

ANNUAL REPORT

2025



NIFA

**Nuclear Institute for Food & Agriculture (NIFA)
Peshawar**

NIFA ANNUAL REPORT

2025

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This Annual Report for 2025 is published by NIFA, Peshawar

Published date : December 31, 2025

No of Copies : 45

ISBN : 978-969-8198-15-2

Citation:

Khattak, G.S.S, S. J. A. Shah, M. Khan, R. Zamir, S. A. Shah, M. Amin, A. Khaliq, A., S. Muhammad, and M. Abid. 2025. NIFA Annual Report 2025. NIFA, Peshawar, KP, Pakistan. 1-91pp

ISO 9001 : 2015 Certified



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PREFACE

As a developing nation, Pakistan faces mounting challenges in achieving food security, intensified by the accelerating impacts of climate change, degradation of land and water resources, and the rising demand for food to sustain a growing population. These challenges are particularly acute in Khyber Pakhtunkhwa, where nearly 80% of the population depends directly or indirectly on agriculture for their livelihoods. The country's food security outlook is becoming increasingly fragile as climate variability continues to disrupt agricultural productivity. Addressing these multifaceted issues requires a coordinated, evidence-based, and forward-thinking strategy, engaging policymakers, researchers, and farming communities alike. To strengthen agricultural resilience in this changing climate, strategic investments in research, innovation, and sustainable technologies are imperative.

The Nuclear Institute for Food and Agriculture (NIFA) plays a pivotal role in addressing agricultural challenges across Khyber Pakhtunkhwa. Adopting an integrated and multidisciplinary approach, NIFA spearheads the development of climate-resilient crop varieties, promotes advanced technology packages, and supports climate-smart agricultural practices designed to improve the efficiency of water and nutrient use. The institute also prioritizes integrated pest management (IPM), soil health improvement, and value addition to enhance the profitability and sustainability of agricultural systems.

Through its applied research initiatives, NIFA continues to tackle both current and emerging agricultural challenges by leveraging conventional and nuclear techniques. The institute remains steadfast in its mission to enhance national food security and ensure food safety through innovative research and development (R&D), harnessing nuclear and other modern technologies in food and agricultural sciences. The key outcomes, innovations, and impacts of NIFA's applied research are elaborated in the subsequent sections of this report.

HIGHLIGHTS**PLANT BREEDING AND GENETICS DIVISION**

Newly evolved high-yielding and disease-resistant varieties NIFA Raya-T24, NIFA Mung-25, NIFA Lobia-25, and NIFA Bhindi-25 were approved for general cultivation in the KP by the Provincial Seed Council in its 45th meeting held on 06th August, 2025. NIFA Raya-T24 is a high-yielding mutant variety having a seed yield of 3300 kg ha⁻¹ and oil content of 42–44%. It outperformed the national check variety, Super Raya, by producing 8% higher seed yield in the national trials. In multilocation trials, mustard genotypes, MR-10-8 and MM-34-13, significantly outyielded Super Raya by 15 and 33 % in seed yield, while rapeseed recombinant CPAT-17-S-15 produced 11% higher seed yield than Super Canola.

NIFA Mung-25 is a green-seeded high-yielding mungbean variety with a grain yield of 2100 kg ha⁻¹. Two green-seeded mungbean candidate lines were contributed to mungbean NUYT-2025. Consolidated results from the National Coordinator (Food Legumes) are awaited. New high-yielding (2071 kg ha⁻¹) kidney variety ‘NIFA Lobia-25’ was approved by the KP Seed Council on 06-08-2025.

NIFA Bhindi-25, developed by the vegetable breeding team, has out yielded the check variety (Green Finger) by 14% in the multilocation trails. The variety has dark green pods and exhibits an extended fruiting duration.

The Wheat Improvement Group is committed to support growers by developing improved varieties with higher yield potential, enhanced disease resistance, and superior seed quality. During 2024–25, a total of 12,850 kg of pre-basic seed of *Fakhre NIFA 2023*, *NIFA Awaz 2019*, and *NIFA Lalma 2013* was produced, sufficient to plant 257 acres. Demonstration plots established on farmers’ fields yielded 92,930 kg of wheat, confirming the superior performance of NIFA varieties. In yield trials, several genotypes outperformed existing cultivars, with NRL 2225 producing 5,373 kg/ha, ranking first in the provincial coordinated trials.

FOOD AND NUTRITION DIVISION

The Food and Nutrition Division (FND), achieved significant progress in food processing, fortification, and analytical research. A hybrid solar dryer was successfully employed to dehydrate high-moisture horticultural produce, including sweet melon, onion, bitter melon, banana, persimmon, and dates, achieving final moisture contents of 4.5–13% within 48–96 hours. The dried products retained satisfactory nutritional and sensory quality, and a field visit to Chitral facilitated the dissemination of this technology among farmers and entrepreneurs. Potassium metabisulfite treated garlic was dried using the hybrid solar dryer to a moisture content below 5%. The resulting garlic powder exhibited improved shelf life and handling, highlighting the dryer's potential for low-cost, energy-efficient processing. In another study, solar-dried peaches irradiated at 5.0 kGy showed the lowest microbial load and no fungal growth up to 180 days, confirming 5.0 kGy as the optimized dose for microbial safety and long-term storage of dried peaches. Similarly, gluten and preservative-free functional muffins prepared from rice flour, flaxseed, and cinnamon and irradiated at 4 kGy, retained desirable texture and flavor up to 21 days thereby confirming this dose as optimal for shelf-life extension. Substantial progress was made in food fortification R&D. The iodine rapid test kit (RTK) was validated for sea salt with varying moisture contents (0–40%), while the vitamin A RTK produced reliable results for both soybean and canola oils. A zinc spot-test method was also initiated for fortified wheat flour, with Reagent-5 (0.01M) optimized for detecting fortification levels between 15 and 80 ppm. To enhance national self-reliance, a standardized laboratory protocol was established for local potassium iodate (KIO_3) synthesis using iodine and potassium hydroxide, achieving 96.3% purity under optimized conditions (4 M KOH, 85°C, 60 minutes). Research on raw honey revealed strong antimicrobial activity against *E. coli* at concentrations above 60%, attributed to higher hydrogen peroxide content. The Mushroom Program recorded a biological efficiency of 112% in oyster cultivation using wheat straw compost supplemented with cotton cake (7:1). In collaboration with partner organizations, 184 participants were trained, and 72 mushroom farms were established across Khyber Pakhtunkhwa.

Analytical advancements included the development of an HPLC-UV method for glucose determination using PMP derivatization, with further optimization for fructose and sucrose underway. A low-cost apparatus for detecting sulfur dioxide (SO₂) in commercial beverages was also developed, revealing excessive SO₂ levels in guava squash (462 ppm), plum squash (433 ppm), and mango jam (153 ppm). The Food Testing Laboratory completed the 2nd surveillance audit of ISO/IEC 17025:2017 on October 28, 2025, reaffirming its compliance with international quality standards and strengthening NIFA's role in food safety and analytical excellence.

SOIL AND ENVIRONMENTAL SCIENCES DIVISION

Agriculture today faces the dual challenge of sustaining high crop productivity while reducing environmental degradation and input costs. Responding to these pressures, a series of research initiatives were undertaken to develop low-cost, eco-friendly and scientifically validated solutions that improve crop performance, enhance soil fertility and support long-term agricultural sustainability. Onion peel extract (OPE), derived from abundant agro-waste, was analyzed as a nutrient-rich liquid fertilizer and demonstrated significant yield improvements in pea and okra when applied as a foliar tonic, proving its potential as an economical organic input. Complementary work on environmental sustainability showed that ionizing radiation can effectively break down greenhouse gases such as CO₂ and N₂O, with optimized irradiation protocols established for future carbon capture applications. To address micronutrient deficiencies, zinc biofortification trials identified Zn-efficient wheat genotypes through hydroponic screening and validated their performance under field conditions, with notable yield enhancement at moderate zinc fertilization levels. Research on compost tea enrichment produced nutrient-dense formulations using locally available materials, which performed comparably to microbial products in boosting potato yield, offering farmers an affordable liquid fertilizer option.

A long-term comparison trial of organic and conventional farming revealed that organic systems can maintain competitive yields for wheat and potato while significantly improving soil organic matter, organic carbon and nutrient availability, underscoring their sustainability advantages. Further work on enhancing nutritive value of agro-waste

compost using nutrient-rich additives resulted in phosphorus- and carbon-enriched compost suitable for small-scale growers. Additionally, the isolation and screening of beneficial rhizobacterial strains capable of improving nutrient availability and significantly increasing wheat and potato yields, supporting the development of a multi-functional microbial fertilizer. These studies collectively demonstrate strong potential for integrating organic amendments, bio-based inputs, microbial solutions and eco-friendly technologies to support sustainable agriculture, reduce reliance on chemical fertilizers and improve long-term soil and environmental health.

PLANT PROTECTION DIVISION

Laboratory and field evaluations revealed the strong insecticidal potential of parthenium, neem, garlic, orange peel, and paneer dodi extracts against the fruit worm in okra. Parthenium extract showed the highest efficacy, reducing larval infestation by 74% in field conditions. Application of the egg parasitoid *Trichogramma chilonis* (2,000 pupae/card) reduced fruit worm density by up to 45%. Gamma irradiation studies established effective phytosanitary doses of 200- 250 Gy for *Helicoverpa zea*, *H. armigera*, and *Ferrisia virgata*, ensuring pest-free trade commodities. Four entomopathogenic fungi, *Nomuraea rileyi*, *Aspergillus parasiticus*, *A. flavus*, and *A. niger*, exhibited strong pathogenicity, causing up to 100% termite control and 80% mortality in corn earworm larvae in lab conditions. Compatibility studies demonstrated that combining *N. rileyi* with orange peel extract (5%) achieved complete aphid mortality, underscoring the synergistic properties of biocontrol–botanical integration. Screening 895 wheat genotypes identified 426 with resistance to wheat aphids, providing valuable breeding material for developing resistant cultivars.

The indigenously developed C-1 organic formulation showed highest residual toxicity (up to 120 days) and deterrence against subterranean termites, comparable to synthetic termiticides. Additionally, optimized bait systems using sugarcane dry slices, alpha-cellulose, and L-proline as attractants enhanced termite aggregation and feeding, thereby improving the efficiency of bait matrix of bait systems. Botanical extracts, particularly neem and garlic, were the most effective against melon and oriental fruit flies, causing over 70% inhibition in pupation and oviposition. Under the IAEA-CRP program, NIFA

identified thermally resistant *Aedes aegypti* strains, laying the groundwork for developing genetic sexing strains for SIT. The Parthenium-based bio-pesticide reduced mosquito larval density by 60–70%, while optimized ovi-traps enhanced vector capture by 65%. Modified “Dengue Guard” formulations using essential oils achieved 80-85% repellency.. Semi-field trials confirmed that a 5:1 sterile-to-wild male ratio in SIT operations reduced wild female insemination by 80%.

Two hundred and twenty sentinel plots at NIFA Farm were used to monitor major wheat diseases. Yellow rust appeared early and reached a mean severity of 35%, affecting 73% of plots significantly higher than the previous season. Leaf rust was recorded in 10% of plots (24% intensity), while powdery mildew was absent. Barley yellow dwarf, transmitted by aphids, occurred in 6% of plots. Four *Puccinia striiformis f. sp. tritici* (Pst) pathotypes-0E0, 208E26, 215E154, and 207E154 were identified, with multiple virulence factors. Resistance genes Yr1, Yr10, Yr15, Yr17, Yr18, Yr21, Yr26, Yr27, Yr28, Yr29, Yr32, Yr35, Yr39+YrAlp, and Yr73+Yr74 remained effective, while Yr2 and Yr9 were compromised. Among 120 PAEC elite lines, 64 moderately resistant varieties delayed rust onset by about 11 days. Black point (*Alternaria alternata*) incidence ranged from <1–35%, while Karnal bunt was absent. Findings from 1,217 entries tested under the National Wheat Improvement Program will guide durable rust resistance breeding and enhance wheat sustainability in Pakistan.

PLANT BREEDING AND GENETICS DIVISION

Wheat Improvement

Early Generation Seed Production

Consistent efforts are being made by NIFA wheat breeders to develop improved cultivars along with potential germplasm, contributing to enhanced farm productivity and ensuring food security in the country. The research activities and achievements are summarized below:

Seed Production

A total of 12,850 kg of quality seed of NIFA wheat varieties (*Fakhre NIFA 2023*, *NIFA Awaz 2019*, and *NIFA Lalma 2013*) was produced and certified by FSC&RD for rapid proliferation through the active involvement of public and private sector partners in Khyber Pakhtunkhwa.

Variety	Seed Class	Quantity (kg)
Fakhre NIFA 2023	Pre-Basic	10150
NIFA Awaz 2019	Pre-Basic	1500
NIFA Lalma 2013	Pre-Basic	1200
Total		12850

NIFA wheat varieties popularization/ demonstration

Demonstration plots on farmers' fields play an important role in varietal dissemination and farmers' access to quality seed. During Rabi 2024–25, 950 kg of seed of *NIFA Lalma 2013* and *Fakhre NIFA 2023* was provided to farmers across various districts of Khyber Pakhtunkhwa for rapid proliferation. Farmers' feedback indicated a total wheat production of 92,930 kg, resulting strong adaptability and performance.

Performance of wheat genotypes in various yield trials

A total of 50 genotypes, including standard checks (*Fakhre NIFA 2023* and *Akbar 19*), were evaluated in advanced yield trials under irrigated and rainfed conditions at the Institute. Based on significantly higher yields (4500–4777 kg/ha) compared to the commercial checks and strong disease resistance, four genotypes were selected for further testing in the Khyber Pakhtunkhwa Wheat Yield Trials (KPWYT). These selected lines produced 4–15% higher grain yield than the checks.

In four preliminary yield trials, 52 genotypes were evaluated. Based on

grain yield and disease resistance, 14 genotypes were selected for advancement to the next season's advanced yield trials. These genotypes produced 3500–4717 kg/ha, representing a 2–18% increase over Fakhre NIFA 2023.

Two sets of Khyber Pakhtunkhwa Wheat Yield Trials (irrigated and rainfed), each comprising 60 entries, were planted at the Institute. NIFA contributed 10 elite genotypes (CT 20011, CT 20014, CT 20230, CT 20241, NRL 2212, NRL 2218, NRL 2223, NRL 2225, NRL 2239, and NRL 21167) for stability testing. Agronomic (days to heading, lodging, plant height, days to maturity, grain yield) and disease (yellow rust) data were recorded and submitted to the KP Agriculture Directorate of Outreach. NRL 2225 ranked 1st, producing 5373 kg/ha.

The National Uniform Wheat Yield Trial (NUWYT), comprising 72 entries, was planted in an alpha lattice design with two replications. NIFA contributed three elite lines (NRL 1701, NRL 1901, CTES 107). CTES-107 yielded 4401 kg/ha, outperforming both local and national checks and exhibiting strong resistance to yellow rust.

Twenty-nine advanced genotypes were submitted to the National Wheat Disease Screening Nursery (NWDSN) at NARC, Islamabad, for disease evaluation during 2024–25. Results indicated resistance to yellow rust, leaf rust, and stem rust.

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

Continuous development of segregating populations through gene pyramiding and mutation breeding remains a core breeding strategy to obtain homozygous genotypes. A crossing block consisting of 30 genotypes was planted on three dates to achieve floral synchrony among early and late-flowering parents.

New crosses were made to transfer genes for disease resistance and other economically important traits into well-adapted cultivars. The F₁ generation, consisting of 27 cross combinations, was raised in two rows (2.5 m apart, 25 plants per row). Seed from the F₁ plants was harvested, bulked, and stored with proper labeling.

In the F₂ generation, 27 cross combinations (1500–2000 plants each) were space planted. Based on field performance, 259 desirable plants were

selected and threshed individually. In the F₃ generation, involving 11 cross combinations, 75 superior progenies were selected. In the F₄ generation of the same 11 combinations, 60 progenies were selected.

Breeder Nucleus Seed production of NIFA wheat varieties

Significant efforts were made to maintain genetic purity and produce Breeder Nucleus Seed (BNS) by raising progeny blocks and rows of NIFA wheat varieties. A total of 400 progeny blocks and 400 progeny rows of Fakhre NIFA 2023, NIFA Nijat 2023, NIFA Awaz 2019, and NIFA Lalma 2013 were grown. After rigorous field inspection, 340 blocks and 320 rows were retained, while the rest were discarded.

A total of 600 kg of Breeder Nucleus Seed of NIFA wheat varieties was produced. All cultivars showed resistance to prevailing yellow and leaf rust races. The BNS will be utilized for pre-basic seed production in the coming Rabi season (2025–26).

