वार्षिक प्रतिवेदन
Annual Report
2023






भा.कृ.अनु.प.-भारतीय सब्जी अनुसंधान संस्थान
वाराणसी - 221305

ICAR-Indian Institute of Vegetable Research
Varanasi -221305

(ISO 9001:2015 Certified)

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PREFACE

The vegetables contain high amounts of essential nutrients such as vitamins, minerals and dietary fibre which are crucial for our overall growth and wellness. Incorporating a diverse range of vegetables into one's diet can effectively mitigate the likelihood of developing chronic ailments such as cardiovascular disease, diabetes, specific forms of cancer etc. Being low in calorie and fat, vegetables are highly suitable for managing human body weight. Integrating a diverse assortment of vegetables in our daily diet can help in leading a healthier life. The ICAR-IIVR is dedicated towards improving the quality and availability of vegetables for the countrymen through research.

During 2023 seven MoUs were signed with different organizations *viz.* Odisha Univ. of Agric. & Tech., Bhubaneshwar; Institute of Agricultural Sciences, BHU, Varanasi; Ch. Charan Singh Univ., Meerut; Deen Dayal Upadhyay Gorakhpur University, Gorakhpur; Udai Pratap Autonomous College, Varanasi; Kumaon University, Nainital, Uttarakhand and Sardar Vallabh Bhai Patel Univ. of Agric. and Tech., Meerut for collaboration in research. A variety of bottle gourd- Kashi Shubhra was identified by AICRP (VC) whereas the variety Kashi Shivani of ridge gourd was commercialized to private sector. A total of 1732 vegetables genetic resources in 19 vegetable crops were distributed to 52 different organizations on MTA basis. Three IIVR developed technologies viz. Brimato: An innovative grafting technology, Extension of Shelf-life of eggplant and capsicum by Chitosan coating and a vegetable-based technology delivery model through FPO were certified by ICAR. A technology promotion day organized by the institute to popularize the institute technologies among private sector served as a major platform for strengthening public private partnership (PPP) apart from a number of trainings, exposure visits and demonstrations. The major infrastructures added to the institute included a Bio control lab for mass production of bio agents, two Hi-tech nurseries and a referral laboratory for pesticide residue analysis in vegetable crops. The old and small main gate of the institute was replaced by a magnificent one. The peripheral boundary wall was constructed for the remaining un-walled portion of the farm area (about 625m). By the end of year 2023, twenty-seven students were working at the institute for partial fulfillment of their degree requirements. Considering the increasing number of research students from different SAUs, six type-II and type-I quarters were converted to students' hostel. To generate funds for research, projects from different agencies like DST (52.76 lakh), DBT (312.86 lakh), NBHM (29.47 lakh), M/s Syngenta India Pvt. Ltd. (15.20 lakh) and M/s Coromandel International Ltd. (7.70 lakh) were initiated apart from various other projects funded by ICAR itself. The project-based budgeting was another milestone during the year. For the project-based budgeting, after discussions in IRC and RAC, the new RPPs were prepared accordingly. The institute initiated several cutting-edge research initiatives during the year which included Genome editing in 4 vegetable crops with 6 traits; Precision farming including grafting, use of Drone, sensors etc; Vertical farming with aquaponics and Monitoring of multiple pesticides residual toxicity for export. Several initiatives like use of 5 star rated electrical gadgets, LEDs at all the places, use of Nano Urea to avoid excessive nitrogen in field and use of Drone for precision spraying etc. were taken to make the institute environment friendly. A major landmark of the year was selection and joining of the three regular HoDs and a Project Coordinator of AICRP (VC) after a long gap.

The senior officials of ICAR provided us continuous encouragement, guidance, and support, which made our accomplishments in 2023 possible. I express my profound gratefulness to Dr. Himanshu Pathak, Secretary, DARE & DG, ICAR, Dr. A.K. Singh, DDG (Hort. Sci.) as well as Dr. T.R. Sharma, DDG (Hort. & Crop Sci.), ICAR and Dr. S. Pandey, ADG (FVSMP), ICAR, New Delhi for their unwavering and continuous support in guiding this institute towards achieving exceptional standards. I would like to express my appreciation to all the staff members of this Institute whose genuine and dedicated efforts have established ICAR-IIVR as a highly respected and recognized institute. I am delighted to present the annual report of this prestigious Institute which is committed to the research and development of vegetables. The valuable contributions of all the three Heads of Divisions, KVK's personnel, Technical, Administration, Accounts & other staff, particularly Dr. P.M. Singh, Chairman, PME Cell, ICAR-IIVR, Varanasi and his team in the development of this publication, are sincerely appreciated.

(T. K. Behera)
Director

Varanasi
May 31, 2024

Contents

EXECUTIVE SUMMARY

The institute has developed vegetable varieties/ lines/hybrids, production and protection technologies to enhance productivity and quality of vegetable crops, and demonstrated transfer of technologies to the farmers' fields during the reporting period.

Division of Vegetable Improvement

A total of 1732 accessions in 19 vegetable crops were supplied to 52 organizations through Material Transfer Agreement (MTA) for use in research and extension. Germplasm collection was undertaken through exploration in collaboration with ICAR-NBPGR, New Delhi. One bottle gourd variety Kashi Shubhra was identified for release by AICRP (VC) for zone IV.

In Solanaceous crops, in tomato over 392 accessions were maintained. Interspecific populations were developed and phenotyped for biotic stresses in populations of P18 and EC520061 (*S habrochaites* resistant to early blight). Promising hybrids were identified based on multiple years of performance such as hybrid CRPVRTH-16-4 for round the year cultivation & processing purpose, and hybrid CRPVRTH-16-3, VRNTH-20141 and VRNTH-20131 for moisture stress tolerance. In addition, high temperature (35-40 °C day) tolerant hybrids were identified such as VRNTH-20131, VRNTH-20122, VRNTH-20149, VRNTH-22033 and VRNTH-22057. The lines such as AVTO-2151 for processing, VRT-34 for moisture stress tolerance, cherry tomato VRCYT-3, jointless tomato VRT-23-37 (selection from EC-695037), beta-carotene rich line (KB-17) and high temperature tolerant line VRT-67 were identified as promising. ToLCV resistant lines over the years were VRT-06, VRT-19, VRT-30, VRT-34, VRT-50, VRT-51, and VRT-67. A total of 73 new crosses were generated, of which 22 were selected for further evaluation such as CRPVRTH-23-34 and others. In brinjal, 213 germplasm were maintained and 61 new accessions were collected through exploration. Hybrid IVBHR-20 was found as promising based on evaluation against brinjal shoot and fruit borer; Kashi Sandesh and IVBHR-17 were found to be highly resistant against little leaf of brinjal; *S. gilo, S. torvum* and IC354557 were highly resistant to bacterial wilt and *Phomopsis* blight. Of total 40 new hybrids (17 round + 23 long), IVBHR-24, IVBHR-18-1, IVBHL-26 and IVBHL-23-1 were superior over checks. Hybrids IVBHL-22 and IVBHL- 24 were found to have potential for high temperature tolerance. In chilli, over 410 accessions were maintained and 10 new accessions were added. Of total 23 new hybrids, promising chilli hybrids were A3 x Jayanti and A3 x EC 519626. New population of EC 519632 and Kashi Abha was developed for genetic studies. RIL population of Kashi Sinduri x BS-35 (F_{11}) with 109 families were screened for ChiLCVD resistance under field condition. Promising new entries like IIVRC-18253 and IIVRC-23002 were identified for MLT in AICRP(VC). GWAS analysis based on GBS data was carried out for various traits in chilli. Promising lines/ hybrids were identified against various pests like black thrips (IIVRC-18057) and chilli mite (IIVRC-19010).

In Cucurbitaceous crops like bitter gourd, 160 accessions were characterized for different traits, and DVBTG-3, DVBTG-4 and DVBTG-5 showed partial resistance against powdery mildew. Further, a gynoecious based hybrid (Gy-323 x VRBTG-10) was identified. In bottle gourd, 96 genotypes were maintained and advance lines like VRBG-101, promising hybrid like VRBG-14 x VRBG-5 were developed. In musk melon, 35 breeding lines (monoecious and andro-monoecious) were maintained. In water melon, 62 accessions were maintained and lines (VRW-55 and VRW-53-1) and hybrids (VRWH-2 and VRWH-3) were found promising. In long melon, promising lines (VRLM-7-1 and VRLM-3) and hybrids (VRLMH-2) were found promising. In cucumber, 162 germplasm were maintained and parthenocarpic line VRCUP-20-2 and promising lines VRCU-13-01 and VRCU-23 were identified as promising. Gherkin hybrids were also grown for breeding. In pumpkin, 48 germplasm were maintained and VRPK-11-6-5 was identified as promising line. In sponge gourd, hybrid Kashi Jyoti × VRSG-1-21 was identified as promising. In ridge gourd, 62 germplasm were maintained and 10 lines and 10 hybrids were found promising for further evaluation.

Under Leguminous vegetable crops, in vegetable pea, genotypes Kashi Ageti and VRPE-949 were found to have acceptable sensory traits. Lines like VRPE-29 and VRPE-30 recorded high yield under high temperature stress. Screening for *Fusarium* wilt resistance showed that line VRPE18 (11.4%) recorded minimum disease incidence. Pea lines VP/23/7 and VP/23/12 were found suitable for export. In cowpea, 15 lines/varieties were evaluated for various traits and maximum number of pods per plant and pod yield/plant was recorded in INDIRALAL x Kashi Kanchan. Bush cowpea genotype 262B was found tolerant to CGMV. Yardlong bean genotype like VRCPP22/1 and VRCPP22/2 were found superior for yield and related traits. In French bean, genotypes 2 x 91-1-1-1-1-1 and Kashi Rajhans were found to have good shelf life. Pole type line 314 x Scarlet bean found promising for number of pods per plant and yield related traits. Pole type French bean line 02/23/

pole was found promising for dual purpose. In Indian bean, 146 lines were maintained and 36 superior lines were selected.

In Okra crop, 795 genotypes were maintained. Various promising lines were identified in red/green fruited (VRO-236 and VROR-166), dwarf & easy to harvest type (VRO-416-10-1), export quality (VRO-112), organic cultivation (VRO-219), low temperature tolerant (VRO-210) and GMS based hybrid VRO-178. Three wild relatives such as *Abelmoschus manihot* (VRmanihot-1), *A. angulosus* (RCM/PK/65) and *A. nova* (RCM/PK/63) showed high resistance to YVMV and OELCV. *A. moschatus* × *A. moschatus* subsp. *tuberosus* derived pre-breed population were screened for viral disease resistance and ornamental value. Screening against shoot and fruit borer (*Earias vitelli*) showed less infection in genotypes like VRO-236 and VRO-235.

Under Cole & roots crops in cauliflower, 95 genotypes were maintained. Five CMS lines were found to be stable under different curding temperature (20-30 ˚C) such as VRCF-41 for 28-30 ˚C. Mitochondrial (mt) DNA markers were validated in Ogura CMS lines. For summer season, high temperature lines were developed such as VRCF-305. Tropical cauliflower genotypes/hybrids were developed for curding under high temperature in October such as VRCF-305; and hybrid VRCF-131×VRCF-305 during 2nd fortnight of October (28-30 °C). In carrot, 87 genotypes were maintained. Tropical carrot genotypes found promising were VRCAR-86 (red), VRCAR-125 (black), VRCAR-132 (orange), VRCAR-153 (yellow), VRCAR-107-1 (rainbow), and VRCAR-161 (white). Further, stable CMS lines were found such as VRCAR-211 (red), VRCAR-252 (black), VRCAR-272 (yellow), and VRCAR-291 (rainbow).

