022.

Maj Gen (Rtd) Mushtaq Ahmed Faisal, Member Admin, PAEC Visited NIFA on 17th March 2022

Brig Muhammad Imran Shahid Director (A&B SPD) is briefed about the product development in Medical Entomology and the invention of NIFA Dengue Guard mosquito repellent during his visit to NIFA on July 01, 2022.

Brig Muhammad Imran Shahid Director (A&B SPD) is briefed about eco-friendly management of termite in crops and fruit orchards during his visit to NIFA on July 01, 2022

One day Training on Value Addition and Food Preservation held on Jun16, 2022

One day Seminar on use of Electron beam/X-ray technology for value addition of food products and gem stones held on July 5, 2022

Mushroom visit on July 20, 2022

NIFA performance audit held on July 21, 2022

Dr. Zaman Technical Officer IAEA is briefed about Rapid Test Kits (RTKs) during his Visit to NIFA on 30th August 2022

Mr. Sajid Hussain Shah Director General of Science and technology visited NIFA on 9th September 2022

Training on Food microbial compositional analysis of food and water Samples held on November 22, 2022

Brig. Chaudhary Nadeem Bashir Director (Agri. Bio. & Chem.) COP SPD visited NIFA on December 07, 2022

46th QMS based requirements and implementation course held on December 12-14, 2022

27th QMS based auditor certification course held on December 12-14, 2022

NUCLEAR INSTITUTE FOR FOOD AND AGRICULTURE
PESHAWAR

ISO 9001 : 2015 Certified

Scientific Events Calendar 2023

FEBRUARY 23, 2023

Workshop on "Use of Electron Beam and X-rays Technology and Qualitative Analysis of Added Micronutrients in Foods"

Venue: NIFA, Peshawar
Organizers: Dr. Zahid Mehmood, PS 0333-5033898
Mr. Alamgeer Khan, PS 0346-9322294
E-mail: zahidnifa@gmail.com
alamgeer_khan86@yahoo.com

MARCH 15, 2023

NIFA Farmers/Seed Day

Venue: NIFA, Peshawar
Organizers: Dr. Farooq-i- Azam, PS 0300-9006616
Dr. Roshan Zamir, DCS 0301-8580109
E-mail: fazamcaas@gmail.com
roshanzamirhort@gmail.com

MAY 03, 2023

Workshop on "Integrated Nutrient Management for Vertical Farming of Vegetables"

Venue: NIFA, Peshawar
Organizers: Dr. Amir Raza, PS 0304-0501455
Mr. Parvez Khan, PS 0333-9386824
E-mail: amir.boku@gmail.com
parvez_08@yahoo.com

JUNE 08, 2023

One Day Workshop on "Drying of Fruits"

Venue: NIFA, Peshawar
Organizers: Dr. Maazullah Khan, DCE 0300-5834039
Mr. M .Asim Irshad, JS 0334-7053090
E-mail: maaznifa@yahoo.com
aaxim.ch@gmail.com

JULY 25, 2023

Workshop on "Popularization and Commercialization of Insect Pests Control Technologies"

Venue: NIFA, Peshawar
Organizers: Mr. Muhammad Zahid, DCS 0336-5352529
Dr. M. Misbah ul Haq, PS 0300-5511402
Dr. M. Hamayoon Khan, SS 0333-9227687
E-mail: zahidnifa200028@yahoo.com
misbah_nifa@yahoo.com
mhkhan170@gmail.com

SEPTEMBER 20, 2023

Workshop on "Management Strategies for Insect Pests of Medical Importance"

Venue: NIFA, Peshawar
Organizers: Dr. Inamullah Khan, DCS 0334-9059180
Dr. Gul Zamin Khan, PS 0331-3811979
E-mail: Inamullah_nifa@yahoo.com
gulzaminkhan@yahoo.com

OCTOBER 16-20, 2023

38th Postgraduate Training Course on "The use of Nuclear and other Techniques in Food & Agricultural Research"

Venue: NIFA, Peshawar
Organizers: Mr. Muhammad Zahid, DCS 0336-5352529
Mr. Shahid Akbar Khalil, PS 0300-5900250
E-Mail: zahidnifa200028@yahoo.com
shahidakhalil@yahoo.com

DECEMBER 20, 2023

Workshop on "Mushroom Farming Popularization as Cottage Industry"

Venue: NIFA, Peshawar
Organizers: Dr. Muhammad Ibrahim, PS 0334-9180642
Mr. Aurang Zeb Khan, PSA 0333-5950937
E-mail: ibra786pk@yahoo.co.uk
zebkhan_75@yahoo.com

Dr. Muhammad Amin PS / Manager ORIC
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NIFA Lobia Yellow-22

NIFA Lobia Red-22

NIFA POV Spot Test Kit

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