NIFA R & D Project on Winter Wheat Seed

The NIFA Wheat Group has initiated a climate-resilient winter wheat development program to address

persistently low productivity in the high-altitude



Sowing NIFA Winter Wheat Experiments at Phandar, GB, October 23, 2024

regions of Gilgit-Baltistan. During the 2024–25, twenty-five winter wheat genotypes were evaluated under farmers' field conditions at Phandar Valley, where crops were exposed to severe winter stress and



Successful Emergence of NIFA Winter Wheat Genotypes after snowmelt, April, 2025

extended snowfall. Most of the tested genotypes survived, demonstrating potential for adaptation to high-altitude environments. Among the evaluated

materials, two advanced winter wheat genotypes i.e., **NIFA Markhor-25** and **NIFA Sadabahar-25** produced comparatively higher yield, 3.0 t/ha and 1.09 t/ha, respectively, and exhibited



Inspection of NIFA Winter Wheat Experiments by Worthy Member Science, PAEC, April 30, 2025

resistance to the prevailing rust races. These promising lines will be further evaluated during the 2025–26 season to confirm yield stability and adaptability. Following successful validation, breeder seed production will be initiated to ensure timely availability of quality seed, with subsequent dissemination to farming communities in the Phandar and Yasin valleys through Agriculture Extension Department of District Ghizar, GB. In addition, thirty-five promising winter wheat genotypes were selected from exotic nurseries planted at NIFA, Peshawar, during 2024–25. These genotypes will be evaluated in the target

environments of the Phandar and Yasin



Harvesting the 1st Winter Wheat Experiment in Phandar, August 1st Week, 2025

valleys to identify additional climate-resilient and high-performing genotypes suitable for harsh cold regions of the country, thereby broadening the genetic base and enhancing long term resilience. This initiative aims to deliver high yielding, climate resilient winter wheat varieties, strengthen local seed systems, and enhance food security and livelihoods in vulnerable mountain communities of Gilgit-Baltistan.

Organizing 1st Farmer's day in Phandar

The 1st Farmers Day was organized in Phandar to demonstrate the performance of improved winter wheat genotypes under local conditions.

Farmers, extension staff, and other



Organized the 1st Farmers Day in Phandar GB under Winter Wheat Project

stakeholders participated to observe the trials and discuss crop management practices, and share experiences. The event helped farmers understand the benefits of improved wheat seed and better agronomic practices for increasing yield and productivity.

Oilseed Brassica Improvement

Approval of a New Mustard Mutant Variety “NIFA Raya-T24”

NIFA Raya-T24 is a new mustard mutant variety developed through radiation breeding by exposing the advanced line NM-1 to 1.2 kGy gamma radiation using a Cobalt-60 source. It exhibits a high seed yield of 3300 kg ha^{-1} and an oil content of 42–44%. In national trials, NIFA Raya-T24 outperformed the check variety, Super Raya, with 8% higher seed yield. It bears tolerance to lodging. NIFA

Raya-T24 is well adapted to both irrigated and rain-fed areas of Khyber Pakhtunkhwa (KP); therefore, it has the potential to enhance farm income for farmers in water-scarce areas, thereby improving their livelihoods under a changing climate scenario. The variety was approved and released for general cultivation in the KP by the Provincial Seed Council, KP, in its 45th meeting on 06th August, 2025, held at Directorate General Research, Peshawar, KP.



NIFA Raya-T24

Evaluation of Rapeseed/ Mustard Mutant/ Recombinant in Yield Trials Rapeseed/ Mustard Adaptability

Trials:

In the National Uniform Rapeseed Yield Trial (2024-25), rapeseed recombinant RR-016-30 was evaluated for the second year across twenty locations in the country. The performance of the candidate line was mediocre to Super Canola, while it was found to be resistant to Alternaria blight and White rust. It showed notable quality attributes in oil

content (43%), low erucic acid (2%), and GSL (37 μ mol/g).

In a multi-location adaptation yield trial conducted at four locations in KP (NIFA Peshawar, ARS Buner, AZRC D.I. Khan, and BARS Kohat), a total of 17 rapeseed recombinant/mutants (CPAT-17-S-15/2, CPAT-17-S-15/1, CPAT-17-S-19, CPAT-17-S-18, CPAT-17-S-1/1, CPAT-17-S-14, CPAT-17-S-1/2, CPAT-17-S-10/2, CPAT-17-S-9, CPAT-17-S-10/1, CPAT-17-S-3, CPAT-17-S-11, CPAT-17-S-8) and five mustard recombinants/mutants (MR-10-8, MM-34-13, MM-34-9, MR-21-3-65, MR-15-3-35) were evaluated for their seed yield performance. The data from ARS, Buner, could not be received as the trial was vitiated due to torrential rains. The results from three locations demonstrated that two mustard genotypes viz., MR-10-8 and MM-34-13 produced 2080 and 2412 kg/ha respectively and significantly out yield the check Super Raya by a margin of 15 and 33 % in seed yield while in rapeseed; a recombinant CPAT-17-S-15 harbored 2645 kg/ha and significantly outperformed the national check Super Canola by attaining 11% higher seed yield on over all location mean basis.

Evaluation of promising lines in Seed Yield Trials at NIFA

At the NIFA breeding station, a comprehensive evaluation of rapeseed and mustard advanced lines was conducted through two sets of Advanced Yield Trials (AYTs).

In the Advanced Yield Trial (AYT-I), seven rapeseed advanced lines (NIFSI-1-3-4, NIFSI-1-18-19, NIFSI-1-52-53, NIFSI-1-53-54, NIFSI-1-74-75, NIFSI-1-91-92, RR-8-3) were tested with the national check Super Canola. The results revealed that two lines, NIFSI-1-52-53, NIFSI-1-53-54, significantly outyielded the check by recording seed yields of 3000 and 3111 kg/ha, respectively, while the lines NIFSI-1-18-19, NIFSI-1-74-75, and NIFSI-1-91-92 remained numerically higher in seed yield over the check variety. Similarly, in the Advanced Yield Trial (AYT-II), three mustard lines (MR-1-8-9, MM-1-17-18, MM-1-30-32) were evaluated along with a national mustard check variety, Super Raya. Mustard mutant MM-1-30-32 produced significantly higher seed yield (1500 kg/ha), up by 15% compared to the check, while MR-1-8-9 harbored 2% higher seed yield than the check.

Generating genetic variability and advancement of breeding materials

Enhancing selection criteria for desirable ideotypes, diversifying genetic materials, and advancing breeding materials are crucial for successful breeding programs. This includes advancing genetic stocks (F₁– F₅, M₁ – M₅) to consolidate desired traits. By utilizing gamma radiation to induce mutations, a genotype was exposed to varying doses (0.5, 1, 1.2, 1.4, and 1.6 kGy), and 70 new crosses were made in three combinations to explore and exploit genetic diversity for the development of high-yielding and climate-resilient new varieties. To tailor the genotypes for rainfed areas, 44 out of 144 M₃ rapeseed genotypes were selected that displayed higher seed yields (8-100%) than parents/ check, while 05 rapeseed genotypes were selected in M₄/M₅ generation that exhibited up to 23% higher seed yield compared to respective checks.

Seed production and varietal maintenance

To achieve high seed yield and quality, it is crucial to maintain varietal purity through meticulous production and certification procedures. The Breeder Nucleus Seed was created by cultivating

20 progeny rows and blocks for each of the six Brassica varieties. Progeny blocks that exhibited true varietal characteristics were carefully selected. A total of 140 kg of Pre-basic Seed of NIFA



Seed Production Block “NIFA Sarson-T23” at NIFA, Peshawar

Sarson-T23 was produced and certified by FSC&RD. Private companies were involved in producing certified seeds, ensuring the overall quality and dependability of the seed supply.

Commercial Seed Production by Private/Public Sectors

Seed Quantities Produced:

- Tarnab Seeds:
545 kg (NIFA Sarson-T23)
- University of Agriculture, Peshawar:
900 kg (NIFA Sarson-T23)
- Broad Way Seeds:
1360 kg (NIFA Sarson-T20)

These companies produced certified class seeds of NIFA Sarson-T20, ensuring that the seeds distributed to farmers are of high quality and true to type.

Mungbean Improvement

A total of 68 green-seeded recombinants derived from 06 different cross-combinations (NFM-5-36-24 × NFM-5-63-18, NM-98 × NFM-5-36-24, V2802 × Ramzan, 6601 × Ramzan, Sona Mung × NM-2011, ML-5 × Sona Mung) and mutants from 02 parents (NFM-5-91-21 @ 300 Gy γ rays and KGM @ 300 Gy γ rays) along with check variety NIFA Mung-19 were evaluated for yield and yield components in replicated yield trials in Kharif 2024 at NIFA. Out of these, 18 genotypes produced statistically significant ($p \leq 0.05$) higher seed yields ranging from 1118–2163 kg ha⁻¹ against the average seed yield of the high-yielding check variety NIFA Mung-19 (1080 kg ha⁻¹).

In the Adaptation Yield Trial (AYT) planted at ARS, Karak, 06 genotypes along with two check varieties were evaluated, and 03 genotypes produced higher yields (1767–1879 kg ha⁻¹) compared with NIFA Mung-19 (1627 kg

ha⁻¹). At ARI, D.I. Khan, 01 genotype surpassed (1947 kg ha⁻¹) the check variety AZRI Mung-18 (1771 kg ha⁻¹). Two candidate lines were contributed to the National Mungbean Uniform Yield Trial in Kharif 2024; 01 genotype (NFM-98-22) produced a seed yield of 1010 kg ha⁻¹, statistically at par with the national check variety NIAB Mung-2021 (1025 kg ha⁻¹). In the case of black-seeded mungbean breeding, 34 genotypes were tested in replicated yield trials at NIFA in Kharif 2024, of which 05 genotypes produced significantly higher seed yields of 1753–2125 kg ha⁻¹ in comparison with the check variety NIFA Mung Spinghar-21 (average yield of 1704 kg ha⁻¹).

Evaluation of mungbean segregating material

Segregating populations (F₃/M₃) comprising of seven different cross-combinations (NIFA Mung Spinghar-21 × NIFA Mung-19 (50 single plants), NIFA Mung-19 × NBM-5-3-6 (81 single plants), NIFA Mung-19 × NIFA Mung Spinghar-21 (70 single plants), NBM-5-3-6 × NIFA Mung-19 (69 single plants), NIFA Mung-19 × NBM-5-3-8 (31 single plants), Jumbo Mung × NIFA Mung Spinghar-21 (19 single plants), and NBM-5-3-8 × NIFA

Mung-19 (23 single plants) were evaluated for yield and related traits at NIFA in Kharif 2024. Based on desired criteria, i.e., seed color, better plant type, more branches and pods per plant, and MYMV tolerance, 80 single plants were selected for testing in the next growing season.

Similarly, the F_4/M_4 generation comprising of ten cross-combinations, i.e., NBM-2-14-4-1 × MPP-15024 (32 single plants), NBM-2-2-4-5 × NFM-19 (138 single plants), NFM-19 × NBM-2-2-4-5 (152 single plants), MPP-15024 × NBM-5-3-4 (98 single plants), NBM-2-14-4-5 × NFM-19 (20 single plants), MPP-15024 × NBM-2-14-4-1 (11 single plants), NBM-2-2-4-8 × Azri Mung-18 (36 single plants), NBM-2-14-4-1 × NFM-19 (16 single plants), NFM-19 × NBM-2-14-4-5 (12 single plants), and NBM-5-3-4 × NFM-19 (12 single plants), were evaluated for yield and related traits at NIFA in Kharif 2024. Based on the pre-set criteria mentioned above, a total of 50 single progenies were selected for evaluation in the next season.

Three new cross-combinations, i.e., NIFA Mung-19 × NBM-2-14-6-7, NIFA Mung-19 × NBM-5-4-16, and NBM-2-14-6-7 × NIFA Mung-19, were attempted at NIFA

in Kharif 2024 for the creation of new genetic variability for seed color, better plant type, and MYMV tolerance.



Newly Approved High Yielding Mungbean Variety (NIFA Mung-25)

Quality Seed Produced:

Two hundred & seventy kg pre-basic seeds of NIFA's green and black-seeded mungbean varieties, i.e., Ramzan, NIFA Mung-17, NIFA Mung-19, NIFA Mung Spinghar-21, and NIFA Mung Sikaram-21 were produced in 2024-25.

Kidney Bean Improvement

Evaluation of kidney bean genotypes in adaptation yield trials

In spring 2025, six kidney bean genotypes, along with two check varieties (NIFA Lobia Red-22 and NIFA Lobia Yellow-22) were evaluated for yield and yield components in a Replicated Yield Trial planted at NIFA. Of these, 03 genotypes, i.e., NKB-22-2, NKB-22-5, and NKB-Naro Bean, produced

statistically significant ($p \leq 0.05$) higher seed yields of 1888, 1899, and 1898 kg ha⁻¹, respectively, compared with the check varieties NIFA Lobia Red-22 (1789 kg ha⁻¹) and NIFA Lobia Yellow (1298 kg ha⁻¹).

Evaluation of kidney bean segregating material

F₁/M₁ generation derived from 04 cross-combinations, i.e., Himalaya-1 × NKB-BL-2 (20 plants), NIFA Lobia Red-22 × Himalaya-1 (21 plants), NIFA Lobia Red-22 × Naro Bean (15 plants), and NARO Bean × NIFA Lobia Red-22 (13 plants) was raised at NIFA in spring 2025. All recombinant-cum-mutant plants were picked, threshed, and bagged individually for evaluation in the F₂/M₂ generation in spring 2026 at NIFA. F₃/M₃ generation derived from 04 different cross-combinations (NKB-BL-2 × NIFA Lobia Red-22, NKB-BL-2 × NKB-Kurram Local, NIFA Lobia Red-22 × NKB-BL-2, and NIFA Lobia Yellow-22 × NKB-G-4495) was raised at NIFA in spring 2025. Forty-three single recombinant-cum-mutant plants were selected based on seed color, plant type, growth habit, and high yield for further evaluation at NIFA in spring 2026. Similarly, F₄/M₄ generation derived from 03 different cross-

combinations, i.e., Himalaya-1 × NKB-Kenya (23 single plants), NIFA Lobia Red-22 × NKB-G-4729 (16 single plants), and NIFA Lobia Yellow-22 × NIFA Lobia Red-22 (13 single plants) was evaluated at NIFA in spring 2025. Based on the desired criteria, 28 single progenies were selected. In case of induced mutation, M₁ generation of 03 parents, i.e., NKB-Afghani, Himalaya-1, and NKB-Kurram, locally irradiated at 150, 310, and 320 Gy γ rays, was raised at NIFA in spring 2025. All M₁ plants were picked, threshed, and bagged individually, parent and dose-wise. M₃ generation of a parent Himalaya-1 irradiated @150 and 200 Gy of γ rays was evaluated at NIFA in spring 2025, and 21 mutants were selected based on desired criteria. M₄ population derived from NIFA Lobia Red-22 (75 Gy of γ rays) was evaluated at NIFA in spring 2025, and 22 mutant progenies were selected for further evaluation in the next growing season.

Evaluation of Kidney Bean Germplasm

Forty local and exotic genotypes as germplasm were evaluated for seed color, growth habit, and grain yield potential at NIFA in Spring 2025 for the selection of suitable parents to create

genetic variability for the traits mentioned above through hybridization and induced mutation. Based on the desired criteria, 11 genotypes were selected for use in the breeding program.



**Newly Approved High Yielding
Kidney Bean Variety (NIFA Lobia-25)**

Quality Seed Produced:

80 kg pre-basic seed of NIFA Lobia Red-22 and NIFA Lobia Yellow-22 was produced in 2024-25.

Peach Improvement

Improvement of Peaches for higher yield and quality

Sixty-one peach plants of two exotic genotypes were assessed for their early blooming, fruit maturity, and short stature characteristics. Germplasm Plawhite-5 matures 2 weeks earlier than Early Grand with a TSS value of 9-10. The plant has a semi-dwarf growth habit and features attractive fruit color and shape. Nectarine line Zinkle-4 has a high TSS value of 10.0 with early maturity and is

ready for harvest in the third week of April. The exotic lines are under evaluation for yield/production in the orchard. Similarly, in local selections, the material was evaluated based on fruit quality at the NIFA orchard. The fruit is large, aromatic, and has a high TSS brix of 11.0. Forty-five plants of new local selections are initially evaluated in orchards for physiological characteristics and fruit-bearing habits. Subsequently, twenty-nine mutant plants (Early Grand & Florida King) were assessed for earliness, short stature, and other characteristics. Mutant plants of Early Grand gave the highest fruit yield of 27 kg/tree as compared to the parent 18.9 kg/tree.