Under Biotechnological interventions, *in-vitro* regeneration protocol was standardized in tomato cv. Kashi Amrit using cotyledon explants from seven days old seedlings cultured on MS medium supplemented with zeatin (1.0 mg/L) and BAP (2.0 mg/L). RNAi mediated OYVMV resistance in okra cv. Kashi Kranti was carried out and 16 plantlets were regenerated. Genetic stability analysis of *in-vitro* regenerated heat tolerant cauliflower (VRCR75-1) was determined using UBC primers. Characterization of RPN10 gene in brinjal was executed for cDNA amplification, sequence analysis and protein structure. Transgenic lines like fruit and shoot borer resistant transgenic brinjal–Cry1Aa3 gene in brinjal (Kashi Taru), fruit borer resistant transgenic tomato – Cry1Ac gene, drought, salt and cold stress tolerance transgenic tomato AtDREB1A, and BcZAT12 were maintained. Microbial bioformulations (BC6 & NPK) were evaluated for their stress mitigation role in tomato, chilli and pea. DNA Profiling of 20 varieties, hybrids and parental lines of the hybrids was done. Genome editing approach was applied in various vegetable crops. For ToLCV resistance in tomato (cv. Kashi Amrit), based on knock-out of the *Pelo* gene, CRISPR/Cas9 construct of binary vector pORE-O4 was developed and confirmed through PCR. Further, *Agrobacterium*-mediated transformations were done and putative plants were regenerated. *In-vitro* regeneration was standardized in tomato line P18. Similarly, CRISPR/Cas9 constructs were developed, confirmed through colony PCR, and transformations were done for developing putative regenerants with high TSS in tomato cv. Kashi Aman by knock-out of negative regulators of sugar metabolism genes i.e. *SlINVINH1* and *SlVPE5*. Regeneration protocol was standardized for tissue culture in hot pepper using hypocotyl cultured on MS media containing TDZ and GA.

Under Seed project, a total of 22979.50 kg vegetable seeds of ICAR-IIVR varieties of tomato, brinjal, chilli, okra, cowpea, pea, bottle gourd, bitter gourd, pumpkin, cucumber, sponge gourd, ridge gourd, ash gourd, radish, French bean, Indian bean, carrot, cauliflower and Palak etc., were produced for the seed indenters and farmers. Among the total seeds, 19345.10 kg was truthfully labelled seeds of the open pollinated varieties of IIVR, 47.80 kg F_1 hybrid seeds at IIVR, 34.00 kg F_1 hybrid seed at Sargatia and 3634.40 kg breeder seeds. Besides, screening for salinity tolerance in chilli and cowpea, and standardization of post-harvest management in summer squash were undertaken.

In Promotional project, demonstrations of different lines/hybrids/varieties of all vegetable crops were undertaken at farmers/KVK fields. Besides, maintenance breeding of vegetable crops, not covered in the major projects were carried out. These crops were pointed gourd, round melon, long melon, Summer squash, basella, amaranth, laipatta, moringa, summer squash, vegetable soybean, baby corn, Indian bean, water chestnut, water spinach, winged bean and others.

Division of Vegetable Production

Based on nutrient removal and use efficiency data, the optimal fertilizer doses were established in tomato as 376.0 kg/ha of N, 189.0 kg/ha of P, and 659.0 kg/ha of K. Trials with varying fertilizer doses indicated that the 125% estimated dose of fertilizers (EDF) yielded the highest overall yield and quality, including the best fruit size and weight, and the highest total soluble solids content.

Soilless vegetable production using substrates like spent mushroom substrate is promising for urban agriculture. In greenhouse trials with cucumber, the BMS (Button mushroom spent) showed superior performance in fruit characteristics and yield, demonstrating its potential for soilless cucumber cultivation.

Four micronutrient liquid formulations were evaluated for their impact on pea and French bean crops. Micromix C outperformed others by significantly enhancing the yield and quality, with increases of 13.39% in pea and 11.93% in French bean compared to controls. The best formulation, named "Kashi Sookshma-Shakti Plus," was made using vermiwash as a base and included a mixture of essential micronutrients (Zn, Fe, Mn, Cu, B, Mo) and plant growth regulators (GA3 and NAA).

In a study comparing the influence of different organic manures and mulching on cauliflower performance, vermicompost from various substrates showed significant impacts. The highest yield of 331.45 q/ha and maximum average curd weight of 1.504 kg were achieved under weed mat mulching with 200 kg N/ha. Among the organic manures, vermicompost derived from radish residue and pea straw produced the highest yields. In addition, in organic farming trials with 14 okra genotypes, Kashi Parakram yielded the highest at 110.8 q/ha, followed by VRO-200 at 109.4 q/ha. VRO-200 also had the highest marketable yield (85.6 q/ha), with significant variations in fruit damage due to insects (4.53% to 37.85%).

In a study on okra with drip irrigation and mulching, twice daily irrigation at 100% ET with Black-silver mulch yielded the highest fruit production (285.66 q/ha), 107.63% more than un-mulched furrow irrigation. Water use efficiency peaked at 8.33 q/ha/cm with alternate day drip irrigation and Black-silver mulch. Black-silver mulches increased yields significantly compared to un-mulched controls, highlighting their effectiveness in enhancing okra growth and yield under experimental conditions.

In a field evaluation for optimized brimato production, the tomato scions K. Aman x K. Sandesh and Vani x K. Uttam produced the highest number of fruits (53.67 and 52.67, respectively), while in brinjal, K. Aman x K. Manohar and K. Chayan x K. Manohar yielded the most fruits (22.33 and 21.00, respectively). Overall, grafting Kashi Aman and Kashi Sandesh onto IC 111056 rootstock resulted in maximum yields of 5.98 kg/plant (3.60 kg from tomato and 2.38 kg from brinjal).

In a summer 2023 pot experiment on okra drought tolerance, genotypes VRO 128 and VROR 160 stood out as resilient. They showed minimal yield reduction (9.7%) under drought stress compared to controls (10.5%) and demonstrated enhanced root characteristics for improved water uptake. These genotypes exhibited higher photosynthesis rates, chlorophyll content, and antioxidant activity while minimizing lipid peroxidation, suggesting their suitability for breeding drought-tolerant okra varieties. Further, in a study on waterlogging tolerance among eight cucurbit species, significant reductions in chlorophyll and carotenoid contents were observed under stress. Cucumber showed severe stress indicators with high MDA and hydrogen peroxide levels, while Pumpkin displayed notable proline and phenol accumulation. Survival rates varied widely, with Cucumber and Bottle gourd being the least tolerant, and Pumpkin exhibiting adaptive adventitious root formation.

Capsicum fruits treated with spermidine and spermine before harvest, followed by a chitosan-CMC edible coating and storage at 10°C, experienced reduced weight loss compared to untreated fruits. These treatments likely reduced respiration rates, preserved moisture content, maintained fruit quality, and enhanced antioxidant properties, such as radical scavenging capacity and phenolic content fluctuations during storage. Additionally, exploration for bioactive potential was conducted on bitter gourd, chili, Indian bean etc.

Empowering rural youth through Entrepreneurship Development Programs (EDPs) resulted in notable improvements in entrepreneurial behavior among 350 beneficiaries. Other traits such as persistence, self-confidence, knowledgeability, persuasibility, manageability, innovativeness and achievement motivation also showed significant enhancements. Additionally, this initiative successfully facilitated institutional marketing for oyster mushrooms, offered technical support to vegetable seedling businesses, and fostered opportunities in vegetable juice entrepreneurship.

Trials of kitchen garden modules validated for rural women at ICAR-IIVR's research farm included two nutri-garden modules. In a 100 m² area, yields were 210.54 kg of leafy vegetables and 359.44 kg of other greens, enough to sustain 5-6 members daily. In a 150 m² area, yields were 271.61 kg of leafy vegetables and 498.89 kg of other greens, sufficient for 7-8 members daily.

The economic assessment of "Kashi Anmol" chilli variety revealed that its cultivation spanned 163,695.95 ha across 165 districts from 2005-06 to 2021-22, constituting 2.46% of total chilli cultivation. It generated a total economic surplus of Rs. 30.88 crores, with Rs. 11.94 crores as producer surplus and Rs. 18.94 crores as consumer surplus. The Benefit: Cost Ratio (BCR) at 81.22, and net return per hectare amounted to Rs. 2,77,971. Adoption of Kashi Anmol proved more cost-effective and profitable than local varieties, which may be attributed to higher yields and better market prices.

Division of Vegetable Protection

Under the project bio-intensive management of major insect pests of vegetables in the current scenario of weather change, amongst the three tested modules, the chemical pest management module i.e. spraying of Imidacloprid 17.8 SL1ml/l at 30DAT, Spiromesifen 22.9 SC 1.25 ml/l at 50 DAT and Indoxacarb 14.5 SC 1ml/l at 70 DAT was found highly effective in managing major insect pests of tomato. Newer molecules like Broflanilide 300 SC @ 0.4 ml/l and Fluxametamide 10 EC @ 1.5 ml/l were found highly effective against black thrips, *Thrips parvispinus* giving 100.0 and 99.07 percent reduction over untreated control, respectively. In toxicological investigations on the novel and botanical insecticides against major insect pests of vegetables, newer molecules like Tolfenpyrad 15% EC @ 2 ml/L and Flupyradifurone 17.09% SC @ 2.5 ml/L can be recommended for the management of sucking pest's complex in okra. In botanicals, neem oil was found the most effective and can be recommended as alternative option to manage the *M. vitrata* in vegetable cowpea. In biological control of major vegetable insect pests, combination of neonicotinoids (Imidacloprid 17.8 SL, Thiamethoxam 25 WG and Acetamiprid 20 SP) and three entomopathogenic fungi (*Beauveria bassiana*, *Metarhizium anisopliae* and *Lecanicillium lecanii*) at half of their recommended doses were not only compatible but also synergistic in action and could be a viable green ecofriendly option against the black bean aphid (*Aphis craccivora*). A gregarious koibobiont larval endoparasitoid *Cotesia ruficrus* Haliday (Braconidae: Hymenoptera) was recovered from Fall Army Worm feeding on baby corn.

In the project "Development of effective integrated management package for important fungal diseases of vegetable crops", it is concluded that the chemical module comprising of seed treatment by captan 70% WP + hexaconazole 5%@ 0.25% during sowing, seedling root dipping in captan +hexaconazole @ 0.25% during transplanting, spray mancozeb 75% WP @ 0.25% at 55 DAT, spray of carbendazim @0.1% at fruit initiation stage 70 days after first spray, spray of carbendazim @ 0.1% 100 DAT and spray of mancozeb @ 0.25% at fruit maturity was best with maximum C:B ratio of 1: 1.6 for the management of fungal diseases and yield of brinjal in variety Kashi Uttam. In bioprospecting of microorganisms associated with vegetables against plant pathogens, entomopathogenic fungus *Cordyceps javanica* isolated from whiteflies infesting brinjal was molecularly characterized. Further, seed treatment with consortia formulation i.e., *Trichoderma asperellum* + *Bacillus subtilis* @ 10g/kg seed recorded minimum incidence of fruit rot (5.67%) in pea. In management of important bacterial diseases of vegetables, among tested cultigens of solanaceous vegetable crops *viz.* brinjal (*S. gilo, IC*-354557, *S. incanum, S. lanciatum, S. aethiopicum, Surya, S. torvum,* IC-111056), Chilli (T-135, Punjab Lal, Andman chilli) and tomato (Punjab Chuhara, EC-520078), were identified as bacterial wilt resistant cultigens under sick plot conditions. In tomato VRTH-16-3 and VRTH -16-5 were found moderately resistant to bacterial wilt. Similarly, IVBHR-17, IVBR-20, IVBHL-20, 22, 26, 23, IVBL-23 and 25 were found highly resistant against little leaf of brinjal. Application of chemical and biological module was found most effective in tomato (VRT-50) with highest yield (34.85 t/ha) and lowest *Xanthomonas* leaf blight disease (8.0 PDI) incidence. Similarly, Application of chemical and botanical module was found most effective in cauliflower (cv. Pusa Snowball) with highest yield (21.76 t/ha) with lowest black rot percent disease index (5).

In characterization of viruses infecting vegetable crops and their management, begomo viruses have been characterized which are causing severe yellow mosaic disease in velvet bean. In management of plant parasitic nematodes infecting vegetable crops, *Trichoderma* isolates TTV1, TTV2 and Tasp were found most effective by causing highest egg hatching inhibition at 50 and 100% culture filtrate concentrations 120 h after exposure under *in-vitro* conditions. In pest and disease dynamics, and behaviour modifying strategies for major insect pests of important vegetable crops in relation to changing weather scenario, a multiple regression forewarning model was developed for *Leucinodes orbonalis* and *Spodoptera litura.*

In bio-management of postharvest diseases in major vegetable crops, potential biocontrol agents (*Bacillus velezensis* AA17, *Bacillus* sp AC26, *Stenotrophomonas maltophilia* AD28, *Bacillus amyloliquefaciens* AD29, *Bacillus subtilis* AH39, *Bacillus velezensis* AH40, *Bacillus subtilis* BE11, *Paenibacillus* sp. CC6) isolated from a soil samples were characterized for P-solubilization siderophore, ammonia and HCN production. Further, effective bioagents were tested for suppressing the postharvest pathogen under field conditions. In residue dynamics, safety evaluation and decontamination, the deltamethrin dissipation kinetics in tomato was observed to be first-order, with a correlation of determination (R^2) of 0.9485 and 0.9823 of RD and DD, respectively. It took less time for Deltamethrin to dissipate at both application dosages to reach the EU-MRL value, the chemical may be used safely in tomato crops to control fruit disease.