Effect of biofumigation on Peach Replant Disorders

Research was carried out on the control of peach stone replant disorder by the application of chemical fumigants for the detoxification of soil. The experimental field used was evacuated from an already raised peach fruit nursery. Initially soil was thoroughly prepared by ploughing with a cultivator and then by rotavator to finish all stubs and clods. The field was cut into subplots for the layout of the experiment. The total field area

was 6480 sq ft., and it was divided into twenty (20) subplots of 15.00 x 18.00 ft. (270 sq ft.) for application of chemical fumigant treatments. The experiment was laid out in a randomized complete block design with four treatments and four replications. Plots that were fumigated consisted of control (untreated), 50 ml of 1,3-dichloropropene, 50 ml of chloropicrin, 150 ml of dimethyl disulfide, and 20 ml of methyl iodide. In all subplots, the fumigants were evenly distributed into the soil to a depth of 30 cm. The fumigated subplots were sealed with a high-density polyethylene (HDPE) plastic. Similarly, after one-month high high-density polyethylene HDPE was removed, and the soil was ploughed, and peach stones were sown 4 cm deep with a distance of one inch in the rows and 2 ½ feet distance between the rows in the soil. All cultural practices, such as hoeing, weeding, and irrigation, were carried out at the proper time. Data were recorded on various parameters, including seed germination percentage, girth of seedling (mm), plant height (cm), number of leaves, number of branches, and mortality or plant survival percentage. The result data shows that

the application of 50 ml of 1,3-dichloropropene gave the highest (46.2%) germination in peach stones, followed by Dimethyldisulphide with 43.8 % germination. Similarly, the highest plant height of 58.5 cm was given by the same chemical fumigant, followed by 45.9 % by Chloropicrin. The highest number of leaves, 80.9, was recorded in the control treatment, followed by 79.30 in 50 ml of 1,3-dichloropropene. The highest mortality of 65.0 % was recorded in the control plot, followed by mortality of 62.2 % in the Methyl Iodide-treated plot. The highest number of branches (4.6) was given by the control plot, followed by 4.16 by 50 ml of 1,3-dichloropropene. Research carried out on different chemical fumigants showed that 50 ml of 1,3-dichloropropene was the best chemical fumigant dose for the peach stones before sowing and had the best results in germination of seeds and survival percentage of peach stone nursery plants.

Plum improvement

Local plum germplasm (35 plants of Santa Rosa, Red Beauty, Blasting Star, and Fazli Manani), along with 9 mutants, were evaluated for morphological characters. First blooming in Fazli

Manani and Santa Rosa was recorded, but it did not reach fruiting; therefore, fruiting data could not be recorded. Plum Fazli Manani mutants irradiated with 20 and 30 Gy treatments were evaluated for blooming and fruiting characters. 02 mutant plants in 30 Gy treatment have initiated flowering but could not reach maturity. Similarly, in 20 Gy treatments, no flowering was observed.

Okra improvement for higher yield and other qualities

The first-ever Okra Vegetable Variety NIFA Bhinidi-25 was approved for general and commercial cultivation in KP. The variety has a higher yield (14819 kg/ha), medium resistance to yellow vein mosaic virus (YVMV), and consumer-preferred dark green color pods. A DNA fingerprinting protocol for Okra has been established.



Newly Evolved High Yielding Variety of Okra (NIFA Bhindi-25)

Okra screening

The screening of 52 okra genotypes in the nursery was carried out for yield potential and other desirable traits, i.e., dark green fruits, etc., at NIFA Peshawar during 2025. This comprehensive assessment involved careful observation and data collection on various growth parameters, including days to flowering and fruiting, pod yield, plant height, and overall productivity. Eleven okra genotypes exhibiting multivariate performance were selected for further evaluation in station trials and as parents in hybridization schemes.

Evaluation of okra genotypes in PYT and AYT

During 2025, 07 okra genotypes were evaluated in the Preliminary Yield Trial (PYT) at NIFA Peshawar. All the genotypes were assessed for key attributes like yield, earliness, and other agronomic traits. The objective of the experiment was to select genotypes that produce high yields and also exhibit other favorable market traits. Preliminary results indicated that two okra genotypes, NOL-15 (16393 kg/ha) and NOL-04 (14692 kg/ha), showed better performance over other genotypes and Green Finger check (12736) for yield

traits. These genotypes will be further evaluated in AYT and subsequent multi-location trials.

Two promising genotypes, NOL-12 with 16896 kg/ha yield and Laila (15063 kg/ha) yield, outperformed Green Finger (check) with 12573 kg/ha yield. These genotypes are selected for further evaluation in adaptation trials across several locations in KP, including the Agriculture Research Station (ARS) in Swabi, ARS Harichand in Charsadda, ARS Serai Naurang, Agriculture Research Institute (ARI), Mingora, Swat, and farmers' fields.

Creation of genetic variability for desired traits in okra

During 2025, one genotype, from five M₂ mutants, was selected. The subsequent M₃ will be further assessed for yield and resistance to YVMV during the next year. Another promising line at the M₇ stage has been finalized for further evaluation in PYT. Eleven potential genotypes selected from the Okra nursery are advanced for inbreeding and subsequent hybrid development. Currently, these lines are in S₁ (selfing-1) generation and will undergo further inbreeding until complete homozygosity.

FOOD AND NUTRITION DIVISION

Development of a Hybrid Indirect-type Solar Dryer for Drying of Fruits and Vegetables

A hybrid solar dryer was successfully used to dehydrate high-moisture horticultural produce, including sweet melon, onion, bitter gourd, banana, and persimmon, achieving target final moisture contents ranging from 4.5% to 13% within 48–96 hours. The moisture content of onion decreased from 87.7% to 4.6%, persimmon from 81.49% to 13.24%, banana from 78.27% to 12.77%,



Solar Dried Products (Persimmon, Banana, Melons, Bitter Gourd)

bitter gourd from 91.1% to 7.3%, and dates from 18.0% to 12.1%. In addition to drying performance, quality parameters such as ascorbic acid (vitamin C) content, total acidity, total phenolic content, and organoleptic characteristics were analyzed, and all dried products

were found to be of satisfactory quality. Furthermore, the project team conducted a field visit to Chitral, where they met with agricultural extension officers and local entrepreneurs to discuss the practical applications and potential dissemination of the hybrid solar drying technology.

Adaptation of Low-Energy Machine-Generated Radiation Sources for Surface Decontamination and Disinfection of Food in Pakistan

Fresh peaches were thoroughly washed, treated with potassium metabisulfite (KMS), sliced, and subsequently dried in the solar dryer. The dried slices were packed in 0.1 mm polypropylene bags and irradiated with gamma and low energy x-rays at doses of 1.5, 3.0, and 5.0 kGy. Microbiological analysis revealed a substantial reduction in microbial load across all treatments, with the 5.0 kGy dose (T3) showing optimal results, achieving the lowest total bacterial count (approximately 10 cfu/g) and undetectable fungal growth at day 180. Nutritional analysis indicated that ascorbic acid and total phenolic content (TPC) were better retained in irradiated samples, with minimal losses observed even at the highest dose. The 5.0 kGy treatment was identified as the most

effective, ensuring microbial safety and



Drying of Peach Fruit Samples and Irradiation with Low Energy X-rays

retained sensory attributes with extended shelf life upto 180 days.

Development of Gluten and Preservative-Free Functional Muffins and their Shelf-Life Extension through Gamma Irradiation

Irradiation provides a promising approach for improving the safety, quality, and shelf stability of bakery products, particularly gluten and preservative-free functional muffins. By effectively inactivating spoilage microorganisms and extending product longevity, it reduces dependency on chemical preservatives and supports the development of clean label baked goods. The present study aimed to evaluate the feasibility of applying gamma irradiation to functional muffins formulated from rice flour, flaxseed, and cinnamon. Different doses of irradiation (2, 4, 6, and 8 kGy) were tested to assess their impact on sensory attributes and storage stability.

Sensory evaluation revealed that muffins irradiated at 4 kGy retained desirable texture, flavor, and overall acceptability comparable to non-irradiated controls while higher doses produced slight off-odors. Moreover, the 4 kGy treated muffins exhibited no visible mold growth or spoilage for up to 21 days of storage, maintaining freshness and safety without the use of preservatives. Therefore, a 4 kGy dose was optimized for extending the optimal shelf life of gluten and preservative-free functional muffins when packed in zipper bags, ensuring product quality and microbial safety.



Irradiation of Fruit Cakes and its Sensorial Analysis

Value Addition of Garlic through Drying

Garlic is well known for its nutritional and medicinal benefits. However, due to its high initial moisture content (86%), it is highly perishable. To reduce these losses and value addition, current study was conducted at NIFA using a hybrid solar

dryer. This technology provides a low-cost, energy efficient drying method that maintains product quality and is suitable for both small-scale and commercial applications. Fresh garlic bulbs were



Garlic Drying and Garlic Powder

sliced and subjected to three treatments: control, blanching, and dipping in potassium metabisulfite (KMS) solution (2%). The treated bulbs were dried in the hybrid solar drier. Moisture content, water activity, acidity, and phenolic content were measured before and after drying. The results showed that all treatments effectively reduced the moisture content to below 5%, with the highest reduction (2.7%) in KMS treated samples. All treatments showed similar final quality in terms of water activity, acidity, and phenolic content. The dried garlic was converted into powder form by grinding, resulting in a value added product with improved shelf life, easier handling, and potential use in food formulations. The study concluded that hybrid solar drying is an efficient and sustainable method for

the value addition of garlic through the production of garlic powder.

Development of an Indigenous Technology for Rapid Testing of added Micro Nutrients in Foods:

Experimental work during the reporting period focused on the validation of the NIFA developed Iodine Rapid Test Kit (RTK) for iodized sea salt and the optimization of the Vitamin-A RTK for various edible oils. Validation of the iodine RTK was carried out using sea salt samples with different moisture contents (0-40%). Fresh samples containing 0.02% moisture developed color instantly, while samples with 5%, 10%, 20%, 30%, and 40% moisture exhibited color development after approximately 3–5, 6–7, 15–18, 24–26, and 170 seconds, respectively. The results indicated that moisture content affects the reaction time but not the final endpoint color. Based on these findings, the iodine RTK was optimized to ensure accurate and reliable performance in sea salt with varying moisture content levels. Further progress was achieved in refining the Vitamin-A RTK and developing an indigenous digital VITA-Meter. The Vitamin-A kit provided consistent qualitative results for both fortified

soybean and canola oils. Tests conducted with fortificant concentrations ranging from 33 to 45 IU/g demonstrated that higher fortification levels produced stronger color intensity and longer color retention, whereas variations in reagent ratios (R1 + R2: 10+90 to 50+50) had no significant impact on the endpoint. These findings confirm the robustness and reproducibility of the developed kits, supporting their continued refinement toward semi-quantitative measurement of vitamin A in fortified edible oils.



Optimization of Kit Reagent Concentrations for VITA-METER NIFA's Testing Laboratories: Strengthening Analytical Capacities and Maintaining ISO/IEC 17025 Accreditation

The Food Testing Laboratory continued to enhance its analytical capabilities and research contributions in 2024-25, focusing on method development for carbohydrate analysis and strengthening

its role in the national food safety program. Significant progress was made in developing an HPLC-UV method for the determination of glucose, fructose, and sucrose in food samples. Since these sugars are UV inactive due to the absence of chromophores, a derivatization approach using 1-phenyl-3-methyl-5-pyrazolone (PMP) was employed to render them UV detectable. The reaction between glucose and PMP successfully produced the UV-active compound glucose-(PMP)₂, while no reaction occurred with fructose under similar conditions. Sucrose, when subjected to acid hydrolysis, yielded fructose and glucose, allowing partial quantification through the developed method. The HPLC-UV method for glucose determination was optimized, whereas optimization for fructose and sucrose is still in progress. For commercial analytical services, the laboratory plans to employ a Refractive Index (RI) detector, which is more suitable for the direct quantification of these sugars without derivatization.

In addition to R&D activities, the Food Safety & Nutrition group continued its active participation in the accreditation and quality assurance framework.

Documentation, internal audits, and management reviews were carried out as part of the preparations for the 2nd surveillance audit of the ISO/IEC 17025:2017 accredited Food Testing Laboratory. The 2nd surveillance assessment was completed on October 28, 2025, reaffirming the laboratory's compliance with international quality standards.

Development of Rapid Test Kit for On-Spot detection of added Zinc (Zn) in Fortified Wheat Flour

Zinc (Zn) is an essential mineral found in living organisms, with three major biological roles: as a catalyst, a structural, and regulatory ion. Its deficiency can induce oxidative damage, alterations in the immune system, neuropsychological impairment, and dermatitis. To curb its deficiency (18.6% in Pakistan according to the National Nutrition Survey, 2018-19) among the marginalized and susceptible population, wheat flour fortification is an effective strategy. Fortificant premix consists of a mixture of micronutrients, including zinc (ZnO) at 30ppm concentration. FND of NIFA is carrying out R&D to develop a spot-test method for the detection of zinc in fortified wheat flour as a cost effective

and sustainable alternative to time consuming & costly conventional methods. During the selection of best-to-



Selection & Optimization of Best-fit Reagents for Zinc Kit Prototype Development

fit reagents, a comprehensive study plan was designed to screen out the best fit reagent for the kit prototype development. Different potential reagents were tested and analyzed for their performance and efficacy on wheat flour samples. Some reagents didn't produce optimum results due to the hindrance/masking effect by the interfering agents (intrinsic & extrinsic). While Reagent-5 (R-5) yielded promising results during testing. So, R-5 was screened out for further studies and its concentration was optimized (0.01M) against different fortification levels (15, 30, 60 & 80ppm). In future studies, efficacy and validation studies against different types and grades of wheat flours

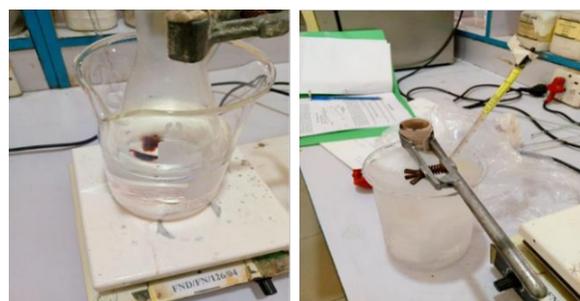
will be carried out to evaluate compatibility with the standard methods.

Method Optimization for Lab-Scale Production of Potassium Iodate (KIO₃)

Iodine is an essential trace element necessary for the synthesis of thyroid hormones, which regulate metabolism, growth, and development in humans. Deficiency of iodine leads to serious health problems collectively known as Iodine Deficiency Disorders (IDDs) including goiter, hypothyroidism, mental retardation, and developmental defects. The level of household consumption of iodized salt in Pakistan surpasses 70%, with potassium iodate being the primary fortificant used by the industry. Fortification of edible salt with iodine is the most effective and sustainable approach to prevent IDD. Potassium iodate (KIO₃) is widely used as the iodine source because of its greater stability compared to potassium iodide, especially under humid and high temperature conditions commonly found in developing regions. Commercial production of potassium iodate often relies on imports, resulting in higher costs and dependency on external suppliers. Therefore, developing a laboratory-scale

and later pilot-scale method for local KIO₃ synthesis is essential for self-reliance, cost reduction, and technology transfer. In response to this critical issue, NIFA planned research work on the production of Potassium iodate. The successful local production of potassium iodate holds significant potential to address malnutrition challenges, and it can also open up avenues for income generation.

This study established a standardized laboratory protocol for KIO₃ production through the chemical reaction between iodine (I₂) and potassium hydroxide



Process Optimization of KIO₃

(KOH). Optimized reaction parameters such as KOH concentration (4 M), temperature (85°C), Maximum time for chemical reaction 60 minutes, and maximum percent purity (96.30%) at 4°C. The successful implementation of this process will support the national iodine fortification program in Pakistan.

Anti-microbial Activities of Various Honey Types

Three raw honey samples, namely Bairi, A. modesta, and Corn seed, were collected from the local market at Tarnab, Peshawar. These samples were tested for antimicrobial activity against *Staphylococcus aureus* and *Escherichia coli*. At lower concentrations (0.1% to 50%), all samples showed no inhibitory



Determination of Anti-Microbial Activities of Various Honey Types

effect against either bacterium. At 50% concentration, Bairi honey also showed no activity. However, at higher concentrations (60% to 80%), all samples exhibited antimicrobial activity against *E. coli* but not against *S. aureus*. At 100% concentration, all samples except A. modesta remained inactive against *S. aureus*. These findings indicate that raw honey possesses stronger antimicrobial properties than processed honey, mainly due to its higher hydrogen peroxide (H_2O_2) content.

Pearl Oyster Yield Enhancement, Commercialization, and Pharmacological Evaluation of Ganoderma Mushroom

The NIFA Mushroom group of the Food and Nutrition Division (FND) has an integrated and active mushroom program. The group has been playing an important role in the improvement of mushroom cultivation technology and promoting its cultivation in Pakistan, particularly Khyber Pakhtunkhwa (KP). Wheat straw compost added with low-cost nitrogen-rich supplement (cotton cake) in a 7:1 ratio, enhanced Oyster yield with % Biological Efficiency (%BE) of 112%. NIFA has transferred improved oyster mushroom cultivation technology through paid training workshops and trained 144 participants (both men and women) from Nowshera District, 20 participants from Peshawar District, and 20 participants from Khyber District in collaboration with LASOONA Organization, SABAWON Organization, and NIDA-Pakistan Organization, respectively. NIFA has also provided 509 kg of oyster mushroom spawn and successfully established 72 mushroom farms in District Nowshera through Farmer Field School (FFS) sessions in

collaboration with LASOONA Organization.