In integrated insect pest management of major vegetable crops for safer vegetable production, the biology of radish root and shot hole borer *Phyllotreta striolata* was studied. Further, in virulence assay, *Heterorhabditis indica* found as a potential entomopathogenic nematode against both third instar and pre-pupal stages of *P.*

striolata. For management of *P. striolata*, organic pest management module was developed, evaluated and compared with farmers' practices. In characterization and integrated management of plant pathogens (diseases) of vegetable crops, pure cultures of fungal pathogens i.e., *Colletotrichum truncatum* from chilli, *Phomopsis vexans* from brinjal, *Alternaria solani* from tomato and *Ralstonia solanacearum* from tomato, brinjal and chilli were established screening method for *R. solanacearum* were standardized. First report of emergence of *Phomopsis* blight in water spinach has been recorded.

In diagnostics of viruses infecting vegetable crops and its management through novel strategies, characterized distinct watermelon bud necrosis virus (*Orthotospovirus citrullonecrosis*) causing necrosis disease on tomato in India. Besides, viruses associated with yellowing disease infected bottle gourd have also been identified. In, bio-intensive management of root-knot nematode in vegetable crops, two germplasms of pumpkin i.e. Swarna Amrit and VRPK-18-1 are found moderately resistant against root-knot nematode (RKN). In brinjal, three germplasms i.e., GB-6, GB-11 and GB-14 have shown resistance reaction against RKN. In tomato, genotypes S1-150-P22-39-9, S1-2018-171-190, S1-2018-150-P22-1, LA2823, S1-150-34-19, S1-150-20-1, S1-150-34-20 and H-88-78-1 have shown resistant reaction against RKN. Among the tested different concentrations of methyl eugenol nano-formulation, 100% mortality of J2 were recorded at 2000 ppm concentration after 24 h of exposure. In dissipation kinetics of fluopyram in tomato fruits, the degradation was faster up to 5 days after application, where almost 50% residues were dissipated in all the doses and after 10 days of application, residues became below the detectable limit.

In residue analysis and risk assessment of pesticides in vegetable crops, different methods were evaluated to decontaminate Deltamethrin residue from tomato, okra, bitter gourd, cowpea, and chilli. In integration of compatible components to develop crop-specific module for the insect-pest and disease management (IPDM) in vegetables, effect of insecticide i.e., Flupyradifurone and Imidacloprid exposure on honey bees, *Apis mellifera* has been studied.

कार्यकारी सारांश

भारतीय सब्जी अनुसन्धान संस्थान ने प्रतिवेदन अवधि के दौरान सब्जी फसलों की उत्पादकता और गुणवत्ता बढ़ाने के लिए सब्जियों की विभिन्न किस्मों/प्रभेदों/संकरों, उत्पादन और संरक्षण प्रौद्योगिकियों का विकास किया है और साथ ही साथ किसानों के खेतों में प्रौद्योगिकी हस्तांतरण का कार्य भी किया है।

सब्जी उन्नयन विभागः

अनुसंधान एवं प्रसार हेतु सामग्री हस्तांतरण समझौते (एमटीए) के माध्यम से 52 संगठनों को 19 सब्जी फसलों के कुल 1732 जननद्रव्यों की आपूर्ति की गई। आईसीएआर-राष्ट्रीय पादप अनुवांशिक संसाधन ब्यूरो, नई दिल्ली के सहयोग से अन्वेषण द्वारा जननद्रव्यों का संग्रह किया गया है। लौकी की प्रजाति काशी शुभ्रा अखिल भारतीय समन्वित शोध परियोजना (सब्जी फसल) द्वारा जोन-IV हेतु चिन्हित की गयी है।

सोलेनेसी कुल की फसलों में, टमाटर के 392 से अधिक जननद्रव्यों को अनुरक्षित किया गया है। पी18 और ईसी 520061 (अगेती झुलसा हेतु प्रतिरोधी) की अंतर-प्रजाति समष्टि विकसित कर के जैव तनावों हेतु मूल्यांकन किया गया। बहुवर्षीय प्रदर्शन के आधार पर टमाटर के कई आशाजनक संकरों की पहचान की गई। वर्ष पर्यंत खेती और प्रसंस्करण के लिए सीआरपीवीआरटीएच-16-4, जल तनाव सहिष्णुता के लिए सीआरपीवीआरटीएच-16-3, वीआरएनटीएच-20141 एवं वीआरएनटीएच-20131 संकर उत्कृष्ट पाए गए। टमाटर की संकर प्रजातियाँ वीआरएनटीएच-20131, वीआरएनटीएच-20122, वीआरएनटीएच-20149, वीआरएनटीएच-22033 एवं वीआरएनटीएच -22057 गर्मी के मौसम में उच्च तापमान हेतु सहिष्णु (35-40 °C दिन का तापमान) पाई गई। प्रसंस्करण के लिए एवीटीओ-215, जल तनाव सहिष्णुता के लिए वीआरटी-34, चेरी टमाटर का संकर वीआरसीवाईटी-3, जॉइंटलेस टमाटर वीआरटी-23-37 (ईसी-695037 से चयनित), बीटा- कैरोटीन समृद्ध पंक्ति के बी-17 और उच्च तापमान सहनशील पंक्ति वीआरटी-67 की पहचान की गई। वीआरटी-6, वीआरटी-19, वीआरटी-30, वीआरटी-34, वीआरटी-50, वीआरटी-51 एवं वीआरटी-67 नामक पंक्तियाँ पिछले कुछ वर्षो से टमाटर के पर्णकुंचन विषाणु के प्रति प्रतिरोधी पाई गयी। टमाटर में कुल 73 नए संकर तैयार किए गए, जिनमें से 22 (सीआरपीवीआरटीएच-23-34 एवं अन्य) को आगे मूल्यांकन के लिए चयनित किया गया। बैंगन के 213 जननद्रव्यों को अनुरक्षित किया गया और अन्वेषण द्वारा 61 नए जननद्रव्य एकत्र किए गए। बैंगन में फल एवं तना छेदक प्रतिरोधकता हेतु मुल्यांकन में आशाजनक संकर आईवीबीएचआर -20 की पहचान की गई। काशी संदेश और आईवीबीएचआर -17 को बैंगन की छोटी पत्ती रोग हेतु अत्यधिक प्रतिरोधी पाया गया तथा एस. गिलो, एस. टोरवम और आईसी-354557 जीवाणु उकठा और फोमोप्सिस झुलसा के लिए अत्यधिक प्रतिरोधी पाए गए। मूल्यांकित किये गए 40 नए संकरों (17 गोल एवं 23 लम्बे) में आईवीबीएचआर-24, आईवीबीएचआर-18-1, आईवीबीएचएल-26 एवं आईवीबीएचएल-23-1 का प्रदर्शन बेहतर रहा। संकर आईवीबीएचएल-22 एवं आईवीबीएचएल-24 में उच्च तापमान सहन करने की क्षमता पाई गई। मिर्च में 410 से अधिक जननद्रव्य अनुरक्षित किये गए तथा 10 नए जननद्रव्य एकत्रित किये गए। कुल 23 नए संकरों में से, मिर्च संकर ए3 x जयंती तथा ए3 x ईसी 519626 आशाजनक पाए गए। आनुवंशिक अध्ययन के लिए ईसी 519632 तथा काशी आभा की नई समष्टि विकसित की गई। 109 वंशावलियों वाली आरआईएल समष्टि काशी सिंदूरी x बी एस-35 को प्रक्षेत्र में पर्ण कुंचन विषाणु रोग प्रतिरोधकता हेतु परखा गया। बहुस्थानिक परीक्षण हेतु नए आशाजनक पंक्तियों आईआईवीआरसी 18253 एवं आईआईवीआरसी 23002 की पहचान की गई। मिर्च में विभिन्न लक्षणों के लिए जीबीएस पर आधारित जीडब्ल्यूएएस विश्लेषण किया गया। मिर्च में ब्लैक थ्रिप्स (आईआईवीआरसी-18057) एवं माईट (आईआईवीआरसी-19010) जैसे कीटों के विरुद्ध आशाजनक पंक्तियों की पहचान की गई।

कद्दूवर्गीय फसलों के अंतर्गत करेला के 160 जननद्रव्यों को विभिन्न बागवानी लक्षणों के लिए मूल्यांकित किया गया, और डीवीबीटीजी-3, डीवीबीटीजी-4 और डीवीबीटीजी-5 पंक्तियों में चूर्णिल आसिता के खिलाफ आंशिक प्रतिरोध पाया गया। इसके अलावा अग्रिम पंक्ति वीआरबीटीजी-28 और गाइनोशियस आधारित संकर (जीवाई-323 x वीआरबीटीजी-10) की पहचान की गई। लौकी के 96 जननद्रव्यों को अनुरक्षित किया गया और अग्रिम पंक्ति वीआरबीजी-101 एवं आशाजनक संकर वीआरबीजी-14 x वीआरबीजी-5 विकसित किए गए। खरबूजे की 35 प्रजनन पंक्तिया (एकलिंगी और एंड्रो-मोनोसियस) अनुरक्षित की गईं। तरबूज के 62 जनन द्रव्यों को अनुरक्षित किया गया और आशाजनक लाइनें (वीआरडब्लू-55 और वीआरडब्लू-53-1) और संकर (वीआरडब्ल्यूएच-2 और वीआरडब्ल्यूएच-3) की पहचान की गई। ककड़ी की आशाजनक पंक्तियों (वीआरएलएम-7-1 और वीआरएलएम-3) और संकर (वीआरएलएमएच-2) की पहचान

की गई। खीरे के 162 जननद्रव्यों को अनुरक्षित किया गया और पार्थेनोकार्पिक लाइन वीआरसीयूपी-20-2 और आशाजनक पंक्तियों वी.आर.सी.यू.-13-01 और वी.आर.सी.यू.-23 की पहचान की गई। प्रजनन हेतु घरकिन के संकर उगाए गए। कद्दू के 48 जननद्रव्यों को अनुरक्षित किया गया और आशाजनक वंशक्रम वीआरपीके-11-6-5 की पहचान की गई। चप्पन कद्दू के 58 जननद्रव्यों को अनुरक्षित किया गया और उन्नत वंशक्रम का मूल्यांकन किया गया। नेनुआ के आशाजनक संकर काशी ज्योति x वीआरएसजी-1-21 की पहचान की गई। तुरई के 62 जननद्रव्यों को अनुरक्षित किया गया तथा 10 वंशक्रम और 10 संकर आगामी मूल्यांकन के लिए आशाजनक पाए गए।

दलहनी सब्जियों में, सब्जी मटर की काशी अगेती और वीआरपीई-949 प्रभेद में स्वीकार्य संवेदी लक्षण पाए गए। वीआरपीई-29 और वीआरपीई-30 जैसी पंक्तियाँ उच्च तापमान में अधिक उपज के लिए उपयुक्त पाई गई। फ्यूजेरियम विल्ट प्रतिरोध मूल्यांकन में वीआरपीई-18 (11.4%) में सबसे कम रोग का प्रकोप देखा गया। मटर की पंक्तियाँ वीपी/23/7 और वीपी/23/12 निर्यात के लिए उपयुक्त पाई गयी। लोबिया में विभिन्न लक्षणों के लिए 15 लाइनों व किस्मों का मूल्यांकन किया गया और प्रति पौधे फली की अधिकतम संख्या और फली की उपज/पौधा इंदिरा लाल x काशी कंचन में उल्लेखित किया गया। झाड़ीनुमा लोबिया का प्रभेद 262बी, सीजीएमवी विषाणु रोग के प्रति सहनशील पाया गया। यार्ड लॉन्ग बीन के प्रभेद वीआरसीपीपी 22/1 और वीआरसीपीपी22/2 उपज और संबंधित लक्षणों के लिए बेहतर पाए गए। फरास बीन में 2x91-1-1-1-1-1 और काशी राजहंस भण्डारण हेतु अच्छी पाई गई। फरास बीन की खम्बनुमा प्रभेद 314 x स्कार्लेट बीन प्रति पौधे फली की संख्या और उपज से संबंधित लक्षणों के लिए आशाजनक पाई गई। फरास बीन की खम्बनुमा प्रभेद 02/23/पोल दोहरे उद्देश्य के लिए आशाजनक पाई गई। सेम के 146 जननद्रव्यों को अनुरक्षित किया गया और 36 उत्कृष्ट प्रभेदों का चयन किया गया।

भिंडी के 795 जननद्रव्यों को अनुरक्षित किया गया। विभिन्न गुणों जैसे कि जैसे लाल/हरे फल वाले (वीआरओ-236 और वीआरओआर-166), बौने और कटाई में आसान प्रकार (वीआरओ-416-10-1), निर्यात गुणवत्ता (वीआरओ-112), जैविक खेती (वीआरओ-219), कम तापमान सहनशील (वीआरओ-210) लाइनों का तथा जीएम एस आधारित संकर वीआरओ-178 को चिन्हित किया गया। भिंडी के तीन जंगली संबंधियों एबेलमोसचस मैनीहॉट (वीआरमैनीहट-1), *ए. एंगुलोसस* (आरसीएम/पीके/65) और *ए. नोवा* (आरसीएम/पीके/63) में वाईवीएमवी और ओईएलसीवी के प्रति उच्च प्रतिरोध पाया गया। ए. मोस्चैटस x ए. मोस्चैटस उपप्रजाति ट्यूबरोसस से प्राप्त पूर्व-प्रजनन आबादी को वायरल रोग प्रतिरोध और सजावटी मूल्य हेतु परीक्षित किया गया। फल एवं तना छेदक (एरियास विटेली) हेतु मूल्यांकन में वीआरओ-236 और वीआरओ-235 जैसे प्रभेदों में कम संक्रमण पाया गया।

गोभी और जड़ वाली फसलों के अंतर्गत फूलगोभी में 95 जननद्रव्यों को अनुरक्षित किया गया। पांच सीएमएस लाइनें अधिक तापमान (20-30 °C) पर कर्ड निर्माण के लिए स्थिर पाई गईं, जैसे कि वीआरसीएफ-41 28-30 °C के लिए उपयुक्त थी। ओगुरा सीएमएस लाइनों में माइटोकॉन्ड्रियल (एमटी) डीएनए मार्करों को मान्य किया गया। गर्मी के मौसम के लिए उच्च तापमान सहिष्णु लाइनें जैसे कि वीआरसीएफ-305 विकसित की गईं। अक्टूबर में उच्च तापमान के तहत अक्टूबर के दूसरे पखवाड़े (28-30 °C) के दौरान कर्ड निर्माण के लिए उष्णकटिबंधीय फूलगोभी प्रभेद/संकर जैसे कि वीआरसीएफ-305 और संकर वीआरसीएफ-131 x वीआरसीएफ-305 विकसित किए गए। गाजर के 87 जननद्रव्यों को अनुरक्षित किया गया। उष्ण कटिबंधीय गाजर जीनोटाइप जैसे कि वीआरसीएआर-86 (लाल), वीआरसीएआर-125 (काला), वीआरसीएआर-132 (नारंगी), वीआरसीएआर-153 (पीला), वीआरसीएआर-107-1 (इंद्रधनुष) और वीआरसीएआर-161 (सफेद) आशाजनक पाए गए। इसके अलावा, स्थिर सीएमएस लाइनें जैसे कि वीआरसीएआर-211 (लाल), वीआरसीएआर-252 (काला), वीआरसीएआर-272 (पीला), और वीआरसीएआर-291(इंद्रधनुष) पाई गईं।

जैव प्रौद्योगिकी परियोजना के अंतर्गत टमाटर की काशी अमृत किस्म में इन-विट्रो पुनर्जनन प्रोटोकॉल को मानकीकृत किया गया, जिसमें सात दिन पुराने पौधों से बीजपत्र एक्सप्लांट का उपयोग किया गया और एमएस माध्यम में जियाटिन (1.0 मिलीग्राम/लीटर) और बीएपी (2.0 मिलीग्राम/लीटर) के साथ पौधों को संवर्धित किया गया। भिंडी की किस्म काशी क्रांति में आरएनएआई मध्यस्थ ओवाईवीएमवी प्रतिरोध पर कार्य किया गया और 16 पौधों को पुनर्जीवित किया गया। यूबीसी प्राइमरों का उपयोग कर के इन-विट्रो पुनर्जीवित गर्मी सहनशील फूलगोभी (वीआरसीआर 75-1) का आनुवंशिक स्थिरता विश्लेषण किया गया। सीडीएनए प्रवर्धन, अनुक्रम विश्लेषण और प्रोटीन संरचना के लिए बैंगन में आरपीएन 10 जीन का लक्षण वर्णन किया गया। बैंगन (काशी तरू) में फल एवं तना छेदक प्रतिरोधी ट्रांसजेनिक बैंगन-क्राय1 एए3 जीन, फल छेदक प्रतिरोधी ट्रांसजेनिक टमाटर-क्राय 1एसी

जीन, सूखा, लवणता और ठंड तनाव सहनशील ट्रांसजेनिक टमाटर एटीडीआरईबी1ए और बीसीजेडएटी12 जैसी ट्रांसजेनिक लाइनें अनुरक्षित कि गईं। टमाटर, मिर्च और मटर में तनाव कम करने में सार्थक भूमिका के लिए माइक्रोबियल बायोफार्मूलेशन (बीसी6 एवं एनपीके) का मूल्यांकन किया गया। 20 किस्मों, संकर और संकर की पैतृक लाइनों की डीएनए प्रोफाइलिंग की गई। विभिन्न सब्जी फसलों में जीनोम एडिटिंग तकनीक पर शोध प्रारंभ किया गया। टमाटर (काशी अमृत) में टीओएलसीवी प्रतिरोध के लिए पैलोटा जीन के नॉक-आउट के आधार पर, बाइनरी वेक्टर पीओआरई-ओ4 में क्रिसपर/कैस 9 को विकसित किया गया और पीसीआर के माध्यम से इसकी पुष्टि की गई। इसके अलावा, एग्रोबैक्टीरियम-मध्यस्थ परिवर्तन किए गए और संभावित पौधों को पुनर्जीवित किया गया। टमाटर लाइन पी18 में इन-विट्रो पुनर्जनन को मानकीकृत किया गया। इसी तरह, उच्च समग्र घुलनशील सामग्री के लिए टमाटर के आईएनवीआईएनएच1 और वीपीई5 जीन आधारित बाइनरी वेक्टर पीओआरई-ओ4 में क्रिसपर/कैस 9 को विकसित किया गया एवं पीसीआर के माध्यम से पुष्टि की गई और टमाटर की किस्म काशी अमन में एग्रोबैक्टीरियम के माध्यम से संभावित पुनर्योजी विकसित करने के लिए परिवर्तन किए गए। टीडीजेड और जीए युक्त एमएस मीडिया पर हाइपोकोटिल संवर्धित का उपयोग करके मिर्च में ऊतक संवर्धन के लिए पुनर्जनन प्रोटोकॉल को मानकींत किया गया।

बीज परियोजना के अंतर्गत, टमाटर, बैंगन, मिर्च, भिंडी, लोबिया, मटर, लौकी, करेला, कद्दू, खीरा, नेनुआ, तुरई, लौकी, मूली, फ्रेंचबीन, सेम, गाजर, फूलगोभी और पालक आदि की आईसीएआर-आईआईवीआर किस्मों के कुल 22979.50 किलोग्राम सब्जी के बीज बीजमांगकर्ताओं और किसानों के लिए उत्पादित किए गए। कुल बीजों में से, 19345.10 किलोग्राम आईआईवीआर की मुक्त परागित किस्मों के ट्रुथफुल लेबल बीज, आईआईवीआर में उत्पादित 47.80 किलोग्राम एफ1 संकर बीज, सरगटिया में उत्पादित 34.00 किलोग्राम एफ1 संकर बीज और 3634.40 किलोग्राम प्रजनक बीज सम्मिलित थे। इसके अलावा, मिर्च और लोबिया में लवण सहनशीलता की जांच तथा चप्पन कद्दू में कटाई उपरांत प्रबंधन का मानकीकरण किया गया।

प्रोत्साहन परियोजना के अंतर्गत सब्जी फसलों की विभिन्न लाइनों/संकरों/किस्मों का प्रदर्शन किसानों/केवीके के खेतों पर किया गया। इसके अलावा, यहाँ उन सब्जी फसलों का अनुरक्षण प्रजनन किया गया, जो प्रमुख परियोजनाओं में शामिल नहीं थीं। इनमें परवल, टिंडा, ककड़ी, चप्पन कद्दू, बसेला, चौलाई, लाईपत्ता, मोरिंगा, सब्जी सोयाबीन, ग्वार, बाकला, बेबीकॉर्न, सेम, सिंघाड़ा, करेमू, पंखिया सेम एवं अन्य सब्जियाँ सम्मिलित थी।

सब्जी उत्पादन विभागः

पोषक तत्व निष्कासन और उपयोग दक्षता आंकड़ों के आधार पर, टमाटर में इष्टतम उर्वरक मात्रा नत्रजन की 376.0 किग्रा/हेक्टेयर, फॉस्फोरस की 189.0 किग्रा/हेक्टेयर, और पोटेशियम की 659.0 किग्रा/हेक्टेयर निर्धारित की गई। उर्वरकों के विभिन्न मात्राओं के साथ किए परीक्षणों ने इंगित किया कि उर्वरकों की 125% अनुमानित मात्रा से सबसे अच्छे आकार और वजन एवं उच्चतम कुल घुलनशील ठोस सामग्री सहित उच्चतम समग्र उपज और गुणवत्ता प्राप्त हुई।

शहरी कृषि के लिए स्पेंट मशरूम सब्सट्रेट (बटन मशरूम) जैसे क्रियाधार का उपयोग कर के मृदा रहित सब्जी उत्पादन आशाजनक रहा। खीरे के ग्रीनहाउस परीक्षणों में, बीएमएस (बटन मशरूम स्पेंट) ने फल विशेषताओं और उपज हेतु बेहतर प्रदर्शन किया, जिससे मिट्टी रहित खीरे की खेती के लिए इसकी क्षमता का पता चला।

मटर और फ्रेंचबीन की फसलों पर चार सूक्ष्म पोषक तरल निरूपण के प्रभाव का मूल्यांकन किया गया। माइक्रोमिक्स सी ने दूसरों से बेहतर प्रदर्शन किया, नियंत्रण की तुलना में मटर में 13.39% और फ्रेंचबीन में 11.93% उपज की वृद्धि के साथ गुणवत्ता में उल्लेखनीय रूप से वृद्धि हुई। सर्वोत्तम निरूपण को ''काशी सूक्ष्म-शक्ति प्लस'' का नाम दिया गया जिसे वर्मीवश एवं सूक्ष्म पोषक तत्वों (जिंक, आइरन आदि) और पादप वृद्धि नियामकों (जीए3 एवं एनएए) के सम्मिश्रण द्वारा बनाया गया था।

जैविक खेती के अंतर्गत, फूल गोभी पर विभिन्न जैविक खादों और पलवार के प्रभाव की तुलना करने पर वर्मीकम्पोस्ट का उपयोग प्रभावी पाया गया। दो सौ किग्रा नत्रजन/हेक्टेयर के साथ वीडमल्च का प्रयोग करने पर 331.45 क्विंटल प्रति हेक्टेयर की उच्चतम उपज और 1.504 किग्रा भार के अधिकतम औसत कर्ड (फूल गोभी का फूल वाला भाग) प्राप्त किए गए। जैविक खादों में, मूली के अवशेष और मटर के भूसे से प्राप्त वर्मी कम्पोस्ट ने सबसे अधिक उपज दी। इसके अतिरिक्त, भिंडी के चौदह आनुवांशिक प्रारूपों के साथ जैविक खेती के परीक्षणों में, काशी पराक्रम ने 110.8 कु./हेक्टेयर की उच्चतम उपज दी। इसके बाद वीआरओ-200 की उच्चतम उपज 109.4 कु./हेक्टेयर रही, साथ ही वीआरओ-200 की बिक्री योग्य उपज भी सबसे अधिक (85.6 कु./हेक्टेयर) थी, जिसमें कीटों के कारण फलों को होने वाले ह्रास में महत्वपूर्ण भिन्नताएं (4.53ः से 37.85ः) देखी गयीं।