Development of a Method for Determination of SO₂ Concentration in Preserved Foods

Ten commercial processed food samples were evaluated for the detection and quantification of Sulfur Dioxide (SO₂) in the local market of the Peshawar District. Sulfur Dioxide (SO₂) was successfully determined/quantified in processed beverages using a low-cost hand-crafted

apparatus. However, the apparatus results showed a higher standard deviation and need refinement for the blockage of gas leakages to bring accuracy in the results. The analysis showed that guava squash contained 462 ppm SO₂, plum squash contained 433.33 ppm, and mango jam contained 153.33 ppm, which exceeded the SO₂ limits established by Pakistan Standards & Quality Control Authority (PSQCA) and the Food and Agriculture Organization (FAO).

**SOIL AND ENVIRONMENTAL
SCIENCES DIVISION****Development of low-cost liquid fertilizer and its application as a foliar tonic for improving crop yield**

Onion is the third most widely consumed vegetable globally, including in Pakistan, after potato and tomato. Its extensive use generates hundreds of thousands of tons of waste annually, particularly in the form of onion peels. Typically, this peel waste is discarded, contributing to greenhouse gas emissions and environmental pollution. However, research has shown that onion peels are rich in bioactive compounds, making them a valuable resource for agricultural applications. Instead of being treated as waste, onion peels can be transformed into useful products, such as soil amendments or potential biostimulants that may enhance plant growth.

This study conducted three experiments to evaluate the plant growth-promoting potential of onion peel extract (OPE). The first experiment was on the extraction of onion peel and the analysis of its essential nutrient content. The second assessed the effects of OPE as a foliar

spray on pea yield, and the third evaluated its impact on the growth and yield of okra through foliar application. In the pea experiment, the treatments used were Control, i.e., only P and K applied as basal dose @ 60 kg ha⁻¹ each (T1), NPK @ 30-60-60 kg ha⁻¹ (T2), Compost applied based on N @ 30 kg ha⁻¹ (T3), Foliar application of OPE at 3:1 dilution (T4), and Rhizobium inoculation (T5). Whereas, the treatments for okra experiment were Control i.e. only P and K applied as basal dose @ 60 kg ha⁻¹ each (T1), NPK @ 60-60-60 kg ha⁻¹ (T2), Compost applied based on N @ 60 kg ha⁻¹ (T3), Foliar application of OPE (T4) and NPK @ 30-30-30 kg ha⁻¹ + Foliar application of OPE at 3:1 dilution (T5). Both field experiments were arranged in a randomized complete block design (RCBD) with three replications, and the plot size was 5 m × 4 m.

Nutrient analysis of the onion peel extract revealed 1.06% nitrogen, 0.02% phosphorus, 1.5% potassium, and 70 ppm zinc, confirming its potential as a nutrient-rich organic input. In the pea experiment, foliar application of OPE at a 3:1 dilution (T4) significantly increased yield, with the highest yield reaching 21.7 kg per plot. Peas were sown in two ways:

on plain beds and on ridges. The ridge-sown plot produced a relatively higher yield, indicating that the sowing method also influenced the results. In the okra experiment, the maximum yield of 16.89 kg per plot was achieved with Foliar application of OPE at a 3:1 dilution (T4). These results demonstrate that onion peel extract (OPE) can serve as an effective organic growth enhancer. It not only improved the growth and yield of both pea and okra crops but also offers an eco-friendly solution for managing onion waste. Overall, this study suggests that OPE has strong potential in promoting sustainable agriculture by recycling agricultural waste into valuable bio-based products.

Mitigating the impact of Greenhouse Gases (GHGs) through irradiation

Greenhouse Gases (GHGs) such as carbon dioxide and methane play a significant role in the greenhouse effect, contributing to global warming and consequential shifts in earth's climate. The resulting rise in temperature leads to various impacts, including altered weather patterns, rising sea levels, extreme weather events, and disturbances to ecosystems. Furthermore, the presence of certain

greenhouse gases combined with other pollutants can compromise air quality, posing health risks to humans, animals, and the environment. In the pursuit of environmental sustainability and materials innovation, radiation technology emerges as a potent tool. Leveraging ionizing radiation, it becomes possible to instigate chemical reactions that break down GHGs into simpler, less harmful compounds or transform them into benign substances. This radiation-based approach holds promise for the development of materials integral to Carbon Capture and Utilization processes. These materials facilitate the capture and conversion of carbon dioxide emissions from industrial sources, turning them into valuable products or ensuring stable storage.

The gas cylinder assembly was designed and installed successfully for the transfer of gas samples from the cylinder to gas vials. Glass vials for gas samples were designed and tested for gas leakage successfully. Samples of CO₂ and N₂O were irradiated at 100 Gy and 200 Gy, respectively. The protocols for irradiation of CO₂ and N₂O gases were established and optimized using a Co-60 Irradiator.

Biofortification of zinc in wheat for balanced human nutrition

Micronutrient deficiency, or hidden hunger, is a major global health challenge, especially in developing nations where poverty limits access to diverse, nutrient-rich diets. Affecting over three billion people, it leads to severe health issues and economic strain on healthcare systems. To combat this, biofortification (an agricultural strategy that enhances the nutritional value of crops) offers a practical, cost-effective, and sustainable solution. Agronomic biofortification, achieved through optimized fertilizer applications, not only improves crop yield but also helps deliver essential micronutrients to populations lacking dietary diversity.

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

Seeds of ten wheat genotypes were surface-sterilized and germinated on moist filter papers in Petri dishes under controlled conditions (20 ± 1 °C). Two seedlings from each genotype were then transplanted into white thermopore sheets positioned over stainless steel containers (50 L capacity) filled with 40 L of chelate-buffered nutrient solution

containing Zn^{2+} activities of 2, 10, and 40 pM. During the first 10 days after transplantation, plants were grown in nutrient solutions containing half-strength concentrations of all macro- and micronutrients, except zinc (Zn) and K_3HEDTA , which were maintained at full strength. Thereafter, full-strength nutrient solutions were supplied. The solutions were renewed on days 10, 15, 19, 24, 28, and 32 after transplantation, and their pH was adjusted to 6.0 ± 0.01 using 0.1 M HCl or 0.1 M KOH as required. Plants were harvested on the 35th day after transplantation. Tissue samples were first air-dried on paper towels, then oven-dried at 70 ± 1 °C for 48 hours (until constant weight), and subsequently analyzed for micronutrient concentrations following standard analytical procedures.

The wheat genotypes under study exhibited variable responses to increasing levels of Zn^{2+} activity. An increase in zinc concentration in the growth medium generally enhanced plant growth. This variation in response among genotypes was used to assess their zinc efficiency. Wheat genotypes NRL-2215 and NRL-2226 produced the maximum biomass under zinc-deficient

conditions (2 pM) and were therefore ranked as Zn-efficient. In contrast, genotypes NRL-2225 and NRL-2239 showed the lowest biomass production at 2 pM Zn and were identified as Zn-inefficient.

Evaluation of Zn efficiency under field conditions

The chelate-buffered nutrient solution used in the above study provides zinc (Zn) activity levels comparable to those found in Zn-deficient soils, allowing for controlled plant growth assessment. However, numerous additional soil factors also influence plant performance under field conditions. Therefore, it is necessary to evaluate the response of selected genotypes in the field to validate the findings obtained from hydroponic studies. A field experiment was conducted using four wheat genotypes (2 Zn-efficient and 2 Zn-inefficient) under two Zn application rates (0 and 5 kg Zn ha⁻¹) in a split-plot design. Soil samples were collected from the experimental plots to determine the initial Zn concentration and other physicochemical properties. The available Zn content in the site soil was 0.20 µg g⁻¹. Recommended doses of P (90 kg ha⁻¹) and K (60 kg ha⁻¹) were applied as a

basal treatment at sowing, while nitrogen (120 kg ha⁻¹) was applied in two splits: half at sowing and half with the first irrigation. Field results revealed that the genotype CTES-136 gave maximum grain yield (6.9 t ha⁻¹) at 5 kg Zn ha⁻¹, whereas genotype CT-18062 produced minimum grain yield (6.0 t ha⁻¹) under Zn-deficient conditions.

Enrichment of compost tea for its nutritive value

The current era, emphasizing sustainability, does not permit excessive chemical input and focuses on the conservation of land & environment. The situation demands to shift partially towards organic production, which is constrained by the limited availability of good-quality organic fertilizer products. One viable option would be to use compost tea (aqueous extracts of compost), as it has the potential to improve plant growth and yield by enhancing plant nutrient status and decreasing disease incidence. However, its use in Pakistan is not quite common on account of its low nutritive value, lack of indigenous research, and limited awareness amongst farmers. The current study addresses these issues through applied research on enhancing the

nutritive value of compost tea for use by the farming community.

Various potential indigenously available sources of plant nutrition were collected and analyzed in the laboratory for their nutrient contents. Analytical results depicted that fish bone meal and rock phosphate had the maximum nitrogen (4.95%) and phosphorus (18%) contents, respectively. The selected nutrient-dense materials were then used in various formulations for the enrichment of compost tea. The enriched compost teas were analyzed in the laboratory for their nutritive value. The findings revealed that the highest value of nitrogen (926 ppm) was found in the compost tea prepared from vermicompost, poultry manure, blood meal & rock phosphate, while the maximum phosphorus content (786 ppm) was recorded when compost tea was prepared by enriching vermicompost with rock phosphate.

The findings of a comparative study conducted on potato crop under field conditions depicted that compost tea gave relatively higher tuber yield in the chemically managed plot as compared with the organically managed plot, and it was found statistically at par with Rhizobacteria and Green Soil

application. This study is likely to generate baseline data that may lead to the development of liquid fertilizer products. Its use may reduce the burden on farmers' pockets as it is an economical source of plant nutrition, eco-friendly, and easy to formulate.

Monitoring the long-term impact of conversion to organic farming systems.

The introduction of fertilizer-responsive wheat varieties has significantly enhanced crop yields per unit area. However, this conventional farming approach - characterized by intensive chemical inputs - poses sustainability concerns due to its associated environmental and agronomic challenges. Conventional systems are increasingly linked to soil degradation, biodiversity loss, yield stagnation, and environmental pollution. Additionally, the rising cost of agricultural inputs such as fertilizers and irrigation water has reduced the profitability of wheat cultivation, prompting many farmers to shift towards alternative crops. This shift could have serious implications for national food security, as wheat remains a cornerstone of Pakistan's food supply.

In this context, there is an urgent need to explore alternative and sustainable farming approaches that ensure profitability while maintaining soil health. Organic farming systems present a promising avenue, offering potential for sustained yields and long-term soil fertility improvement. However, comprehensive and systematic research comparing conventional (chemical-based) and organic farming systems under long-term field conditions has been limited. The current project addresses this research gap through the establishment of a long-term field trial aimed at evaluating the comparative performance of both systems.

A long-term field experiment was initiated in 2019–2020 and continued through 2024-2025. The study focused on comparative assessment of wheat and potato yields, along with the impact of conventional and organic farming systems on key soil fertility indicators. Nutrient requirements for the test crops were met using chemical fertilizers under conventional farming, while farmyard manure, compost, and *Sesbania* (as a green manure crop) were employed under the organic system.

Results from the 2024-2025 wheat trial demonstrated that grain yield, water use efficiency, protein content, and nutrient uptake (nitrogen, phosphorus, and potassium) were statistically at par between the two systems. Wheat grain yields of 5.17 t ha⁻¹ and 5.00 t ha⁻¹ were recorded under conventional and organic systems, respectively. Water use efficiency was slightly higher under conventional management (11.5 kg ha⁻¹ mm⁻¹) compared to organic (11.1 kg ha⁻¹ mm⁻¹). Protein content followed a similar pattern, being marginally higher under conventional (8.2%) than organic (7.9%) farming.

Nutrient uptake results revealed higher nitrogen (137 mg plant⁻¹) and phosphorus (35 mg plant⁻¹) absorption under conventional farming compared to organic farming (129 mg plant⁻¹ and 33 mg plant⁻¹, respectively). Potassium uptake also followed this trend, with 104 mg plant⁻¹ recorded under conventional versus 97 mg plant⁻¹ under organic management.

For the potato crop, higher tuber yields were obtained under conventional farming (30.7 t ha⁻¹) compared to organic farming (25.2 t ha⁻¹). Despite the slight yield reduction under organic conditions,

improvements in soil fertility indicators were noteworthy.

Soil analyses indicated significant improvement in fertility parameters under organic management, including increases in soil organic matter, organic carbon and available nitrogen, phosphorus and potassium. These enhancements were achieved without substantial yield penalties, demonstrating that organic farming systems can improve soil health and sustainability while maintaining competitive productivity levels.

The findings highlight the potential of organic farming systems as a viable and sustainable alternative to conventional chemical-based agriculture. The long-term trial provides valuable insights into maintaining crop productivity while enhancing soil fertility. The project will continue to refine agronomic practices and is expected to develop a comprehensive production technology package and recommendations for the cultivation of organic wheat and potato.

Enrichment of agro-waste compost for nitrogen and phosphorus contents

The intensive use of chemical fertilizers to enhance crop yields has become

increasingly unsustainable due to rising fertilizer prices and growing environmental concerns. This situation necessitates a gradual shift toward organic production systems. However, the expansion of organic farming is limited by the inadequate supply of high-quality organic fertilizers. Compost (a slow-release organic fertilizer primarily produced from agro-wastes) offers a promising alternative to reduce dependence on chemical fertilizers while simultaneously improving soil health and fertility for sustainable crop production. Nonetheless, most compost products available in local markets are derived from urban or municipal wastes, which often contain heavy metals and have low levels of essential plant nutrients, particularly nitrogen (1–2%) and phosphorus (0.3–0.5%).

The current project aims to enhance the nutritional value of NIFA agro-waste compost by utilizing naturally available sources of plant nutrients. To achieve this, various potential nutrient sources such as animal manure, poultry manure, blood meal, fish bone meal, rock phosphate, filter cake, mushroom spent, etc., were analyzed in the laboratory for their nitrogen (N) and phosphorus (P)

contents. Analytical results indicated that blood meal contained the highest nitrogen content (10.2%), followed by fish bone meal (6.2%).

A composting trial was conducted at the composting facility of the institute, where nutrient-rich materials were combined with green and dry agro-wastes in different formulations to prepare enriched compost. The mature compost samples were analyzed for phosphorus (P) content and total organic carbon (TOC). Among the various formulations tested, the highest P content (2.0%) was observed in the compost prepared by adding animal manure, rock phosphate, and poultry manure, while the highest TOC value (20%) was recorded in the compost prepared by adding animal manure, rock phosphate, poultry manure, blood meal, and fish bone meal. The findings from this study provide valuable insights for the development of nutrient-enriched, slow-release organic fertilizer (compost) that could serve as a cost-effective and sustainable option for small-scale vegetable and nursery growers.

Isolation, screening and biochemical characterization of different rhizobacterial strains for the

development of an effective microbial product

Rhizobacteria are beneficial microorganisms that colonize the rhizosphere and contribute to plant growth by fixing atmospheric nitrogen, solubilizing phosphorus & potassium, and producing plant growth-regulating compounds such as auxins. These microbes naturally enhance soil fertility, making them environmentally friendly and sustainable alternatives to chemical fertilizers. While most commercially available biofertilizers target only one or two aspects of soil fertility, this project aims to develop a consortium of compatible rhizobacterial strains to provide a comprehensive solution addressing multiple soil fertility challenges.

In this study, bacterial strains were initially isolated from chickpea and berseem root nodules, the rhizosphere of wheat, maize, and potato crops, and from enriched Compost Tea. The isolates were characterized based on their ability to produce ammonia, hydrogen cyanide (HCN, or prussic acid), and various enzymes.

The results revealed that the isolate obtained from Compost Tea exhibited the highest ammonia production ($25.67 \mu\text{g mL}^{-1}$) along with increased enzyme activity, indicating its superior nitrogen metabolism and organic matter degradation potential. These traits suggest that it could enhance soil fertility and plant nitrogen availability more effectively than other isolates. Furthermore, the presence of motility, catalase activity, and HCN production – particularly in isolates from Compost Tea, berseem, and maize – highlighted their potential for stress tolerance and effective root colonization.