बूंद-बूंद सिंचाई और पलवार के साथ भिंडी पर किए गए एक अध्ययन में श्याम-रजत (ब्लैक-सिल्वर) पलवार के साथ 100% ईटी पर दिन में दो बार सिंचाई करने से सबसे अधिक उत्पादन (285.66 क्विंटल/हेक्टेयर) प्राप्त हुआ, जो बिना पलवार वाली हल-रेखा (फरो) सिंचाई की तुलना में 107.63% अधिक था। एकान्तरिक दिन पर दिये जाने वाली बूंद-बूंद सिंचाई और श्याम-रजत पलवार के संयोजन से जल उपयोग दक्षता 8.33 क्विंटल/हेक्टेयर/सेमी तक पहुंच गई। श्याम-रजत पलवार के उपयोग से बिना पलवार वाले नियंत्रणों की तुलना में उपज में अप्रत्याशित वृद्धि देखी गयी।

ब्रिमेटो उत्पादन को अनुकूलित करने हेतु तीन टमाटर और तीन बैंगन के किस्मों का प्रक्षेत्र मूल्यांकन किया गया। टमाटर के पौधों काशीअमन काशी संदेश और वाणी काशी उत्तम ने सबसे अधिक फल (क्रमशः 53.67 और 52.67) दिए, जबकि बैंगन में, काशी अमन काशी मनोहर और काशी चयन काशी मनोहर ने सबसे अधिक फल (क्रमशः 22.33 और 21.00) दिए । कुल मिलाकर, आईसी 111056 मूलवृंत पर काशी अमन और काशी संदेश को कलम करने से अधिकतम उपज 5.98 किलोग्राम/पौधा (टमाटर से 3.60 किलोग्राम और बैंगन से 2.38 किलोग्राम) प्राप्त हुई।

भिंडी के सूखा सहनशीलता पर किए गए प्रयोग में, जीन प्रारूप वीआरओ 128 और वीआरओआर 160 अनुकूल पाये गए। उन्होंने नियंत्रण (10.5%) की तुलना में सूखे के तनाव के तहत उपज में न्यूनतम कमी (9.7%) दिखाई, तथा बेहतर जल अवशोषण के लिए उन्नत जड़ विशेषताओं का प्रदर्शन किया। इन जीन प्रारूपों ने उच्च प्रकाश संश्लेषण दर, क्लोरोफिल और प्रति ऑक्सीकारक गतिविधि का प्रदर्शन किया, जबकि वसा पराक्सीकरण को कम किया, जो सूखा-सहिष्णु भिंडी की किस्मों के प्रजनन के लिए उनकी उपयुक्तता की ओर इंगित करता है। इस के अतिरिक्त, आठ खीरा प्रजातियों के बीच जल भराव सहिष्णुता पर एक अध्ययन में, क्लोरोफिल और कैरोटीनॉयड की मात्रा में महत्वपूर्ण कमी देखी गई। खीरे ने उच्च एमडीए और हाइड्रोजन पराक्साइड स्तरों के साथ गंभीर तनाव संकेतक दिखाए, जबकि कद्दू में उल्लेखनीय रूप से प्रोलिन और फिनोल की अभिवृद्धि अभिलेखित की गयी। उत्तरजीविता के संदर्भ में खीरा और लौकी सबसे कम सहनशील जबकि कद्दू एक सशक्त मूल प्रणाली के साथ जल भराव सहिष्णु पाया गया।

तुड़ाई से पहले स्पर्मिडीन और स्पर्माइन से उपचारित शिमला मिर्च के फलों पर चिटोसन-सीएमसी खाद्य लेप लगाया गया और 10 डिग्री सेल्सियस पर भंडारण किया गया, जिससे बिना उपचारित फलों की तुलना में वजन में न्यूनतम कमी देखी गई। इन उपचारों से श्वसन दर में कमी आई, नमी की मात्रा संरक्षित रही, फलों की गुणवत्ता बनी रही और भंडारण के दौरान रेडिकल स्कैवेंजिंग क्षमता और फेनोलिक सामग्री में उतार-चढ़ाव जैसे एंटीऑक्सीडेंट गुणों में वृद्धि हुई। इसके अतिरिक्त, करेला, मिर्च, सेम आदि की जैव सक्रिय क्षमता को भी मापा गया।

उद्यमिता विकास कार्यक्रमों के माध्यम से ग्रामीण युवाओं को सशक्त बनाने के परिणाम स्वरूप 350 लाभार्थियों के बीच उद्यमशीलता व्यवहार में उल्लेखनीय सुधार हुआ। उनके दृढ़ता, आत्मविश्वास, ज्ञान, अनुनय, प्रबंधनीयता, नवीनता और उपलब्धि प्रेरणा जैसे अन्य गुणों में भी उल्लेखनीय वृद्धि देखी गई। इस के अतिरिक्त, इस पहल ने ओएस्टर मशरूम के लिए संस्थागत विपणन को सफलता पूर्वक सुगम बनाया, सब्जी बीज के व्यवसायों को तकनीकी सहायता प्रदान की गयी, और सब्जियों के रस संबन्धित उद्यमिता के अवसरों को बढ़ावा दिया।

संस्थान में ग्रामीण महिलाओं के लिए दो पोषण वाटिका मॉड्यूल पर कार्य किया गया। सौ वर्गमीटर के वाटिका से 210.54 किलोग्राम पत्तेदार सब्जियां और 359.44 किलोग्राम अन्य सब्जियाँ उपजी जो प्रतिदिन 5-6 सदस्यों की आवश्यकताओं के लिए पर्याप्त हैं। 150 वर्गमीटर के वाटिका से 271.61 किलोग्राम पत्तेदार सब्जियां और 498.89 किलोग्राम अन्य सब्जियाँ उपजी जो प्रतिदिन 7-8 सदस्यों के लिए पर्याप्त हैं।

''काशी अनमोल'' मिर्च किस्म के आर्थिक मूल्यांकन से पता चला है कि 2005-06 से 2021-22 तक इसकी खेती 165 जिलों में 1,63,695.95 हेक्टेयर में फैली हुई थी, जो कुल मिर्च की खेती का 2.46% है। इसने 30.88 करोड़ रुपये का कुल आर्थिक अधिशेष उत्पन्न किया, जिसमें 11.94 करोड़ रुपये उत्पादक अधिशेष और 18.94 करोड़ रुपये उपभोक्ता अधिशेष के रूप में थे। लाभः लागत अनुपात (बीसीआर) 81.22 पर, और प्रति हेक्टेयर शुद्ध रिटर्न 2,77,971 रुपये था। काशी अनमोल को अपनाना स्थानीय किस्मों की तुलना में अधिक लागत प्रभावी और लाभदायक साबित हुआ, जिसका श्रेय अधिक पैदावार और बेहतर बाजार मूल्यों को दिया जा सकता है।

सब्जी सुरक्षा विभागः

जलवायु परिवर्तन के वर्तमान परिदृश्य में सब्जियों के प्रमुख कीटों के जैव-सघन प्रबंधन परियोजना के अंतर्गत, तीन परीक्षण मॉड्यूलों में से, रासायनिक कीट प्रबंधन मॉड्यूल यानी 30 दिन पर इमिडाक्लोप्रिड 17.8 एस एल1 मिली/ली, 50 दिन पर स्पाइरोमेसिफेन 22.9 ^{0}C 1.25 मिली/ली और 70 दिन पर इंडोक्साकार्ब 14.5 एससी

1 मिली/ली का छिड़काव टमाटर के प्रमुख कीटों के प्रबंधन में अत्यधिक प्रभावी पाया गया। ब्रोफ्लैनिलाइड 300 एससी/0.4 मिली/ली और फ्लक्सामेटामाइड 10 ईसी/1.5 मिली/ली जैसे नए अणु ब्लैक थ्रिप्स (थ्रिप्स परविसपिनस) के खिलाफ अत्यधिक प्रभावी पाए गए, जो अनुपचारित नियंत्रण की तुलना में क्रमशः 100.0 और 99.07 प्रतिशत की कमी देते हैं। सब्जियों के प्रमुख कीटों के खिलाफ नए और वानस्पतिक कीटनाशकों पर विषाक्तता संबंधी जांच में, टोल्फेनपाइराड 15% ईसी/2 मिली/एल और फ्लूपाइराडिफ्यूरोन 17.09% एससी/2.5 मिलीध्एल जैसे नए अणुओं को भिंडी में चूसने वाले कीटों के परिसर के प्रबंधन के लिए अनुशंसित किया जा सकता है। वानस्पतिकों में, नीम का तेल सबसे प्रभावी पाया गया और इसे लोबिया में एम. विट्राटा के प्रबंधन के लिए वैकल्पिक विकल्प के रूप में अनुशंसित किया जा सकता है। प्रमुख सब्जी कीटों के जैविक नियंत्रण में, अनुशंसित मात्रा के आधे पर नियोनिकोटिनोइड्स (इमिडाक्लोप्रिड 17.8 एसएल, थियामेथोक्सम 25 डब्ल्यूजी और एसिटामिप्रिड 20 एसपी) और तीन एंटोमोपैथोजेनिक कवक (ब्यूवेरिया बेसियाना, मेटारिजियम एनीसोप्लाई और लेकनिसिलियम लेकानी) का संयोजन न केवल संगत था, बल्कि क्रिया में सहक्रियात्मक भी था और यह ब्लैक बीन एफिड (एफिस क्रैकसिवोरा) के खिलाफ एक व्यवहार्य हरित पर्यावरण अनुकूल विकल्प हो सकता है। बेबी कार्न पर भोजन करने वाले फॉल आर्मी वर्म से एक मिलनसार कोइबोबायंट लार्वा एंडोपैरासिटाइड कोटेसिया रूफिक्रस हैलिडे (ब्राकोनिडेः हाइमेनोप्टेरा) पृथ्थेंत किया गया था।

"सब्जी फसलों के महत्वपूर्ण फफूंद रोगों के लिए प्रभावी एकीकृत प्रबंधन पैकेज का विकास" परियोजना में, यह निश्कर्ष निकाला गया है कि रासायनिक मॉड्यूल जिसमें बुवाई के दौरान कैप्टान 70% डब्ल्यूपी हेक्साकोनाजोल 5%/0.25% द्वारा बीज उपचार, रोपाई के दौरान कैप्टान + हेक्साकोनाजोल/0.25% में अंकुर जड़ डुबाना, रोपण के 55 दिन बाद मैंकोजेब 75% डब्ल्यूपी/0.25% का छिड़काव, पहले छिड़काव के 70 दिनों के बाद फल शुरू होने की अवस्था में कार्बेन्डाजिम/0.1% का छिड़काव, रोपण के 100 दिन बाद कार्बेन्डाजिम/0.1% का छिड़काव और फल पकने पर मैंकोजेब/0.25% का छिड़काव फफूंद रोगों के प्रबंधन और काशी उत्तम किस्म के बैंगन की उपज के लिए 1% 1.6 के अधिकतम सीःबी अनुपात के साथ सर्वोत्तम था। पौधों के रोगजनकों के खिलाफ सब्जियों से जुड़े सूक्ष्मजीवों की जैव-पूर्वेक्षण में, बैंगन को नुकसान पहुँचाने वाले सफेद मक्खियों से अलग किए गए एंटोमोपैथोजेनिक कवक कॉर्डिसेप्स जावनिका को आणविक रूप से चिह्नित किया गया था। इसके अलावा, कंसोर्टिया फॉर्मूलेशन यानी ट्राइकोडर्मा एस्परेलम + बैसिलस सबटिलिस/10 ग्राम/किग्रा बीज के साथ बीज उपचार ने मटर में फल सड़न (5.67%) की न्यूनतम घटना दर्ज की। सब्जियों के महत्वपूर्ण जीवाणु रोगों के प्रबंधन में, सोलेनेसियस सब्जी फसलों की परीक्षित किस्मों में से बैंगन (एस. गिलो, आईसी-354557, एस. इनकैनम, एस. लैंसिएटम, एस. एथियोपिकम, सूर्या, एस. टोरवम, आईसी-111056), मिर्च (टी-135, पंजाब लाल, अंडमान मिर्च) और टमाटर (पंजाब छुहारा, ईसी-520078) को सिक प्लॉट की स्थितियों के तहत जीवाणु विल्ट प्रतिरोधी किस्मों के रूप में पहचाना गया। टमाटर में वीआरटीएच-16-3 और वीआरटीएच-16-5 जीवाणु विल्ट के लिए मध्यम रूप से प्रतिरोधी पाए गए। इसी तरह, आईवीबीएचआर-17, आईवीबीआर-20, आईवीबीएचएल-20, 22, 26, 23, आईवीबीएल-23 एवं 25 बैंगन की छोटी पत्ती के खिलाफ अत्यधिक प्रतिरोधी पाए गए। रासायनिक और जैविक मॉड्यूल का प्रयोग टमाटर (वीआरटी-50) में सबसे अधिक उपज (34.85 टनध्हेक्टेयर) और सबसे कम जैंथोमोनस लीफ ब्लाइट रोग (8.0 पीडीआई) के साथ सबसे प्रभावी पाया गया। इसी तरह, रासायनिक और वनस्पति मॉड्यूल का प्रयोग फूलगोभी (किस्म पूसा स्नोबॉल) में सबसे अधिक उपज (21.76 टन/हेक्टेयर) और सबसे कम ब्लैक रॉट प्रतिशत रोग सूचकांक (5) के साथ सबसे प्रभावी पाया गया।

सब्जी फसलों को संक्रमित करने वाले विषाणुओं के लक्षण वर्णन और उनके प्रबंधन में, बेगोमो विषाणुओं की पहचान की गई है जो वेलेवेट बीन में गंभीर पीले मोजेक रोग का कारण बन रहे हैं। सब्जी फसलों को संक्रमित करने वाले पादप परजीवी नेमाटोड के प्रबंधन में, ट्राइकोडर्मा आइसोलेट्स टीटीवी1, टीटीवी2 और टीएएसपी को इन-विट्रो स्थितियों के तहत एक्सपोजर के 120 घंटे बाद 50 और 100ः कल्चर फिल्ट्रेट सांद्रता पर उच्चतम अंडा हैचिंग अवरोध पैदा करते हुए सबसे प्रभावी पाया गया। कीट और रोग गतिशीलता में, और बदलते मौसम परिदृश्य के संबंध में महत्वपूर्ण सब्जी फसलों के प्रमुख कीटों के लिए व्यवहार संशोधित रणनीतियों में, ल्यूसिनोड्स ऑर्बोनालिस और स्पोडोप्टेरा लिटुरा के लिए एक बहु प्रतिगमन पूर्व चेतावनी मॉडल विकसित किया गया।

प्रमुख सब्जी फसलों में तुड़ाई के बाद होने वाले रोगों के जैव प्रबंधन में, मिट्टी के नमूनों से पृथक किए गए संभावित जैव नियंत्रण एजेंटों (बैसिलस वेलेजेंसिस एए17, बैसिलस एसपी एसी26, स्टेनोट्रोफोमोनस माल्टोफीलिया एडी28, बैसिलस एमाइलोलिकेफैसियंस एडी29, बैसिलस सबटिलिस एएच39, बैसिलस वेलेजेंसिस एएच40, बैसिलस सबटिलिस बीई11, पैनीबैसिलस एसपी. सीसी6) को पी-सॉल्यूबिलाइजेशन साइडरोफोर, अमोनिया और एचसीएन

उत्पादन के लिए चिह्नित किया गया था। इसके अलावा, खेत में तुड़ाई के बाद के रोगाणु को कम करने के लिए प्रभावी जैव एजेंटों का परीक्षण किया गया। अवशेष गतिशीलता, सुरक्षा मूल्यांकन और परिशोधन में, टमाटर में डेल्टामेथ्रिन अपव्यय गतिकी को पहले क्रम में देखा गया, डेल्टामेथ्रिन को दोनों अनुप्रयोग खुराकों पर विघटित होकर ईयू-एमआरएल मान तक पहुँचने में कम समय लगा, इसलिए इस रसायन का उपयोग टमाटर की फसलों में फलों के रोगों को नियंत्रित करने के लिए सुरक्षित रूप से किया जा सकता है।

सुरक्षित सब्जी उत्पादन के लिए प्रमुख सब्जी फसलों के एकींत कीट प्रबंधन में, मूली की जड़ और शॉट होल बोरर फिलोट्रेटा स्ट्रियोलाटा के जैविकी का अध्ययन किया गया। इसके अलावा, विषाणु परख में, हेटेरोरहैबडाइटिस इंडिका को पी. स्ट्रियोलाटा के तीसरे इंस्टार और प्री-प्यूपल चरणों के खिलाफ एक संभावित एंटोमोपैथोजेनिक नेमाटोड के रूप में पाया गया। पी. स्ट्रियोलाटा के प्रबंधन के लिए, जैविक कीट प्रबंधन मॉड्यूल विकसित किया गया, उसका मूल्यांकन किया गया और किसानों की प्रथाओं के साथ तुलना की गई। सब्जी फसलों के पादप रोगजनकों (रोगों) के लक्षण वर्णन और एकीकृत प्रबंधन में, फफूंद रोगजनकों की शुद्ध कल्चर जैसे, मिर्च से कोलेटोट्रीकम ट्रंकैटम, बैंगन से फोमोप्सिस वेक्सन्स, टमाटर से अल्टरनेरिया सोलानी और टमाटर, बैंगन और मिर्च से राल्स्टनिया सोलानेसीरम की स्थापना की गई और आर. सोलानेसीरम के लिए स्क्रीनिंग विधि को मानकीकृत किया गया। करेमू में फोमोप्सिस ब्लाइट की पहली रिपोर्ट दर्ज की गई।

सब्जी फसलों को संक्रमित करने वाले विषाणुओं के निदान और नई रणनीतियों के माध्यम से इसके प्रबंधन में, भारत में टमाटर पर नेक्रोसिस रोग पैदा करने वाले विशिष्ट तरबूज कली नेक्रोसिस विषाणु (ऑर्थोटोस्पोवायरस सिट्रुलोनेक्रोसिस) की पहचान की गई है। इसके अलावा, लौकी में पीली बीमारी से संक्रमित विषाणुओं की भी पहचान की गई है। सब्जी की फसलों में जड़-गाँठ सूत्रकृमि के जैव-सघन प्रबंधन में, कद्दू के दो जर्मप्लाज्म यानी स्वर्ण अमृत और वीआरपीके-18-1 जड़-गाँठ सूत्रकृमि (आरकेएन) के विरुद्ध मध्यम रूप से प्रतिरोधी पाए गए हैं। बैंगन में, तीन जर्मप्लाज्म यानी जीबी-6, जीबी-11 और जीबी-14 ने आरकेएन के विरुद्ध प्रतिरोध प्रतिक्रिया दिखाई है। टमाटर में, जीनोटाइप एस1-150-पी22-39-9, एस1-2018-171-190, एस1-2018-150-च्22-1, एलए 2823, एस 1-150-34-19, एस 1-150-20-1, एस 1-150-34-20 और एच-88-78-1 ने आरकेएन के खिलाफ प्रतिरोधी प्रतिक्रिया दिखाई है। मिथाइल यूजेनॉल नैनो-फॉर्मूलेशन की विभिन्न सांद्रताओं के परीक्षण में, 24 घंटे के एक्सपोजर के बाद 2000 पीपीएम सांद्रता पर जे2 की 100% मृत्यु दर दर्ज की गई। टमाटर के फलों में फ्लूओपाइरम के अपव्यय गतिकी में, आवेदन के 5 दिन बाद तक गिरावट तेज थी, जहाँ सभी खुराकों में लगभग 50: अवशेष नष्ट हो गए और आवेदन के 10 दिनों के बाद, अवशेष पता लगाने योग्य सीमा से नीचे हो गए।

सब्जी फसलों में कीटनाशकों के अवशेष विश्लेषण और जोखिम मूल्यांकन में, टमाटर, भिंडी, करेला, लोबिया और मिर्च से डेल्टामेथ्रिन अवशेषों को शुद्ध करने के लिए विभिन्न तरीकों का मूल्यांकन किया गया। सब्जियों में कीट और रोग प्रबंधन (आईपीडीएम) के लिए फसल-विशिष्ट मॉड्यूल विकसित करने के लिए संगत घटकों के एकीकरण में, कीटनाशक यानी फ्लूपीराडिफ्यूरोन और इमिडाक्लोप्रिड के शहद की मक्खियों, एपिस मेलिफेरा पर प्रभाव का अध्ययन किया गया।

Abbreviations

AI	Active Ingredient
AICRP(VC)	All India Coordinated Research Project (Vegetable Crop)
AIR	All India Radio
ASCI	Agriculture Skill Council of India
ATIC	Agricultural Technology Information Centre
ATMA	Agricultural Technology Management Agency
AU	Astronomical Unit
BOLD	Barcode of Life Database
B-S PE	Black-Silver Polyethylene Mulch
CAPS	Cleaved Amplified Polymorphic Sequences
CD	Critical Difference
CDD	Conserved Domain Database
CMS	Cytoplasmic Male Sterile
CMS	Cytoplasmic Male Sterility
CT	Conservation Tillage
CTC	Co-toxicity Coefficient
CV	Coefficient of Variation
DAI	Days After Inoculation
DAS	Days After Sowing
DAT	Days After Transplanting
DDG	Deputy Director General
DFF	Days Required to First Flowering
DNA	Deoxyribonucleic Acid
DS	Drought Stress
DSI	Drought Sensitivity Index
DTPA	Diethylene Triamine Pentaacetic Acid
DW	Dry Weight
DWR	Directorate of Weed Research
EC	Emulsifiable Concentrate
EDTA	Ethylene Diamine Tetraacetic Acid
EPN	Entomopathogenic Nematodes
FD	Fruit Diameter
FL	Fruit Length
FLD	Front Line Demonstration
FSB	Fruit & Shoot Borer
FW	Fresh Weight

GDD	Growing Degree Days
GDP	Gross Domestic Product
GMS	Genetic Male Sterility
GMV	Golden Mosaic Virus
HAT	Hours After the Treatment
IAA	Indole Acetic Acid
IC Numbers	Indigenous Collection Numbers
ICAR	Indian Council of Agricultural Research
IIVR	Indian Institute of Vegetable Research
INLFH	Inter Node Length at First Harvest
IRM	Insecticide Resistance Management
KVK	Krishi Vigyan Kendra
LC_{50}	Lethal Concentration 50
MI	Mycelial Growth Inhibition
MTA	Material Transfer Agreement
MtCOI	Mitochondrial Cytochrome Oxidase I
NBAIR	National Bureau of Agricultural Insect Resources
NFP	Number of Fruits per Plant
NNFH	Number of Node at First Harvest
NT	Not Tested
NUE	Nutrient Use Efficiency
OC	Organic Carbon
OD	Optical Density
OFT	On Farm Trials
PBNV	Peanut Bud Necrosis Virus
PCR	Polymerase Chain Reaction
PDI	Per cent Disease Index
PHI	Pre Harvest Interval
PLW	Physiological Loss in Weight
PPM	Parts Per Million
PPOC	Per cent Protection Over Control
PPP	Public Private Partenership
PR	Percent Reduction
PRP	Proline Rich Protein
PTC	Pre-Treatment Count
QTL	Quantitative Trait Loci
R&D	Research and Development
RAPD	Random Amplified Polymorphic DNA

RBD	Randomized Block Design
RH	Relative Humidity
RILs	Recombinant Inbred Lines
RNA	Ribonucleic Acid
RT	Reduced Tillage
Sc	Number of Sclerotia
SD	Standard Deviation
SDI	Sub-surface Drip Irrigation
SEM	Standard Error Mean
SNPs	Single Nucleotide Polymorphism
SPS	Single Plant Selection
SR	Survival Rate
SSDI	Sub Surface Drip Irrigation
SSR	Simple Sequence Repeat
TI	Tolerance Index
ToLCV	Tomato Leaf Curl Virus
TSS	Total Soluble Solids
WBNV	Watermelon Bud Necrosis Virus
WEY	Wheat Equivalent Yield
WFPP	Weight of Fruit Per Plant
WG	Water Dispersible Granules
WUE	Water Use Efficiency
YVMV	Yellow Vein Mosaic Virus
ZT	Zero Tillage

Research Achievements

Vegetable Improvement

PROJECT 1: IMPROVEMENT OF SOLANACEOUS VEGETABLE CROPS FOR STRESS TOLERANCE, YIELD AND QUALITY TRAITS (w.e.f 01.04.2023)

Old project names: [1.1 Genetic Improvement of Tomato; 1.2 Genetic Improvement of Brinjal; 1.3 Genetic Improvement of Chilli)] (till 31.03.2023)

[A] Tomato

Germplasm maintenance and evaluation: Seven accessions of 6 wild species and over 392 cultivated genotypes were maintained and evaluated.

Development of interspecific populations and phenotyping for biotic stresses: F_1, F_2 and back cross (P18 × EC520061) populations of P18 and EC520061 (*S. habrochaites* resistant to early blight) were developed. Three F_6 families (Tag 61, 62, and 67) of Kashi Amrit × *S. arcanum* were screened against root-knot nematode and were found immune. Punjab Chhuhara was used as susceptible check. In total 160 back cross population of Kashi Amrit × *S. chilense* (LA1972) were evaluated for ToLCV resistance under epiphytotic conditions. Four back cross families (15 CH B2 17 P3-4, 15 CH B2 22 P4-3, WSS 2265 P1 and 0.875) were found promising with DSI < 1.