A field trial was subsequently conducted to evaluate the efficacy of *Green Soil* (a commercial microbial product), Compost Tea, and Rhizobacteria on wheat and potato crops under both organic and inorganic conditions. The results showed that the highest wheat grain yields (7.1 and 6.3 t ha^{-1}) and potato tuber yields (37.07 and 34.05 t ha^{-1}) were obtained by applying Rhizobacteria under organic and inorganic conditions, respectively. These preliminary findings demonstrate the strong potential of the isolated strains for developing an effective microbial product capable of enhancing plant growth and yield.



**PLANT PROTECTION
DIVISION**

Biological Control

Tomato fruit worm, *Helicoverpa armigera* (Hub.), and wheat aphid, *Schizaphis graminum* (Rondani) are polyphagous insect pests that cause damage to tomato (53%) and wheat (35-40%), respectively. Indiscriminate use of insecticides against these insect pests causes serious issues like health problems, destruction of beneficial insects, and threatens the sustainability of agricultural systems. Bio-control Group is working on the beneficial insects that are egg parasitoid, *Trichogramma chilonis* (Ishii), entomopathogenic fungi (*Nomuraea rileyi*), and plant extracts (garlic, orange peel etc.) for the control of tomato fruit worm and wheat aphid. Several key findings emerged from the comprehensive studies on the management of these agricultural insect pests.

Evaluation of plant extracts against fruit worm through the bioassay technique in the Lab

Maximum fruit worm mortality was recorded in aqueous solutions of

parthenium - treated okra fruit, i.e., 23.33% followed by orange peel & paneer dodi extracts (21.67%); garlic (18.67%), neem (18.33%) & the lowest (11.67%) was recorded in the control under lab condition. Parthenium extract showed the highest lab efficacy, achieving 23.33% mortality of fruit worm larvae as compared to other treatments.

Evaluation of Plant extracts against fruit worm in okra field

Minimum fruit worm infestation was recorded in parthenium extract, i.e., 0.32 larvae/ okra plant, followed by neem (0.36), orange peel (0.58), paneer dodi (0.74), garlic (0.80), and control (1.24) under field conditions. Field trials confirmed that the parthenium extract reduced fruit worm infestation by approximately 74% compared to the control.

Fruit worm infestation after the release of egg parasitoid, *Trichogramma*, in the okra crop

Minimum fruit worm infestation was recorded up to 0.40 larvae/24 m² plot after application of Trichocard (*Trichogramma* pupae = 2000 nos.), followed by 1500 T.C. (0.46), 1000 T.C. (0.63), and higher in control (0.73) under

field conditions. Trichocard @ 2000 pupae/card reduced fruit worm infestation up to 45% in a 24 m² plot as compared to the untreated plot.

Evaluation of entomopathogenic fungi against fruit fly, corn earworm, and subterranean termites under laboratory conditions

Four entomopathogenic fungal species (*Nomuraea rileyi*, *Aspergillus parasiticus*, *A. flavus*, and *A. niger*) were evaluated for their pathogenic potential against major insect pests, including fruit fly, corn earworm, and subterranean termites. Among these, *A. niger* and *N. rileyi* demonstrated notable efficacy against fruit flies, reducing the adult population by 50–55%. Similarly, *A. parasiticus* and *N. rileyi* exhibited strong pathogenicity against corn earworm, causing 76–80% larval mortality. In addition, *N. rileyi* and *A. flavus* showed the highest effectiveness in managing subterranean termites, achieving up to 100% control.

Evaluation of Entomopathogenic fungi on the ovipositional preference of the fruit worm

Different entomopathogenic fungi spp. (*Nomuraea rileyi*, *Aspergillus parasiticus*, *A. flavus* & *A. niger*) were evaluated

against the ovipositional preference of the tomato fruit worm in a free-choice bioassay. *N. rileyi*, *A. niger*, and *A. parasiticus* @ 1×10⁸ spores/ml reduced the oviposition of *H. armigera* up to 74-92% as compared to the control.

Compatibility of Entomopathogenic fungi with garlic & orange peel extract against aphids

Garlic and orange peel extracts (5%) were evaluated alone and in combined form with *N. rileyi* & *A. parasiticus* @ 1×10⁸ spores/ml against wheat aphids. The combination of orange peel extract (5%) with *N. rileyi* at 1×10⁸ spores/ml produced the highest aphid mortality (100%), surpassing all other treatments.

Evaluation of natural and artificial diets on the biological parameters of Black Soldier Fly (*Hermetia illucens* L.) in vitro conditions

Different natural and artificial diets were evaluated on the biological parameters of Black Soldier Flies under controlled conditions to assess their feeding performance. A field survey was conducted in Peshawar during 2024-25 to collect adult flies from habitats such as fruit mandi and vegetable market using

sweeping nets. Collected adults were reared in muslin cloth cages (60×60×60 cm) at 25 ± 5°C, 65 ± 5% relative humidity, and a 16:8 light-to-dark ratio. Hydration and feeding were maintained through water-soaked cotton and 10% sugar solution, while larvae were reared on six diets including fruits, vegetables, poultry feed, wet wheat, wheat-based artificial diet, and chickpea-based artificial diet. Two-week-old larvae were oven-dried at different temperatures to determine optimal conditions. Results showed successful completion of the BSF life cycle under laboratory conditions, with poultry feed and wheat-based artificial diets yielding healthier larvae and higher survival rates. The ideal drying temperature was found to be 70–80°C for 45–50 minutes, which preserved larval color and shape. Overall, the study demonstrated that BSF can efficiently thrive on various organic substrates and represents a promising protein alternative for poultry and feed industries.

Host plant resistance studies in various wheat genotypes against the wheat aphid

A host plant resistance study was conducted on different wheat genotypes

at the NIFA farm. Results showed that out of 895 wheat genotypes tested in the NWDSN trial, 426 were resistant to wheat aphids. Similarly, 33 out of 72 genotypes in the NUWYT trial and 112 out of 220 commercial wheat varieties also showed resistance.

Termites Management

Subterranean termites threaten wooden structures and crops due to cryptic nature, making conventional control difficult. Current reliance on synthetic insecticides is costly and environmentally risky. The Termite Group is developing organic formulations and improved baiting systems as eco-friendly, sustainable alternatives. The goal is to introduce safe, economical solutions with long-term control while advancing modern bait technologies recognized globally for their effectiveness and environmental safety.

Exploitation of insecticidal characteristics of local plants for the management of subterranean termites.

Extensive laboratory evaluations on termite management demonstrated that the indigenously developed C-1 organic formulation exhibited remarkable toxicity

and deterrent properties against subterranean termites. The formulation not only caused high mortality but also strongly inhibited feeding activity and tunneling behavior, reflecting its potential as an effective bio-based control agent. Its residual toxicity persisted for up to 120 days, showing performance comparable to that of commercial synthetic termiticides. This sustained activity indicates its suitability for longer-term protection in both structural and soil applications. Furthermore, when the C-1 formulation was applied as a chemical barrier in soil, it significantly disrupted termite tunneling and foraging activity, effectively reducing their movement and establishment potential. These findings highlight the C-1 organic formulation as a promising, environmentally safe alternative to synthetic chemicals, supporting the development of sustainable and eco-friendly termite management strategies at NIFA.

Development of local attractive bait matrix and toxin delivery foraging stations for control of subterranean termite species.

Detailed laboratory investigations were carried out to identify suitable attractants and feeding stimulants for improving

termite bait formulations. Among ten tested locally available cellulosic materials, sugarcane dry slices were found to be the most attractive to termites, showing higher feeding activity compared to other substrates. Similarly, among five synthetic cellulosic materials evaluated, alpha cellulose exhibited the highest levels of termite aggregation and feeding activities, indicating its strong potential as a base material for bait development.

In parallel, six amino acids were tested to determine their role in enhancing termite attraction, where L-proline proved to be the most effective in stimulating feeding and tunneling responses. Behavioral assays further revealed that termites showed notable aggregation and activity towards 2-phenoxyethanol (10 ppm), 1-octanol, and 1-decanol, compared to untreated controls. Incorporating these identified attractants into the formulation, the revised bait matrix demonstrated a significantly higher attractiveness than the previously developed version, highlighting its improved potential for efficient and targeted termite management.

Fruit Fly Management

Fruit flies (Diptera: Tephritidae) are among the most damaging pests of horticultural crops across the world. They attack a wide variety of fruits and vegetables, causing heavy losses to farmers, traders, and exporters. Conventional control practices depend largely on the use of chemical pesticides, which not only pose risks to human health but also harm beneficial insects, contaminate the environment, and lead to resistance in pest populations. To overcome these challenges, researchers are now focusing on developing safer and more sustainable control approaches. These eco-friendly methods form an essential part of an Integrated Pest Management (IPM) system aimed at managing fruit flies effectively while reducing negative impacts on human health and the environment.

Investigation on the synergistic interactions of volatile compounds in fruit fly bait formulations

The synergistic effect of trimethylamine, in varying ratios, was evaluated in guava-enriched proteinaceous and ammonium acetate bait formulations for their effectiveness in attracting *Bactrocera* species. The baits were prepared by mixing the specified concentrations with

200 ml of water and placing them in locally designed traps made from 1.5-liter plastic bottles. These traps were installed at a height of approximately 2 m in guava orchards and spaced adequately to minimize interference. Among the tested formulations, blend T5 showed enhanced attraction to both male and female *Bactrocera* flies, indicating a potential synergistic effect of trimethylamine. However, the control bait (T6), composed of guava juice, brewer's yeast, and ammonium acetate without trimethylamine, recorded a comparable overall fly catch to T5. To confirm these results, the experiment will be repeated under pesticide-free field conditions, as heavy pesticide applications in the previous season may have affected trap performance and fly activity.

Assessing the impact of gamma irradiation on key biological traits of peach fruit fly, *Bactrocera zonata*, under laboratory conditions

The present study investigated the effects of gamma irradiation on key biological parameters of *Bactrocera zonata* under controlled laboratory conditions. Six-day-old pupae of *B. zonata* were subjected to irradiation doses of 0, 30, 40, 50, 60, and 70 Gy, and subsequent developmental and

reproductive traits were studied to evaluate the impact of irradiation. Post-irradiation results revealed a dose-dependent trend. Higher irradiation doses (50 Gy & above) adversely affected adult emergence with a higher percentage of partially emerged or deformed adults, and reduced longevity of the emerged adults. Sterility levels in irradiated males were the highest at upper dose ranges, i.e., 60 & 70 Gy, while females exhibited complete sterility beyond a 40 Gy threshold. The present study manifested that 70 Gy could be an effective dose for sterility induction in *B. zonata*.

Laboratory bioassays of botanicals against Melon fruit Fly (*Bactrocera cucurbitae*)

Laboratory bioassays were conducted to evaluate the efficacy of botanical extracts, Neem (*Azadirachta indica*), Garlic (*Allium sativum*), Clove (*Syzygium aromaticum*), and Bakain (*Melia azedarach*) against the melon fly (*Bactrocera cucurbitae*). All botanicals showed significant inhibitory effects, with Neem proving most effective, recording the highest non-preference (50.0%), lowest pupation (22.2%; 72% inhibition), highest ovipositional deterrence (58%),

shortest adult longevity (22), lowest adult emergence (56%), and highest mortality (78%). Garlic showed moderate effects with 42% non-preference, 33% pupation (52% inhibition), 36% ovipositional deterrence, 30% longevity, 56% emergence, and 31% mortality. Clove and Bakain exhibited relatively lower efficacy, with Clove showing 41% non-preference and 62% mortality, while Bakain had 37% non-preference and 43% mortality. The control recorded the highest pupation (35%) and longevity (48) with the lowest mortality (8%), confirming Neem's superior bioactivity and the potential of all tested botanicals, particularly Neem, followed by Garlic and Clove as eco-friendly alternatives for *B. cucurbitae* management.

Laboratory bioassays of botanicals against Oriental Fruit Fly (*Bactrocera dorsalis*).

Laboratory bioassays assessing the efficacy of Neem, Garlic, Tobacco, and Bakain against the oriental fruit fly (*Bactrocera dorsalis*) showed that all botanicals significantly affected the pest's development and survival, with Neem being the most effective. Neem caused the highest pupal mortality (52%), greatest pupation inhibition

(71%), strongest ovipositional deterrence (69%), lowest adult emergence (43%), and shortest adult longevity (23 days). Bakain and Tobacco showed moderate efficacy, with Bakain recording 33% pupal mortality, 57% pupation inhibition, 64% deterrence, and longest treated longevity (39 days), while Tobacco had 45% mortality and 55% inhibition. Garlic exhibited comparatively lower effects, with 37% pupal mortality and 54% deterrence. In contrast, the control group showed the shortest pupal duration (4 days), highest adult emergence (95%), and longest adult longevity (38 days). Overall, Neem proved most potent, followed by Bakain, Tobacco, and Garlic, highlighting their potential as eco-friendly options for *B. dorsalis* management.

To Investigate the effect of gamma irradiation in the production of pest-free commodities for trade promotion in Pakistan and elsewhere

Insect pests pose a major threat to agricultural commodities, often spreading through trade and causing significant losses to food production and global commerce. To address this challenge, research efforts have increasingly focused on the use of

irradiation as a phytosanitary treatment to eliminate quarantine pests and safeguard traded produce. The IAEA-funded project titled “Investigating the Effect of Gamma Irradiation in the Production of Pest-Free Commodities for Trade Promotion (IAEA RC-24975)” aims to evaluate the effectiveness of gamma irradiation in producing pest-free agricultural commodities. This initiative seeks to standardize effective gamma irradiation doses for various insect pests of quarantine importance, thereby strengthening both domestic and international trade by ensuring pest-free produce and promoting safer, more sustainable trade practices.

First Record of the Striped Mealybug (*Ferrisia virgata* Cockerell) in Khyber Pakhtunkhwa, Pakistan

During the development of phytosanitary irradiation doses against the cotton mealybug under the IAEA Coordinated Research Project (CRP-24975), mealybug specimens were collected from infested host plants and brought to the laboratory for rearing and experimentation. After a few days of rearing, it was observed that the morphological characteristics of the specimens differed from those of the

typical cotton mealybug. Subsequently, the collected specimens were properly slide-mounted, examined, and identified by a taxonomic expert. The species was confirmed as the striped mealybug, *Ferrisia virgata* (Cockerell), which had previously been reported only from Sindh province of Pakistan. This identification, therefore, represents the first record of *F. virgata* in Khyber Pakhtunkhwa (KP). This finding marks an important entomological record for the KP province and highlights the expanding distribution of *F. virgata* within Pakistan.

Development of Phytosanitary Irradiation Treatment against the Striped Mealybug, *Ferrisia virgata* (Cockerell)

The present study was conducted to evaluate the radio-tolerance of different developmental stages of the striped mealybug, *F. virgata*, by determining the effects of various gamma irradiation doses. A laboratory culture of *F. virgata* was established and maintained under controlled conditions. The target stages first instar nymphs, second instar nymphs, and adults were subjected to irradiation doses of 0, 30, 60, 90, 120, 150, 200, and 250 Gy using a gamma radiation source. The results indicated

that at irradiation doses of 150 Gy and above, no adult emergence was observed from the immature stages. Among the tested developmental stages, adults exhibited comparatively higher radio-tolerance than the first and second instar nymphs, showing lower mortality rates with increasing radiation doses over the observation period. Based on these findings, it was concluded that a dose of 250 Gy can be considered effective as a phytosanitary or quarantine treatment for *F. virgata* across all developmental stages. At this dose, no reproductive females were observed, and fecundity was completely suppressed.

Development of Phytosanitary Irradiation Treatment against the Corn Earworm, *Helicoverpa zea* (Boddie)

The present study was conducted to determine the radio-tolerance of various developmental stages of the corn earworm, *Helicoverpa zea*. Eggs and different larval instars were exposed to gamma irradiation doses of 50, 100, 150, 200, and 250 Gy. Data were recorded on egg hatch rate, larval development, mortality, pupation, and adult emergence. Post-irradiation results

revealed that the fully grown (late instar) larvae were the most radio-tolerant stage, exhibiting comparatively lower mortality even with increasing radiation doses. However, a dose of 200 Gy proved to be critical, as no adult emergence was observed from any larval instar, and no egg hatching occurred at this level. Therefore, an irradiation dose of 200 Gy was found to be highly effective against both the egg and larval stages of *H. zea* and can be considered a suitable phytosanitary treatment to ensure quarantine security.

Gamma Irradiation as a Phytosanitary Treatment for the Control of Chickpea Pod Borer, *Helicoverpa armigera* (Hübner)

The present study was conducted to determine an effective phytosanitary irradiation dose against the chickpea pod borer, *Helicoverpa armigera*. A laboratory culture of *H. armigera* was established and maintained under controlled conditions. Fully grown larvae from the culture were exposed to gamma irradiation doses of 50, 100, 150, 200, and 250 Gy. Data were recorded on percent pupation, adult emergence, and inhibition of adult formation. The results

revealed that an irradiation dose of 250 Gy completely inhibited larval development and prevented adult formation, indicating its effectiveness as a phytosanitary irradiation treatment for *H. armigera*.