Phenotypic and molecular characterization of tomato lines: A total of 153 tomato lines were characterized based on horticultural traits, total soluble solids (TSS) and tomato yellow leaf curl virus (ToLCV) resistance under natural field conditions. Molecular markers were also applied for ToLCV (*Ty-2* and *Ty-3*) (Fig. 1), late blight (*Ph-3*) and root knot nematode (*Mi-1.2*) resistance genes. The identified promising lines were VRT-06, VRT-19, VRT-34 and VRT-51, jointless (EC-605037 and EC-695037), cherry tomato (VRCYT-3, VRCRT-5,

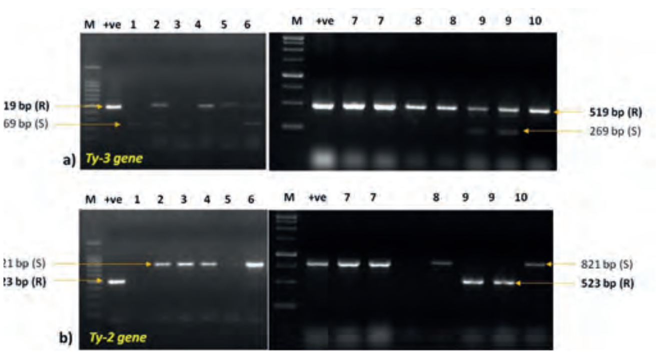


Fig. 1: Detection of ToLCV resistance genes (Ty-2 and Ty-3) in tomato. Samples: 1) ToLCV-41, 2) ToLCV-32, 3) VRT-67, 4) VRT-50, 5) VRT-34, 6) VRT-02, 7) VRT-30, 8) VRT-51, 9) H-88-78-1, 10) H-88-78-2; Resistant controls cv. Sankranti (*Ty-2*) and cv. Kashi Aman (*Ty-3*)

VRCRT-14 and VRCRT-15), beta-carotene line (KB-3-1, KB-3-2, KB-20, KB-17, KB-32). The genotypes containing high TSS (>5 °Brix) were improved line (VRT-67), jointless (EC-695037), cherry tomato (VRCYT-3) and some germplasm (Cheti tomato, EC-521047, EC-538380, EC-620362, and EC-620510). Importantly, we identified ToLCV resistant improved lines (VRT-06, VRT-19, VRT-30, VRT-34, VRT-50, VRT-51, and VRT-67) and many in others groups.

Generation of new crosses and evaluation of hybrids in winter season: A total of 73 new crosses were generated during the year and evaluated in three seasons (winter, summer and rainy), of which 22 were selected for further evaluation. In addition, 23 previously developed hybrids were also evaluated. Out of total 52 hybrids evaluated in winter season for yield and yield-related traits, selected hybrids produced yield in the range of 749.99 q/ha (CRPVRTH-23-14) to 839.99 t/ha (CRPVRTH-23-34).

Evaluation of hybrids in summer season: Total 19 hybrids were evaluated in summer season (transplanting: first week of February). Ten hybrids produced yield in the range of 409.9 q/ha (CRPVRTH 16-4) to 616.6 q/ha (CRPVRTH 22-11).

Evaluation of hybrids in rainy season: Total 38 hybrids were evaluated in rainy season, of which 7 hybrids yielded > 300 q/ha with yield range between 116.98 q/ha (CRPVRTH-22-11) to 485.31 q/ha (CRPVRTH-23-10).

Identification of tomato hybrids for round the year cultivation and processing purposes: Based on the last four years performance, the hybrid CRPVRTH-16-4 (avg. fruit weight: 105-110 g) was found the highest yielder in rainy (550-750 q/ha), winter (950-1400 q/ha) and summer (280-350 q/ha) with fulfilling processing standards (TSS: 4.55 °Brix, acidity: 0.32%, lycopene: 8.49 mg/100 g FW, and pericarp thickness: 0.62 cm). Hybrid CRPVRTH-16-4 recorded 17-27% yield gain over the best check Abhilash (148-584 q/ha) during all three seasons. The hybrid CRPVRTH-16-4 is semi-

Fig. 2: Hybrid CRPVRTH-16-4

determinate type, round fruited, medium fruit firmness and high resistance to ToLCV (*Ty-3* gene) (Fig. 2).

Identification of tomato hybrids for moisture stress or rainfed cultivation: Based on the last four years performance under moisture stress (stopped irrigation from first week of November to first week of February) during winter season, hybrid CRPVRTH-16-3 recorded the highest yield (800-1000 q/ha) under moisture stress (only 50% irrigation) compared to 1100-1300 q/ha with full irrigated conditions over the best control (hybrid Abhilash), which produced 680 q/ha (50% irrigation) and 967 q/ha (full irrigation). The hybrid CRPVRTH-16-3 is semi-determinate type, round fruited, avg. fruit weight (90-100 g), moderate TSS (4.2 ^{o}Brix), medium fruit firmness and high resistance to ToLCV (*Ty-3* gene) (Fig. 3).

Fig. 3: Hybrid CRPVRTH-16-3

Identification of hybrids and lines suitable for processing purpose: Of total 52 hybrids evaluated during winter season, few hybrids were identified having high TSS ^{0}Brix such as CRPVRTH-18-26 (4.96), CRPVRTH-16-4 (4.66), CRPVRTPH-23-26 (4.63), CRPVRTPH-23-4 (4.6), CRPVRTPH-23-13 (4.56) and CRPVRTH-21-21 (4.46). Parental lines namely VRT-34, VRT-67 and ToLCV-32 were identified with high TSS for processing.

Identification of line for rainy season and high temperature tolerance: Out of 15 lines, VRT-67 (350 q/ha) and VRT-16-1 (330 q/ha) were identified promising for high temperature stress tolerance.

Characterization of exotic tomato lines for processing traits: A total of 60 exotic collections were evaluated under natural field conditions for processing and other agronomic traits. A few promising lines were AVTO-2151 (400 q/ha, TSS: 4.1 ^{0}Brix), AVTO-2149 (450 q/ha, TSS: 4.3 ^{0}Brix), AVTO-1906 (TSS: 4.2 ^{0}Brix), AVTO-1706 (TSS: 4.5 ^{0}Brix), AVTO-9801 (TSS: 5.0 ^{0}Brix), AVTO-2037 (cherry tomato, TSS: 6.4 ^{0}Brix), AVTO-0102 (TSS: 4.5 ^{0}Brix), AVTO-9706 (TSS: 5.6 ^{0}Brix), AVTO-1349 (TSS: 5.2 ^{0}Brix), AVTO-1174 (TSS: 5.1 ^{0}Brix) and AVTO-9805 (TSS: 5.6 ^{0}Brix). In addition, some promising lines were LA-4453 (TSS: 4.6 ^{0}Brix), LA-3911 (TSS: 4.8 ^{0}Brix), LA-4082 (TSS: 4.4 ^{0}Brix), LA-2093 (TSS: 6.2 ^{0}Brix), Jointless LA-4454 (TSS: 5.26 ^{0}Brix), LA-0315 (TSS: 4.6 ^{0}Brix), LA-1501 (TSS: 4.5 ^{0}Brix), LA-1222 (TSS: 4.3 ^{0}Brix), and LA-1310 (TSS: 6.1 ^{0}Brix).

Identification of improved lines of Cherry tomato, jointless and beta-carotene rich tomatoes: Total 28 cherry tomatoes were evaluated under open field conditions. Of which, cherry tomato advance line VRCYT-3 produced the highest yield (353 q/ha) with TSS (8.6 °Brix) and fruit weight of 7.5 g, while another Cherry tomato line VRCRT-14 produced 290 q/ha with TSS 6.5 °Brix and fruit weight of 7.6 g, and VRCRT-15 produced 350 q/ha with TSS 5.4 °Brix and fruit weight 10-11 g. Further, 23 beta-carotene rich (KB lines) tomatoes were evaluated and promising lines were KB-3-1, KB-3-2, KB-17, KB-19-1, KB-19-2, KB-20 which yielded between 100-225 q/ha and free from ToLCV. In addition, nine Jointless tomatoes were evaluated, of which VRT-23-37 (EC-695037) recorded the highest yield 503.33 q/ha with average fruit weight of 75 g and 4.6 ^{0}Brix TSS followed by VRT-69 with 756.66 q/ha yield, average fruit weight of 96 g and TSS of 4.4 ^{0}Brix (Fig. 4).

Fig. 4: Kashi Cherry Tomato - 3

Generation advancement and maintenance of improved lines: A total of 121 segregating generations were evaluated and advanced to the next generations viz., F_2 to F_3 (34), F_3 to F_4 (8), F_4 to F_5 (9), F_5 to F_6 (8), F_6 to F_7 (14), F_7 to F_8 (6), F_8 to F_9 (22) and F_{10} to F_{11} (20). In addition, 192 germplasm, 19 improved lines, 20 cherry tomatoes, 16 beta-carotene rich lines, 8 jointless, 59 exotic collection, and 8 varieties were maintained for breeding for processing and nutrition rich tomatoes.

Entries in AICRP (VC): A total of three tomato hybrids were introduced in AICRP (VC) for multilocation testing *viz.*, CRPVRTH-19-32 for biotic stress, CRPVRTH-19-18 and CRPVRTH-16-4-1 for processing traits. In addition, two cherry tomato lines (VRCRT-14 and VRCRT-15) were also introduced in AICRP (VC) trials.

AICRP (VC) trials: Six AICRP (VC) trials viz., IET Cherry tomato (10 entries), AVT-II Cherry tomato (6 entries), IET tomato (Det.) (6 entries), AVT-II tomato (Det.) (6 entries), IET tomato (Indet.) (8 entries), IET tomato processing (9 entries) were conducted.

Sharing of germplasm through Material Transfer Agreement (MTA): Total 130 accessions of tomato were supplied to 13 organizations/SAUs/FPOs through MTA for research purpose.

[B] Brinjal

Maintenance and evaluation of germplasm: A total of 213 germplasm of brinjal including 9 wild related species (e.g. *Solanum torvum*, *S. sisymbriifolium*, *S. gilo, S. viarum, S. incanum, S. trilobatum, S. virginianum, S. aethiopicum* and *S. coagulans)* were maintained and evaluated for further use in crop improvement programme.

Screening of genotypes against brinjal shoot and fruit borer (*Leucinodes orbonalis*) under in-vitro conditions: Twelve genotypes of brinjal were selected for screening against Brinjal Shoot and Fruit Borer (BSFB), *L. orbonalis* under in-vitro conditions. Maximum egg-laying was recorded in Punjab Sadabahar, Kashi Taru, Kashi Modak, IVBSR-2, IVBHR-17 and IVBR-19 whereas less number of eggs were noted in IVBHR-20, IVBHR-21, IVBHL-25, Selection-10. Maximum egg laying was observed on fruits followed by peduncle and then flowers. The egg-laying was recorded in the range of 10.3-35.3, 54.3-161 and 19.3-47.6 on brinjal flowers, fruit and peduncle, respectively.

Metabolomics study for resistance against brinjal shoot and fruit borer (*Leucinodes orbonalis*): Based on the previous findings, the resistant genotype selection-10 and the susceptible genotype Kashi Taru were selected for the metabolomics study. The plant was infected with third instar larvae of *L. orbonalis* in shoot and fruit tissues and the infected as well as uninfected samples were collected 4 days after infestation and stored in -80^{0}C for further processing.

Screening against little leaf of brinjal: Among tested germplasm/varieties Kashi Sandesh, IVBHR-17, IVBR-20, Kashi Manohar, Kashi Utsav, IVBHL-26, IVBHL-23, Kashi Vijay and IVBL-25 were found highly resistant on the basis of disease reaction against little leaf.

Screening against bacterial wilt and *Phomopsis* blight: Pathogenicity of isolates of *R. solanacearum* and *Phomopsis vexans* obtained from ICAR-NBAIM, Mau were tested under sick plot condition for identification of resistant lines/hybrids of brinjal. All tested accessions *viz. S. gilo,* IC354557, *S. incanum, S. lanciatum, S. aethiopicum,* Surya, *S. torvum* and IC111056 were found resistant to bacterial wilt (Fig. 5). Among tested accessions all except *S. incanum* were found resistant to *Phomopsis* blight.