Plant Pathology

Epidemiology of wheat diseases

Status of airborne and vector-borne diseases during 2024-25

Meticulous seasonal information plays a pivotal role in enhancing our understanding of various wheat diseases, aiding in the development of disease-resistant wheat varieties, and ultimately contributing to sustainable food security. During 2024-25, 220 diverse wheat collections were established as sentinel plots at the NIFA Farm for comprehensive epidemiological investigations into airborne and vector-borne diseases. Several distinct temporal disease assessments of sentinel plots were meticulously documented during the 2024-25 cropping cycle, and the findings are highlighted below.

Airborne diseases

Yellow rust manifested initially as sporadic flickering in the early season,

and following the latent period, its progression in the last assessment in April exhibited a mean disease severity of 35%. This situation is quite different from the previous season, in which the mean disease value reached 9% during the first week of April. However, during the current season, the epidemic was extended for one week, and yellow rust was prevalent in 73% of the sentinel plots established at NIFA. Conversely, powdery mildew did not manifest throughout the season, while leaf rust was prevalent in 10% of the plots during April, with a mean intensity of 24%.

Aphid-borne disease

The aphid-borne barley yellow dwarf disease symptoms under field conditions were patchy and displayed in 14 plots (6%) during February and March, showing variability in severity levels between 5-40%.

Integrative analysis of *Puccinia striiformis* f. sp. *tritici* (*Pst*) dynamics, resistance efficacy, resistance genes postulation, and wheat seed health

Detection and understanding of *Pst* pathotypes/virulences, identifying effective genes, and postulation of resistance genes and seed health

analyses are essential components for effective disease management and promoting wheat resistance development and deployment. Findings of 2024-25 are summarized below.

Proposed *Pst* pathotypes and associated virulences

A comprehensive investigation into the temporal variability of natural *Pst* virulences & races throughout the growing season at NIFA Farm was carried out using standard differential sets. Throughout the season at NIFA, four distinct *Pst* pathotypes were detected with proposed names: 0E0, 208E26, 215E154, & 207E154, while associated virulence factors were up to 10.

Efficacy of resistance genes

Different yellow rust resistance genes were investigated to decipher their effectiveness at the adult plant stage against prevalent pathotypes during 2024-25. Results indicate that 15 single genes including *Yr1*(AvSYr1NIL), *Yr10* (AvSYr10NIL), *Yr15* (AvSYr15NIL), *Yr17* (AvSYr17NIL), *Yr27*(AvSYr27NIL), *Yr32* (AvSYr32NIL), *Yr18* (AvSYr18NIL), *Yr26* (AvSYr26NIL), *Yr28* (AvSYr28NIL), *Yr21* (LEMHI), *Yr29* (Lal Bahadur/Pavon 1B

Line 1), and two different pair of genes *Yr39 + YrAlp* (ALPOWA), *Yr35*, and *Yr73 + Yr74* (Avocet R) were found effective at NIFA site.

Postulation of yellow rust resistance genes in PAEC elite wheat lines

A total of 120 elite wheat lines from PAEC A&B Institutes were evaluated for yellow rust resistance under field conditions, along with a panel of 34 yellow rust differential cultivars, each carrying a single or known combination of *Yr* resistance genes, which was used as the reference set. Assessments were conducted at regular intervals, recording disease severity (%) and infection type (0 = resistant, 1 = susceptible). By comparing elite line responses with those of the differentials, candidate resistance genes were postulated. Frequencies of the predicted genes in the descending order were *YrSD* (67%), *Yr32* (14%), *YrA* and *Yr3* (6% each), *Yr5* and *Yr8* (5% each), *Yr6* and *Yr7* (4% each), *Yr1* (3%), *Yr17* (2%), *Yr24*, *Yr7+*, *Yr9+2* and *Yr27* (1% each). This study identified *Yr17*, *Yr32*, *Yr5*, and *Yr15* as the most effective resistance genes in elite wheat lines under field conditions. While *Yr2* and *Yr9* were compromised. The findings highlight the urgent need for strategic

deployment and pyramiding of multiple *Yr* genes to achieve durable resistance against rapidly evolving *Pst* populations.

Longitudinal analysis for detecting durable resistance

Mitigating the impact of yellow rust over 70% of the wheat landscape in the low-altitude districts of the KP Province, it is imperative to minimize the initial inoculum (allo and subsequent auto infection) of *Pst* originating from both the source area (i.e., mid and high-altitude districts) and exotic territories. Attaining this objective involves repeatedly measuring the same subjects over an extended period to observe changes, trends, and patterns over time. Longitudinal analysis using the Area Under the Disease Progress Curve (AUDPC) summarizes yellow rust over time into a single value, representing total disease stress. Relative AUDPC values of 220 test varieties ranged from 0 to 100. Relative AUDPC values of 64 varieties were 21-40, signifying a state of moderate resistance and potential for durability in combating rust progression. These 64 varieties have also reduced yellow rust epidemic development by 11 days and are suggested for strategic deployment in the source area to

effectively manage *Pst* and limit its spread, ultimately safeguarding wheat cultivation in the region.

Post-harvest wheat seed disease risk analyses

A laboratory study was conducted using post-harvest seeds from 220 wheat varieties, which were raised at the NIFA Farm, to investigate disease risk analyses. Major and economically important seedborne diseases include black point and karnal bunt, caused by *Altemaia altennta* (Fr.) Keissler and *Tilletia indica* Mitra (= *Neovossia indica* (Mitra) Mundkur), respectively. Incidences of black point and Karnal bunt of each variety underwent meticulous scrutiny, with a thousand seeds per variety manually examined for occurrences of black point and Karnal bunt using a magnifying lens equipped with a built-in light source. The results indicated that karnal bunt was not detected, while the incidence of black point varied between <1 to 35%. Black point was not recorded in 13 (6%) varieties. Less than 1 and up to 3% incidence was recorded in 102 (46%) tested varieties. Similarly, >3% incidence was recorded in 47% of the tested varieties. Threshold of black point

caused by *A. altennta* (Fr.) Keissler for pre-basic seed is none; for basic seed is 0.05% and for certified seed is 3%. Black point Incidence rates recorded in several tested varieties surpass the permissible thresholds, emphasizing the critical need for seed treatment employing appropriate fungicides.

Disease resistance characterization under the national coordinated wheat improvement program

Fostering the advancement and promotion of disease-resistant wheat germplasm and varieties is being done annually under the national wheat improvement program led by the Pakistan Agricultural Research Council (PARC), Islamabad, involving around 32 key national institutions, including PAEC Agri & Biotec Institutes. During 2024-25, three distinct sets of wheat germplasm: the National Wheat Disease Screening Nursery (NWDSN), a set of candidate future varieties (National Uniform Wheat Yield Trial-Nursery), and a collection of released varieties totaling around 1217, were raised under artificially induced yellow rust epidemic conditions for accurate evaluation at NIFA. Throughout the growing season, meticulous disease data for each entry in these three sets

were recorded. These invaluable insights will be collated and presented in the final country report by the PARC, Islamabad. This report will serve as a critical resource for national breeding programs, provincial and federal seed councils, guiding the strategic release and recommendation of cultivars. This strategic approach is instrumental in averting potential epidemics of *Pst* and ensuring the optimal cultivation of released cultivars, ultimately fortifying the wheat farming landscape.

Medical Entomology

Development of Parthenium-Based Bio-Pesticide and Ovi-Trap/ Bait Systems for Enhanced Surveillance and Control of Vector Mosquitoes.

Reliance on synthetic insecticides for dengue vector control poses serious risks to human health and the environment while promoting insecticide resistance. To address these challenges, the Medical Entomology team focused on developing indigenous, eco-friendly alternatives using botanical extracts and improved trapping systems. The bio-pesticide was formulated and tested under laboratory and field conditions, demonstrating a 60–70% reduction in larval density within 3–4 weeks of

application. Parallely, the design and optimization of ovi-trap and bait prototypes resulted in up to 65% higher mosquito retention during semi-field trials, enhancing surveillance efficiency. Furthermore, screening for modification of the Dengue Guard formulation achieved 80–85% adult repellency, zero human landing, and a residual effect lasting 3–4 hours. Collectively, these R&D outcomes is contributing to the development of effective, low-cost, and environmentally safe mosquito control tools with potential for commercialization, community adoption, and income generation, thereby promoting sustainable and self-reliant vector management strategies.

Integrated Optimization of Mosquito Traps: Design, Attractants, and Insecticides

To strengthen vector surveillance and control, efforts were focused on the integrated optimization of mosquito trap design, attractants, and insecticidal components. Various trap prototypes were evaluated under laboratory and semi-field conditions using different visual cues, color contrasts, and olfactory attractants derived from natural sources to enhance mosquito response.

Incorporation of safe insecticidal agents and improved entry–exit dynamics significantly increased trap efficiency. The refined prototypes demonstrated up to 65% higher mosquito retention during semi-field trials compared to conventional designs. These optimized traps not only provide a cost-effective and environmentally friendly surveillance tool but also support early detection of vector population trends and reduce dependence on chemical spraying, contributing to sustainable mosquito management programs.

Bio-Pesticide Efficacy in Various Field Sites

Field evaluations of the Parthenium-based bio-pesticide were conducted at multiple dengue-prone locations to assess its effectiveness under diverse environmental conditions. The formulation was applied to typical mosquito breeding habitats, including domestic water containers, discarded tires, and agricultural water storage sites. Regular monitoring of larval density was carried out weekly to determine the persistence and residual activity of the treatment. Results showed a 60–70% reduction in larval density within three to four weeks of application, confirming

strong and sustained larvicidal performance. The bio-pesticide proved to be eco-friendly, safe for non-target organisms, and suitable for community-level application. Its use demonstrates potential for large-scale deployment as a cost-effective alternative to chemical larvicides, supporting integrated vector management and reducing reliance on synthetic insecticides.

Modification in Dengue Guard Formulation (evaluation of various organic oils for modification in Dengue Guard Formulation)

To enhance the efficacy and user safety by making it DEET-free of the existing Dengue Guard formulation DEET-free, various organic essential oils were evaluated for their repellent and residual properties. Laboratory bioassays were conducted to determine optimal concentrations, blend ratios, and formulation stability under different temperature and humidity conditions. The modified formulation exhibited 80–85% higher adult mosquito repellency, resulting in zero human landing during exposure tests. However, the residual protective period was short with a lasting effect of 2–3 hours. The formulation,

therefore, needs improvement to provide a safe, non-toxic, and cost-effective personal protection tool, suitable for public use and potential commercialization. This advancement will strengthen dengue prevention strategies by offering a locally developed, environmentally friendly alternative to synthetic repellents.

Enhancing the Capacity and the Utilization of the Sterile Insect Technique (SIT) for *Aedes* Mosquito Control.

Pakistan is an active partner in the regional International Atomic Energy Agency (IAEA) initiative focused on the application of the Sterile Insect Technique (SIT) for sustainable control of *Aedes* mosquitoes, the primary vectors of dengue, chikungunya, and Zika viruses. With technical and material support from the IAEA, national efforts are directed toward strengthening vector surveillance systems, scaling up mosquito rearing capacity, and optimizing sterile male production and release protocols in accordance with the IAEA's Phased Conditional Approach (PCA) framework.

At the national level, NIFA plays a pivotal role by generating baseline

entomological and ecological data, refining colony maintenance and irradiation procedures, and conducting quality control assessments to ensure the fitness and competitiveness of sterile males. NIFA also contributes to regional capacity building through expert training, laboratory demonstrations, and knowledge sharing under coordinated research and technical cooperation projects. These efforts collectively establish the foundation for large-scale, eco-friendly, and sustainable SIT-based vector control in Pakistan, integrating nuclear technology with conventional approaches to reduce reliance on chemical insecticides and support national dengue prevention programs.

Effect of Sterile Wild Male Ratios on Wild Female, Success (%)

To determine the optimal ratio of sterile to wild male mosquitoes for effective population suppression, a series of field cage experiments was conducted under semi-natural conditions. Sterile and wild males were released in varying ratios; 1:1, 3:1, 5:1, and 7:1 and allowed to compete for wild females over several mating cycles. The proportion of inseminated females was subsequently

analysed to evaluate the effectiveness of each ratio.

Results revealed that the 5:1 sterile-to-wild male ratio achieved the highest suppression efficiency, resulting in over 80% reduction in wild female insemination while maintaining high sterile male mating competitiveness. Ratios above this level showed no significant improvement, suggesting that 5:1 represents a practical and cost-effective balance for large-scale field releases. These findings provide an important operational benchmark for SIT implementation, helping optimize release strategies to achieve maximum impact with minimal resource use in future dengue vector suppression programs.

Semi-field Tests of the Competent Sterile Males

In any Sterile Insect Technique (SIT) program, success largely depends on the mating competitiveness of sterile males against their wild counterparts. To assess this critical parameter, semi-field cage experiments were conducted using *Aedes* males sterilized through gamma irradiation at doses of 70 Gy and 80 Gy. These sterile males were released with wild males and females under controlled

environmental conditions to evaluate their performance in natural-like settings. The results demonstrated that sterile males retained high mating competitiveness, with competitive index (C) values of 1.79 and 2.30 for 70 Gy and 80 Gy treatments, respectively. A C-value greater than 1 indicates that the sterile males were more competitive than wild males, effectively securing a greater proportion of matings. Furthermore, the Induced Egg Sterility (IES) reached 100% for both irradiation doses, confirming complete sterility without compromising male vigour or behavior. These findings validate the field readiness and biological quality of the irradiated males, reinforcing their potential for use in large-scale SIT-based dengue vector suppression programs in Pakistan.

Hunt for naturally existing *ts1* mutation in *Aedes aegypti* and *Ae. albopictus* for the construction of a more robust Genetic Sex Strain (GSS) for SIT.

Under the IAEA-CRP (D44003), RC No. 24085, extensive field collections of *Aedes* eggs and larvae were conducted from diverse climatic and topographic regions across Pakistan to identify naturally existing temperature-sensitive

lethal (*ts*) mutations and thermal resistance patterns. From these collections, one *Aedes aegypti* strain and one Iso-male strain were identified and characterized as thermally resistant, demonstrating high survival rates when exposed to elevated temperatures of 39°C and 40°C for three hours under laboratory conditions. Interestingly, the male pupae exhibited greater thermal resistance compared to

females, suggesting a potential avenue for developing a sex separation mechanism based on heat tolerance. This finding holds considerable importance for future work on genetic sexing strain (GSS) development and improving the efficiency of the Sterile Insect Technique (SIT) programs aimed at vector population suppression in Pakistan.

SOCIO-ECONOMIC IMPACT

PLANT BREEDING AND GENETICS DIVISION

The main objective of the Plant Breeding and Genetics division is to develop Wheat, rapeseed, Mungbean, Kidney bean, and horticulture crop varieties that yield more seeds/fruits, increasing overall production on the same land area and boosting farmers' income. By enhancing yields and resilience, the aim is to provide varieties that bring economic advantages to farmers, making crop farming more profitable. NIFA Sarson-T20 and NIFA Sarson-T23 have shown up to a 20% increase in seed yield compared to other varieties in the KP region. This yield improvement leads to higher production per unit area. With a seed yield of over 100 kg per acre in rapeseed, farmers can earn an additional income of Rs. 20,000-25,000 per acre. This extra income significantly improves the economic feasibility of rapeseed cultivation.

During 2024-25, a total of 12850 kg quality seed of NIFA wheat varieties, i.e., Fakhre NIFA 2023, NIFA Awaz 2019, and NIFA Lalma 2013, was produced, which is sufficient to plant 257 acres of land. Two hundred and seventy kilograms of pre-basic seed of NIFA's green and black-seeded mungbean varieties were sold to AED, KP in 2024–25 for further multiplication in the mungbean-growing areas of KP. The multiplied seed will positively play a significant role in enhancing overall mungbean production as well as supporting the rural economy of the province. As far as kidney bean socio-economics is concerned, the produced seed is awaiting certification by the FSC&RD. Upon completion of the process, the seed will be distributed to progressive growers/AED, KP for further multiplication in the province. This will also positively affect the socio-economic condition of the subsistence growers

FOOD AND NUTRITION DIVISION

FND achieved a total income of Rs. 8.39 million, reflecting its growing socioeconomic and commercial impact. The Rapid Test Kits (RTKs) for iodine and vitamin A fortification contributed the largest share of Rs. 4.46 million (53%), reducing import dependence and supporting national nutrition programs. The Gemstone Irradiation services generated Rs.

1.78 million (21%), adding value to local gemstones and enhancing export potential, while value-added food products earned Rs. 1.13 million (13%), promoting technology commercialization in food processing. The Mushroom Cultivation Program brought in Rs. 0.88 million (10%), improving rural livelihoods through training and entrepreneurship, and analytical services contributed Rs. 0.15 million (2%), strengthening food safety and quality assurance. Collectively, these activities reflect FND's dedicated efforts to achieve institutional self-sustainability, enhance food safety, and achieve food and nutrition security at the national level.

SOIL AND ENVIRONMENTAL SCIENCES DIVISION

The Soil and Environmental Sciences Division has developed and optimized various climate-smart and cost-effective water and nutrient management packages as well as production technologies for both field and horticultural crops. These innovations are being widely promoted among farmers through training workshops, demonstrations, and media outreach. As a result, water and nutrient use efficiencies at the farm level have significantly improved, leading to higher overall productivity and increased net returns for farmers, thereby contributing to the uplift of their socio-economic conditions.

The adoption of these technologies has led to remarkable outcomes – for instance, wheat yields have increased up to 30%, along with notable improvements in grain quality. The socio-economic impact is even more pronounced in vegetable production, where yields have risen to tenfold through tunnel farming compared to traditional methods.

PLANT PROTECTION DIVISION

Crop diseases and insect pests substantially reduce agricultural productivity and profitability, driving up costs of chemical control and breeding for resistance against evolving pathotypes. In Khyber Pakhtunkhwa, major wheat diseases-yellow rust, leaf rust, powdery mildew, barley yellow dwarf, and blight complexes- collectively cause yield losses exceeding 1% across production zones. Under Pakistan's national wheat rust resistance program, an annual investment of about A\$12.3 million yields cumulative benefits valued at A\$123 million. Similarly, polyphagous insect pests such as the tomato fruit worm (*Helicoverpa armigera*) and wheat aphid (*Schizaphis graminum*) inflict yield losses of up to 53% and 35–40%, respectively. To address the environmental and health

risks of indiscriminate insecticide use, the Bio-Control Group is developing sustainable alternatives, including egg parasitoids (*Trichogramma chilonis*), entomopathogenic fungi (*Nomuraea rileyi*), and plant-based extracts (garlic, orange peel), which have shown promising efficacy.

Subterranean termites remain highly destructive, damaging crops, infrastructure, and wooden structures, with crop losses ranging from 20-45%, sugarcane losses reaching 30-90%, and maize up to 30%. Annual termite-related repair costs are estimated at PKR 150 million in Lahore, 130 million in Faisalabad, and 80 million in Multan. Pakistan consumes 300–400 metric tons of synthetic termiticides each year, creating economic and environmental burdens. In response, the Termite Group is formulating organic baits and eco-friendly control systems to reduce chemical dependence, repair costs, and promote bio-based industries.

The fruit fly management program significantly reduces the 20–80% crop losses through eco-friendly tools like MAT and food-baited traps, lowering pest populations by about 70% and improving fruit quality and farmer income. The development of a local bait reduces pesticide use and production costs, promoting safer, sustainable farming. At the same time, PPD’s research on phytosanitary irradiation treatments for key quarantine pests strengthens export potential by meeting international standards and reducing trade barriers.

Likewise, Medical Entomology R&D has advanced mosquito control technologies, achieving up to 65% higher trap efficiency, 60-70% larval reduction through bio-pesticides, and 80-85% repellency in modified *Dengue Guard* formulations with three to four hours of residual protection—offering effective, safer, and sustainable vector management solutions.



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FUNDED RESEARCH PROJECTS

Sr.#	Project Title	Project Duration	Total Funds (M)	Principal Investigator	Funding Agency
1	Breeding Winter Wheat Genotypes for Gilgit Baltistan (GB)	2025-28	39.81	Dr. Akhtar Ali, SS	SPD
2	Genetic improvement of field crops (wheat, oilseed brassica and pulses) and horticultural crops (peach/plum and okra) for high grain/Fruit yield and resilience to changing climate	2024-27	10.0	Dr. Salman Ahmad, PS	PAEC
3	Strategies for Mitigating Postharvest Losses in Fruits and Vegetables through Various Processing & Storage Techniques, and Analytical Optimization	2024-27	10.0	Dr. Maazullah Khan, DCE	PAEC
4	Development of bio-control technology for sustainable management of important agricultural insect pests/diseases & vector of human importance	2024-27	10.0	Mr. Muhammad Zahid, DCS	PAEC
5	Development and deployment of climate smart technology packages and fertilizer products for enhancing crop and soil productivity	2024-27	10.0	Dr. Amir Raza, PS	PAEC
6	Developing Tools and Germplasm for Production of Hybrid Wheat	2024-27	9.5	Dr. Muhammad Irfaq Khan, PS	PAEC

Sr.#	Project Title	Project Duration	Total Funds (M)	Principal Investigator	Funding Agency
7	Development of germplasm for hybrid seed production in okra	2024-27	11.75	Dr. Syed Tariq Shah, PS	PAEC
8	Development of germplasm for hybrid seed production in rapeseed	2024-27	5.858	Hafiz Munir Ahmad, PS	PAEC
9	Promoting research for productivity enhancement in pulses	2020-25	24.446	Dr. Gul Sanat Shah, DCS	PARC-PSDP
10	Genetic improvement of oilseed brassicas through induced mutations and hybridization techniques	2023-26	3.169	Mr. Hafiz Munir Ahmed, PS	PARC-ALP
11	Breeding of okra (<i>Abelmoschus esculentus</i> L.) for high-yielding genotypes development through induced mutations and breeding techniques	2023-26	2.0	Dr. Syed Tariq Shah, PS	PARC-ALP
12	Evaluation and deployment of multiple stress tolerant bio fortified wheat germplasm in Khyber Pakhtunkhwa	2024-25	0.820	Dr. Farooq-i-Azam, PS	CIMMYT Pakistan
13	Sustainable approaches for effective control of atone fruits replant disorders	2022-25	2.8	Dr. Roshan Zamir, DCS	PSF
14	Development of a hybrid indirect-type solar dryer for drying of fruits and vegetables	2022-25	3.261	Dr. Maazullah Khan, DCE	PSF
15	Production of Black Soldier Fly, <i>Hermetia illucens</i> larvae as sustainable proteinaceous food for the poultry industry	2023-26	2.257	Mr. Muhammad Zahid, DCS	PSF

Sr.#	Project Title	Project Duration	Total Funds (M)	Principal Investigator	Funding Agency
16	Development of Local attractive Bait matrix and toxin delivery foraging stations for the control of Pakistani Subterranean termites.	2024-27	2.298	Muhammad Irfan, SS	PSF
17	Development and commercialization of microbial bio pesticide as eco-friendly product for the area wide management of Fall armyworm (<i>Spodoptera frugiperda</i>) damaging maize crop in Pakistan	2025-28	2.293	Mr. Usman Khalique, JS	PSF
18	R&D for up-gradation of Vitamin A Test Kits for Quantitative Assessment of Vitamin A in Fortified Oil	2024-26	3.54	Dr. Zahid Mehmood, PS	NI
19	Hunt for naturally existing tsl mutation in <i>Aedes aegypti</i> and <i>Ae. albopictus</i> for the construction of a more robust genetic sex strain for SIT.	2020-25	5.20	Dr. Muhammad Misbah ul Haq, PS	IAEA
20	Adaptation of Low Energy Machine Generated Radiation Sources for Surface Decontamination and Disinfestation of Food in Pakistan	2021-26	9.17	Mr. Alamgeer Khan, PS	IAEA
21	Enhancing the Capacity and the Utilization of the Sterile Insect Technique for <i>Aedes</i> Mosquito Control, IAEA Technical Cooperation	2022-26.	32.73	Dr. Gul Zamin Khan, DCS	IAEA (RAS)

Sr.#	Project Title	Project Duration	Total Funds (M)	Principal Investigator	Funding Agency
22	Investigating the effect of gamma irradiation in the production of pest-free commodities for trade promotion.	2022-28	12.65	Dr. Muhammad Hamayoon Khan, PS	IAEA
23	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	2022-25	89	Dr. Amir Raza, DCS (NIFA Counterpart)	IAEA (TC)
24	Creation of Genetic Variability in Citrus (<i>Citrus reticulata</i>) and Avocado (<i>Persea americana</i>) for Climate Resilience, flowering synchrony and Early Bearing through Induced Mutations and In Vitro Culture Techniques	2025-2028	19.57	Dr. Roshan Zamir, DCS	IAEA

EVENTS/TRAININGS ORGANIZED

S. #.	Title	Date	Name of Organizers
1	Four 3-Days Training Workshops on Mushroom Cultivation Popularization as Cottage Industry	Feb-Mar, 2025	Dr. Muhammad Ibrahim, PS
2	NIFA Farmer's Day	16-04-2025	Dr. Roshan Zamir, DCS
3	Workshop on Use of Electron Beam and X-rays Technology and Qualitative Analysis of Added Micronutrients in Foods	23-04-2025	Dr. Zahid Mehmood, PS
4	Workshop on "Application of Bio-control techniques for the management of vegetable insect pests"	21-05-2025	Mr. Muhammad Zahid, DCS
5	Workshop on "Balanced Application of Fertilizer for Enhancing Productivity"	16-07-2025	Dr. Syed Azam Shah, DCS
6	One day workshop on "Managing fruit flies, termites and other trade-related insect pests"	24-09-2025	Dr. Muhammad Hamayoon Khan, PS
7	Three Day Training Workshop for Male Participants from Low Income Community of District Peshawar-KP on "Mushroom Cultivation as Cottage Industry" in Collaboration with SABAWON, October 01-03, 2025	01-10-2025 03-10-2025	Dr. Muhammad Ibrahim, PS
8	40 th Postgraduate training course on "The use of nuclear and other techniques used in food and agricultural research"	13-10-2025 17-10-2025	Dr. Muhammad Amin, PS
9	Management of Dengue Vectors/Mosquitoes Using Conventional and Advanced Nuclear Techniques	18-10-2025	Dr. Gul Zamin Khan, DCS
10	11 th Training Course for PAF Officers on "Modern Food Handling Techniques"	17-11-2025 21-11-2025	Dr. Zahid Mehmood, PS

S. #.	Title	Date	Name of Organizers
11	Two Day Training Workshop for Male Participants -KP on Mushroom Cultivation from Low Income Community of District Khyber as Cottage Industry at NIFA in Collaboration with NIDA-Pakistan	19-11-2025 20-11-2025	Dr. Muhammad Ibrahim, PS
12	Workshop on "Popularization of Solar Drying and Mushroom Farming	23-12-2025	Dr. Maazullah Khan, DCE

EVENTS/TRAININGS ATTENDED

Title	Period	Place	Scientist Name(s)
Basic Management Course (BMC-22)	05-01-2025 31-01-2025	PIEAS, Islamabad	Mr. Usman Khalique, JS Mr. Tauqeer Ahmad, JS Mr. Muhammad Asim Irshad, JS
Training workshop on Scientific Data Analysis using R-software	18-02-2025 20-02-2025	NIAB, Faisalabad	Mr. Usman Khalique, JS Mr. Shahzada Asif Ali, SS Dr. Haroon Shahzad, JS
Traveling wheat Seminar NUWYT Evaluation- 2025	19-02-2025 25-02-2025	Karachi / Islamabad	Dr. M. Irfaq Khan, PS
Three days training course on screening and post screening techniques for veterinary drug residues pesticides and mycotoxins in food feed	15-04-2025 17-04-2025	NIAB, Faisalabad	Mr. Khurshid Ahmad, SS Mr. Aurang Zeb Khan, ARO
One-day workshop on varietal development and seed production (wheat)	23-04-2025	PARC, Islamabad	Dr. M. Irfaq Khan, PS Dr. Farooq-i-Azam, PS
Regional training course on "Developing climate-smart agriculture using nuclear and isotopic techniques"	21-04-2025 02-05-2025	PARC, Islamabad & NIAB, Faisalabad.	Mr. Shahzada Asif Ali, SS Dr. Haroon Shahzad, JS
Three days online training course on "leadership & proactive management skills"	22-04-2025 24-04-2025	PARC, Peshawar	Mr. Muhammad Irfan, SS Mr. Usman Khalique, JS
62 nd meeting of farm forum advisory committee meeting	24-04-2025	Bureau of Agriculture information, Peshawar	Dr. Muhammad Amin, PS
IAEA Webinar on "food authenticity in nuclear application"	24-04-2025	Vienne / Time	Dr. Zahid Mehmood, PS Mr. M. Asim Irshad, JS Mr. Tauqeer Ahmad, JS
Oral presentation of research study in 2 nd international conference on climate change impacts on agriculture & food security	24-04-2025	University of Swabi, Swabi	Dr. Iqbal Saeed, PS
Workshop on innovative approaches for wheat productivity enhancement	06-05-2025	NARC, Islamabad.	Dr. Farooq-i-Azam, PS

Title	Period	Place	Scientist Name(s)
Two days National Conference on “Formulation of assimilated advanced approaches for productivity enhancement of wheat in Pakistan”	22-05-2025 23-05-2025	Ayub Agricultural Research Institute (AARI), Faisalabad	Dr. Haroon Shahzad, JS
Workshop on “Pathogen population genomics and resistance breeding” organized by CIMMYT-Pakistan	12-06-2025	NARC, Islamabad	Dr. Salman Ahmad, PS Dr. Akhtar Ali, SS
One-day Training on value addition of local fruits and vegetables grown in southern Khyber Pakhtunkhwa	18-06-2025	University of Agriculture, D. I. Khan	Mr. Muhammad Asim Irshad, JS Mr. Muhammad Waseem Jan, ATO
4 th Research Coordination meeting of CRP (D61025) on “Innovating radiation processing of food with low energy beams from machine sources”	02-06-2025 06-06-2025	Chengdu, China	Mr. Alamgeer Khan, PS
Workshop on “Pathogen population genomics and resistance breeding” organized by CIMMYT-Pakistan	12-06-2025	NARC, Islamabad	Dr. Salman Ahmad, PS Dr. Akhtar Ali, SS
Three days’ workshop on capacity building workshop on food safety and quality organized by , Food & Agriculture Organization (FAO)	25-08-2025 27-08-2025	Serena Hotel, Peshawar	Mr. Khurshid Ahmad, SS
Train the Trainer Program	22-09-2025 26-09-2025	Marriott Hotel Islamabad	Dr. Zahid Mehmood, PS
21 st National Training Course on Modern Techniques in Biotechnology	20-10-2025 24-10-2025	NIBGE, Faisalabad	Mr. Muhammad Irfan, SS Mr. Shahzada Asif Ali, SS Dr. Haroon Shahzad, JS
Atomic Absorption and ICP-OES: Advanced Hands-on Workshop on Elemental Analysis and Instrumental Techniques	10-11.2025	ARI, Tarnab, Peshawar	Dr. Farooq-i-Azam, PS Mr. Zahid Ali, PS
Virtual Training Workshop on Monitoring and Controlling Microplastics Contamination in Food and Agriculture	25-11-2025 28-11-2025	NIFA, Peshawar	Mr. Tauqeer Ahmad, JS

DETAILED LIST OF OFFICERS

Name	Designation
Dr. Gul Sanat Shah, Ph.D. Botany	Director/CS
I. PLANT BREEDING & 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
Dr. Farooq-i-Azam, Ph.D. Genetics & Breeding	PS
Dr. Muhammad Amin, Ph. D. Statistics	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	PS
Dr. Akhtar Ali, Ph.D. Breeding & Genetics	SS
Mr. Shahzad Ahmad, M.Sc. (Hons.) Plant Breeding & Genetics	JS
Mr. Ghulam Ullah, M.Sc. (Hons.) Plant Breeding & Genetics	JS
II. FOOD & NUTRITION DIVISION	
Dr. Maazullah Khan, 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
Mr. Khurshid Ahmad, M.Phil. Chemistry	SS
Mr. Tauqeer Ahmad, M.Sc. (Hons.) Food Science	SS
Mr. Muhammad Asim Irshad, M.Sc. (Hons.) Food Science	SS
Mr. Nisar Ahmad, M. Phil Chemistry	ARO

Mr. Aurang Zeb Khan, M. Sc Chemistry	ARO
Mr. Arshad Ali, M. Phil Chemistry	ARO
Mr Waseem Jan, DAE Chemical	ATO
III. SOIL AND ENVIRONMENTAL SCIENCES DIVISION	
Dr. Syed Azam Shah, Ph.D. Agronomy	Head / DCS
Dr. Amir Raza, Ph.D. Natural Resources & Life Sciences	DCS
Mr. Zahid Ali, M.Sc. (Hons.) Soil Science	PS
Mr. Yasir Anwar, MS (Nuclear Engineering)	PS
Mr. Shahzada Asif Ali, M.Sc. (Hons.) Agronomy	SS
Dr. Haroon Shahzad, Ph.D. Soil Science	JS
IV. PLANT PROTECTION DIVISION	
Dr. Syed Jawad Ahmad Shah, Ph.D. Plant Pathology	Head/DCS / Officiating Director
Mr. Muhammad Zahid, M.Sc. (Hons.) Entomology	DCS
Dr. Gul Zamin Khan, Ph.D. Entomology	DCS
Dr. Muhammad Misbah ul Haq, Ph.D. Entomology	PS
Dr. Muhammad Hamayoon Khan, Ph.D. Entomology	PS
Mr. Muhammad Salman, M.Sc. (Hons.) Entomology	SS
Mr. Muhammad Arfan, M.Sc. (Hons.) Entomology	SS
Mr. Usman Khaliq, M.Sc. (Hons.) Entomology	SS
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	PE
Mr. Qadeer Ahmed, MS Computer Science	SS

VI. ADMINISTRATION & ACCOUNTS	
Mr. Imran Khan, MBA Finance	Administrator
Syed Muhammad Abdullah, MBA	Admin Officer
Mr. Muhammad Ibrahim, MBA Financial Management	Account Officer
Mr. Raufullah, M.L.I.Sc.	Pr. Librarian

**PROMOTIONS/TRANSFERS/RETIREMENTS/
APPOINTMENTS**

Promotions:

S#	Name	From	To	On
1.	Dr. Amir Raza	Pr. Scientist	Dy. Chief Scientist	01-12-2025
2.	Mr. Jahangir Khan	Sr. Engineer	Pr. Engineer	01-12-2025
3.	Mr. Usman Khalique	Jr. Scientist	Sr. Scientist	01-12-2025
4.	Mr. Tauqeer Ahmad	Jr. Scientist	Sr. Scientist	01-12-2025
5.	Mr. Muhammad Asim Irshad	Jr. Scientist	Sr. Scientist	01-12-2025
6.	Mr. Iftikhar Gul	Sr. Assistant (Admin)	Superintendent	28-05-2025
7.	Mr. Haseeb-ur-Rehman	Sr. Tech	Pr. Tech	28-05-2025
8.	Mr. Muhammad Waqas	Jr. Assistant (Admin)	Assistant (Admin)	28-05-2025
9.	Mr. Noor Muhammad Khan	Driver-II	Driver-I	28-05-2025
10.	Mr. Nasir Khan	SA-II	SA-I	28-05-2025
11.	Mr. Abdullah	Mali-I	Sr. Mali	28-05-2025

Transfer / Posting: Officials transferred from various PAEC establishments

S#	Name	From	To	On
1.	Mr. Amir Mansoor, SA-IV	NIFA, Peshawar	PIEAS, Islamabad	07-02-2025
2.	Mr. Muhammad Fasih Zeb, Tech-I	PIEAS, Islamabad	NIFA Peshawar	10-02-2025
3.	Mr. Muhammad Ibrahim, Acc/Officer	PAEC HQ Islamabad	NIFA Peshawar	10-03-2025

S#	Name	From	To	On
4.	Mr. Ghulam Ullah, Jr. Scientist	NIA Tandojam	NIFA, Peshawar	14-04-2025
5.	Mr. Muhammad Jamil, Pr. Acct./Officer	NIFA, Peshawar	REO Peshawar	17-04-2025
6.	Mr. Waqas Khan, SA-IV	NIFA, Peshawar	DGRE, Islamabad	18-04-2025
7.	Mr. Zahid Ullah Khan, Tech-I	DGRE, Islamabad	NIFA, Peshawar	02-05-2025
8.	Mr. M. Khuram Shehzad, SA-IV	NIFA, Peshawar	CMT, Islamabad	05-05-2025
9.	Ms. Noor Fatima, Jr. Scientist	NIFA, Peshawar	PAEC HQ Islamabad	09-05-2025
10.	Mr. Tahir Ali, SA-III	CMT, Islamabad	NIFA, Peshawar	15-05-2025
11.	Mr. Iftkhar Gul, Superintendent	NIFA Peshawar	REO, Peshawar	16-07-2025
12.	Mr. Sardar Khalid Khan, SAO	NIFA Peshawar	PAEC HQ Islamabad	30-07-2025
13.	Mr. Imran Khan, SAO	MDP Secrtt. Islamabad	NIFA Peshawar	31-07-2025
14.	Mr. Moazzam Ali Shah, ATO	NIA, Tandojam	NIFA, Peshawar	15-10-2025

Transfer / Posting: NIFA Officials transferred to various PAEC establishments

S#	Name & Designation	Transferred To
1.	Mr. Syed Raza Shah, Superintendent	NILOR Islamabad
2.	Mr. Ajmal Shah, Stenographer	PAEC HQ Islamabad
3.	Mr. Muhammad Ali, Asstt Admin	-- do --
4.	Mr. Taufeeq Ullah, Gen. Attdt-II	-- do --
5.	Mr. Muhammad Bilal, Gen. Attdt-II	-- do --
6.	Mr. Mian Sajid Shah, Cook-II	-- do --
7.	Mr. Amjad Abbas, Gen. Attdt-I	-- do --
8.	Mr. Muhammad Junaid, Jr.Asstt-I (A/C)	-- do --
9.	Mr. Ghulam Akbar, Gen. Attdt	-- do --

S#	Name & Designation	Transferred To
10.	Mr. Amjad Khan, Gen. Attdt-I	-- do --
11.	Mr. Ahmad Ali Shah, Gen. Attdt-I	-- do --
12.	Mr. Mustakeem Shah, Gen. Attdt-I	-- do --
13.	Mr. Abdul Zaman, Gen. Attdt-I	-- do --
14.	Mr. Nazar Ali Khan, Gen. Attdt-I	-- do --
15.	Mr. Haider Khan, Mali-I	Rest House, Islamabad
16.	Mr. Fazal Dad, Chowkidar-I	PAEC General Hospital, Islamabad
17.	Mr. Mir Muhammad, Chowkidar-I	-- do --
18.	Mr. Iftikhar Ali, Chowkidar-I	-- do --
19.	Mr. Malik Pervez, Chowkidar-I	-- do --
20.	Mr. Muhammad Boota, Chowkidar-I	-- do --
21.	Mr. Sanaar Ali, Chowkidar-I	-- do --
22.	Mr. Bakhur Zaman, Chowkidar-I	-- do --
23.	Mr. Anwar Din, Chowkidar-I	-- do --
24.	Mr. Muqeem Jan, Gen. Attdt-I	-- do --
25.	Mr. Saeed Ullah, Gen. Attdt-I	-- do --
26.	Mr. Mir Ahmad, Gen. Attdt-I	-- do --
27.	Shaz Ali, Gen. Attdt-I	-- do --
28.	Shakeel Khan, Mali-II	-- do --
29.	Abdullah, Sr. Mali	-- do --
30.	Syed Muhammad Usman Shah, Mali-II	-- do --
31.	Mustajab, Mali-II	-- do --
32.	Shah Zubair, Mali-II	-- do --
33.	Zahid Ali, Gen. Attdt-II	PIEAS, Islamabad

Appointments

S#	Name	Date
1	Mr. Hakimullah, Tech-II (Death Compensation Package)	14-01-2025
2.	Mr. Salman Khan, Imam	11-06-2025

Retirements

S#	Name	Date
1	Mr. Pervez Khan, PS	14-02-2025
2	Mr. Amir Nawas Khan, Superintendent	02-04-2025
3	Mr. Muhammad Younas, Chowkidar-I	31-12-2025
4	Mr. Tilawat Khan, Chowkidar-I	31-12-2025

PICTORIAL VIEW OF SCIENTIFIC EVENTS/ DEVELOPED TECHNOLOGIES



Monitoring & Evaluation Team of PSDP Pulses Project visit on 06.02.2025



QMS Management Review Meeting on 12.02.2025



Mushroom Cultivation workshops, Feb-Mar 2025



Wheat Travelling Seminar at NIFA - April 10, 2025



Glimpses of NIFA Farmers Day April 16, 2025



One-Day Awareness Seminar on “Use of Electron Beam-X-ray Technology and Qualitative Analysis of Added Micronutrients in Foods” on 23.04.2025



One-Day workshop on “Application of Bio-control Techniques for the management of insect pests of vegetables” on May 21, 2025



One-day workshop on “Balanced Application of Fertilizer for Enhancing productivity” on July 16, 2025



One-day workshop on "Managing Fruit Flies, Termite and other trade related insect pests" held at NIFA on September 24, 2025



**40th Postgraduate Course on “The Use of Nuclear and other Techniques in Food and Agricultural Research”
October 13-17, 2025**



One-day workshop on “Management of Dengue Vectors Mosquitoes using Conventional and Advanced Nuclear Techniques” on November 18, 2025



Workshop on Popularization of Solar Drying and Mushroom Farming at NIFA, Peshawar, on December 23, 2025

28TH MAY 2025 CELEBRATIONS



Dr. Muhammad Hamayoon Khan, PS



Mr. Iftikhar Gul, Superintendent



Mr. Sultan Muhammad, Sr. Computer Operator

OFFICIAL VISITS



Dr. Sajid Khan, CIMMYT Country Coordinator and his team visited NIFA on May 13, 2025



DQM Surveillance of QMS NIFA held on August 6-7, 2025



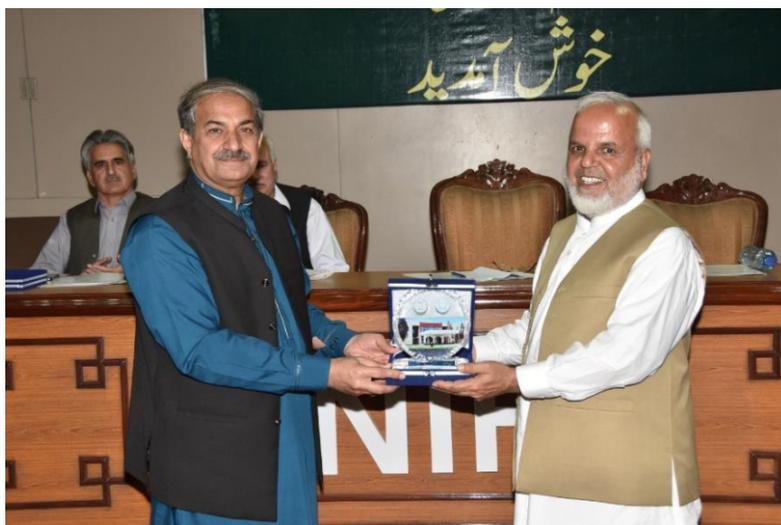
DG (Agri & Biotech) Dr. M. Yussouf Saleem Visit to NIFA on August 27, 2025



DG COP Maj Gen . Muhammad Inthikhab Alam, HI (M) Visit to NIFA on September 5, 2025



Participants of Senior Officer Leader Course (SOLC) Visit on October 10, 2025



Director NIFA Presenting Shield to Member Science, PAEC



DG (A&B) PAEC Presenting Shield to DG COP



Director NIFA Presenting Shield to DG (A&B), PAEC



Director NIFA Presenting Shield to Director (R&D) COP

EDUCATIONAL TRIPS TO NIFA



Students of Department of Botany, Govt. Post Graduate College for Women, Mardan visited NIFA on February 26, 2025



Students of College of Home Economics Peshawar visited NIFA on May 06, 2025

TRANSFERS/POSTINGS

Transfer IN : WELCOME



Mr. Muhammad Fasih Zeb, Tech-I
PIEAS, Islamabad
10-02-2025



Mr. Muhammad Ibrahim, Acc/Officer
PAEC HQ Islamabad
10-03-2025



Mr. Ghulam Ullah, Jr. Scientist
From NIA Tandojam
14-04-2025



Mr. Zahid Ullah Khan, Tech-I
From DGRE, Islamabad
02-05-2025



Mr. Tahir Ali, SA-III
From CMT, Islamabad
15-05-2025



Mr. Imran Khan,
Administrator
From MDP Secrtt. Islamabad
31-07-2025



Mr. Moazzam Ali Shah, ATO
From NIA, Tandojam
15-10-2025

Transfer OUT : **ALLAH HAFIZ**



Mr. Amir Mansoor
SA-IV
To PIEAS, Islamabad
07-02-2025



Mr. Muhammad Jamil,
Pr. Acct./Off
To REO Peshawar
17-04-2025



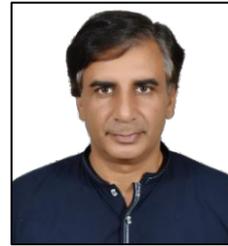
Mr. Waqas Khan
SA-IV
To DGRE, Islamabad
18-04-2025



Mr. M. Khuram
Shehzad, SA-IV
To CMT, Islamabad
05-05-2025



Ms. Noor Fatima
Jr. Scientist
To PAEC HQ
Islamabad
15-05-2025



Mr. Sardar Khalid Khan
SAO
To PAEC, HQ
Islamabad
30-07-2025



Mr. Iftikhar Gul
Superintendent
To REO
Peshawar
31-07-2025

APPOINTMENT / RETIREMENTS

APPOINTMENTS



Mr. Hakimullah, Tech-II
(Death Compensation Package)
14-01-2025

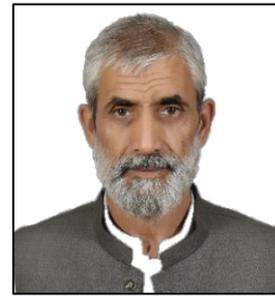


Mr. Salman Khan, Imam
(11-06-2025)

RETIREMENTS



Mr. Pervez Khan
Pr. Scientist
14-02-2025



Mr. Amir Nawas Khan
Superintendent
02-04-2025



Mr. Muhammad Younas
Chowkidar-I
31-12-2025



Mr. Tilawat Khan
Chowkidar-I
31-12-2025

FAREWELL ON RETIREMENT



Mr. Pervez Khan
Pr. Scientist



Mr. Amir Nawas Khan
Superintendent



Christmas Celebration



SAD DEMISE OF NIFA EMPLOYEES



**Dr. Muhammad Jamil Qureshi
(Ex-Director NIFA Peshawar) Passed away December 21, 2025**



Mr. Said Hasan Passed away April 27, 2025

SCIENTIFIC EVENTS CALENDAR 2026

NUCLEAR INSTITUTE FOR FOOD AND AGRICULTURE PESHAWAR



ISO 9001 : 2015 Certified

Scientific Events Calendar 2026



March 31, 2026

NIFA Farmers Day

Organizers

Dr. Farooq-i-Azam, PS 0300-9006616
fazamcass@gmail.com
Dr. Roshan Zamir, DCS 0301-8580109

April 07, 2026

Workshop on "Smart Agricultural Practices for Sustainable Farming under a Changing Climate"

Organizers

Dr. Amir Raza, PS 0304-0501455
amir.boku@gmail.com
Mr. Shahzada Asif Ali, SS 0302-3437974

May 20, 2026

Black Soldier Fly Farming for Sustainable Poultry Feed Production and Fall Armyworm Control through Entomopathogens in Maize Crop

Organizers

Muhammad Zahid, DCS 0332-9201361
zahidnifa200028@yahoo.com
Usman Khaliq, JS 0301-9401154

June 09, 2026

Workshop on "Value Addition of Fruits & Vegetables"

Organizers

Mr. Muhammad Asim Irshad, JS 0334-7053090
aaxim.ch@gmail.com
Mr. Waseem Jan, ATO 0300-5857850

July 15, 2026

Management of Fruit Flies, Termites and other Trade-Related Insect Pests

Organizers

Dr. Muhammad Hamayoon Khan, PS 0333-9227687
mhkhan170@gmail.com
Mr. Muhammad Salman, SS 0333-9854670

August 19, 2026

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

Organizers

Dr. Zahid Mahmood, PS 0333-5033898
zahidnifa@gmail.com
Mr. Alamgeer Khan, PS 0346-9322294

September 24, 2026

Management of Dengue Vector Mosquitoes through Eco-friendly Techniques

Organizers

Dr Gul Zamin Khan, DCS 0331-3811979
gulzaminkhan@yahoo.com
Dr. M. Misbah ul Haq, PS 0300-5511402

October 12-16, 2026

41st Postgraduate Training Course on "The use of Nuclear and other Techniques in Food and Agricultural Research"

Organizers

Dr. Muhammad Amin, PS 0333-9156518
aminkanju@gmail.com
Dr. Haroon Shahzad, JS 0323-6038220

November 16-18, 2026

3rd National Interdisciplinary Workshop on Statistical Data Analysis

Organizers

Dr. Muhammad Amin, PS 0333-9156518
aminkanju@gmail.com
Dr. Farooq-i-Azam, PS 0300-9006616

December 23, 2026

Workshop on "Mushroom Farming Popularization as Cottage Industry"

Organizers

Dr. Muhammad Ibrahim, PS 0334-9180642
ibra786pk@yahoo.co.uk
Mr. Muhammad Nisar, ARO 0300-9051358

P.O. Box 446, Peshawar, 25000 Ph: 091-2964873 Fax: 091-2964059
mails@nifa.org.pk, www.nifa.org.pk



NIFA Bhindi-25



NIFA Lobia-25



NIFA Raya-T24



NIFA Mung-25



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