Development of new crosses and evaluation of hybrids: A number of crosses with bacterial wilt

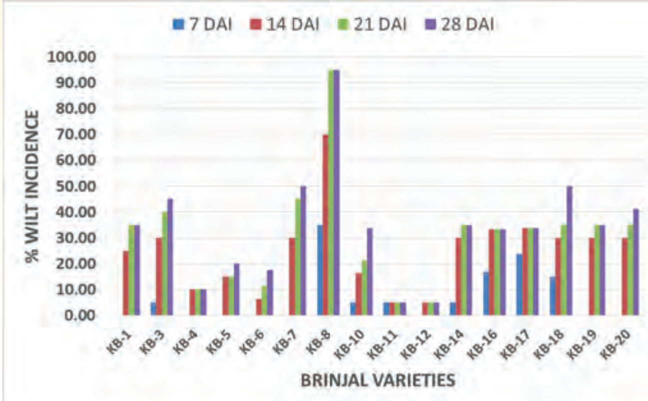


Fig. 5: Bacterial wilt incidence in brinjal varieties/hybrids under artificial inoculation against virulent strain Rs-09-161. (KB1: Kashi Modak, KB-3: Kashi Himani, KB-4: Kashi Vijay, KB-5: IVBL-22, KB- 6: Kashi green round, KB-7: Kashi Uttam, KB-8: Kashi Taru, KB-10: ADM-190, KB-11: Kashi Manohar, KB-12: Selection 10, KB-14: IVBHL-22, KB-16: Punjab Barsati, KB-17: Kashi komal, KB-18: Pant Rituraj, KB-19: Kashi Uttam, KB-20: Kashi Sandesh)

resistant varieties Goa Brinjal-2, Goa brinjal-3, Goa Brinjal-4, Brinjal-5, selection 10 were generated. Total 40 hybrids (17 round fruited and 23 long fruited types targeting various market segments were evaluated for fruit quality and yield parameters along with standard checks. Among round fruited types, IVBHR-24 and IVBHR-18-1 performed better over checks, while among long fruited types IVBHL-26 and IVBHL-23-1 surpassed the check (Fig. 6).

Fig. 6: Selected lines of brinjal

Evaluation of advance lines and generation advancement: Among advance lines, IVBR-24 and IVBR-19 in round fruited type and IVBL-32 and IVBL-27-1 in long fruited type were evaluated for two years and identified as promising for multi-location testing through AICRP (VC) trials. Further, 510 segregating populations (40:F_1 to F_2; 40: F_2 to F_3; 56: F_3 to F_4; 58: F_4 to F_5; 52: F_5 to F_6; 69: F_6 to F_7; 111: F_7 to F_8; 51: F_8 to F_9; 33: F_9 to F_{10}) were advanced to next higher generations.

Evaluation of advance lines and hybrids for ratoon cropping: A total of 66 advance lines and hybrids (24 hybrid long, 17 hybrid round, 13 round and 12 long segments) were selected to evaluate the suitability of ratooning in brinjal genotypes.

Evaluation for performance in high temperature conditions: A total of 34 genotypes including 26 OP and 8 hybrids were evaluated for tolerance to high temperature during summer season. Of these, IVBHL-22, IVBHL- 24, IVBHR-16, Kashi Brinjal Green Round (IVBR-17) were found to have potential for flowering and fruiting at day temperature 42±2°C.

Maintenance breeding: Seeds of Kashi Sandesh (600g), Kashi Taru (500g), Kashi Komal (400g), Kashi Prakash (300g), Kashi Himani (800g), Kashi Vijay (250g), Kashi Manohar (900g), Kashi Brinjal Green Round (300g), Kashi Modak (450g) and Kashi Uttam (600g) being multiplied for distribution and multi-location demonstration. Seeds of the parental lines of the hybrids were also maintained.

[C] Chilli

Germplasm management: A total of 410 accessions of chillies were maintained. Besides, 340 stable advanced lines and four sets of RILs were also maintained (Fig 7). The germplasm pool included eight sets of CMS, one GMS, and 12 wild, indigenous and exotic collections. Nucleus seeds of IIVR varieties along with parental lines were also multiplied. A total of 34 new accessions acquired during 2021-22 were grown, evaluated and multiplied. Out of 34, only 11 could be characterized, others either did not germinate or no fruit obtained. The fruit length ranged from 11.4 cm (GAVC-101) to 2.1 cm (NUKC-9) while the fruit width was found maximum in PKS-19 (6.6 cm) and minimum in NUKC-9 (0.9 cm).

IC-112974 IC- 413713

Fig. 7: Promising germplasm of chilli

Spicy Yellow Long chilli GAVC-131 PKS-15

Fig. 8: Evaluation of new chilli collection

One entry (Yellow Spicy long chilli) (Fig 8) was having yellow fruit colour at maturity while PKS-19 was capsicum type.

Augmentation of chilli & sweet pepper germplasm: Ten lines of chilli were collected from different parts of the country (Gujarat, KKG, CPCT-IARI). Ten lines of sweet pepper were also collected from IARI-RS Katrain centre.

Evaluation and development of F_1 hybrids in chilli: A total of 23 new F_1 hybrids were evaluated along with 8 commercial hybrids during 2022-23. The fruit length in these hybrids ranged from 5.46 – 11.88 cm while fruit width varied from 0.78-2.52 cm. Green fruit yield of tested hybrids ranged from 19.53 – 198.55 q/ha (Fig 9).

Evaluation of pickle type chilli: A total of 19 accessions of pickle type chilli were evaluated for fruit quality and yield related traits. The fruit length among evaluated genotypes ranged from 5.08-10.1 cm while fruit width ranged from 1.94-3.06 cm. Similarly, yield potential of these accessions ranged from 80.1-290.60 q/ha.

A3 x Jayanti (198.55 q/ha) A3 x EC 519626 (178.75 q/ha)

Fig. 9: Promising F1 hybrids in chilli for yield and disease resistance

New population development for genetic study in chilli: A new population was developed utilizing two diverse parent (EC 519632 and Kashi Abha) for fruit quality traits and disease resistance. Parents, F_1 and 191 individuals were characterized and high variability was recorded in F_2 population.

Breeding for ChiLCVD resistance: RIL population of Kashi Sinduri x BS-35 (F_{11}) with 109 families screened for ChiLCVD resistance under field condition. A total of 20 lines were showing field tolerance and grafting and alternate grafting was successfully performed using susceptible/resistant scion.

New entries for AICRP trial: IIVRC-18253- High number of fruit, light green colour foliage, long and dark green fruits. Solitary bearing and drooping (first harvest approx 60 days after transplanting). Highly pungent fruit, fruit length (10.5-11.0 cm), medium thick (1.20-1.22 cm), straight fruit and acute shaped at base and fruit end. Dark green, medium thick and shiny fruits (Fig. 10).

Fig. 10: Field view of IIVRC-18253

IIVRC-23002: High number of fruit, light green colour foliage, medium sized fruits. Solitary bearing and drooping (first harvest approx 65 days after transplanting). Highly pungent fruit, fruits length (6.6-6.9 cm), medium thick (0.85-0.90 cm), acute shaped and slightly curved fruit at the fruit end. Light green, medium sized fruit, slightly wrinkled. Tolerant to ChiLCV and anthracnose under field condition (Fig. 11).

Fig. 11: Field view of IIVRC-23002

GBS analysis in chilli: A total of 100 diverse chilli genotypes were genotyped through GBS to identify QTLs/Genes/SNPs associated with 11 traits related to fruit quality, yield attributes and disease tolerance. Analysed data revealed vast variability for all the recorded parameters such as fruit length (1.50 - 11.78 cm), fruit width (0.59 – 2.75 cm), number of fruits per plant (8.40 – 107.50), ten fruit weight (4.0 – 175 g), plant height (34.50 – 93.50 cm) and fruit yield per plant (41.70 – 922.75 g). Eleven genotypes showed resistant reaction for leaf curl virus disease tolerance whereas five were found resistant for anthracnose disease. Fruits of 30 genotypes were found to be highly pungent on a scale of 1-4. For fruit colour, 17 genotypes exhibited dark green colour while three genotypes has light green fruit colour. Majority of the genotypes exhibited drooping fruit orientation with only 16 genotypes having erect fruit orientation. Principal component analysis revealed vast variability in data and total phenotypic variance was explained by first six PCs. (Fig. 12).

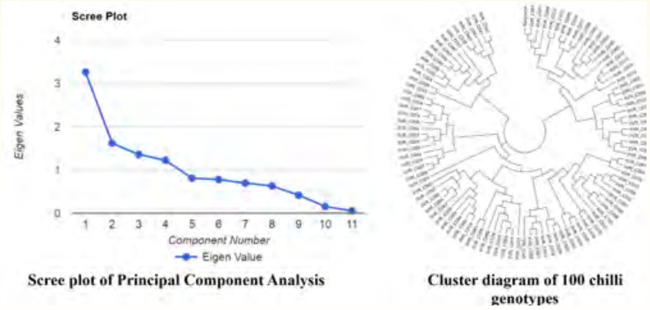


Fig. 12: PCA analysis and cluster diagram of chilli genotypes used for GBS

Screening for anthracnose resistance: A total of 485 chilli germplasm were screened for anthracnose resistance at red ripe stage on a 0 – 5 scale. Based on percent incidence, 4 lines were highly resistant, 152 lines resistant, 239 lines moderately resistant, 77 lines moderately susceptible, 8 lines susceptible and 5 lines were highly susceptible (Fig. 13).

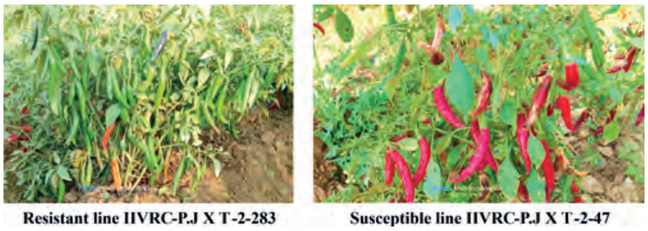


Fig. 13: Resistant and susceptible genotypes for anthracnose disease

Screening of RIL population against chilli thrips (*Scirtothrips dorsalis*): A total of 297 individual of RIL population (Kashi Annmol x Japani Longi) were screened for resistance against thrips (*Scirtothrips dorsalis*). Lines *viz.* KA X JL RIL No. 145, 161, 305, 309 etc. were found resistant.

Screening against black thrips (*Thrips parvispinus*) in flower: A total of 50 chilli genotypes were screened for presence of black thrips in flower. IIVRC-18057, IIVRC-19136 were identified as promising lines against black thrips.

Reaction of varieties/advanced lines of chili against chilli mite: A total of 50 chilli genotypes screened against mites incidence. Kashi Garima, IIVRC-19010, Kashi Abha etc. were identified as promising lines against mite infestation.

Screening for heat tolerance: A total of 400 lines of chilli germplasm was screened for heat tolerance based on flowering and pollen fertility. Few lines were found tolerant based on above selection criterion. Pollen fertility in tolerant lines ranged from 50-80%.

AICRP (VC) trials: A total of ten trials of chilli/capsicum varieties and hybrids were allotted during 2022-23. All the trials were planted and data was recorded. Apart from this, total entries (3 in IET, one in AVT-I and 3 in AVT-II) of chilli are at different stages of testing in trials of AICRP (VC).

PROJECT 2: IMPROVEMENT OF CUCURBITACEOUS CROPS FOR STRESS TOLERANCE, YIELD AND QUALITY TRAITS (w.e.f. 01.04.2024)

Old project names: [1.7: Genetic Improvement of seed propagated gourds (Bitter gourd, Bottle gourd and Ash gourd; 1.8 Genetic Improvement of Luffa [Sponge gourd, Ridge gourd and Satputia; 1.9: Genetic Improvement of Pumpkins and Cucumber; and 1.10: Genetic Improvement of Melons; 1.15 Genetic Improvement of clonally propagated & perennial vegetables [Pointed gourd, spine gourd, ivy gourd, sweet gourd, basella, moringa etc.] (till 31.03.2023)

[A] Bitter gourd

Germplasm maintenance: A total of 160 accessions were characterized for different horticultural traits *viz.* fruit colour, fruit shape/size (small/medium/large), protubrenant /non-protuberent rind etc. and seeds were multiplied. Four accessions namely DVBTG-3 (2.55 kg/plant), DVBTG-4 (1.75 kg/plant), VRBTG-23 (1.72 kg/plant) and VRBTG-2-1 (2.75 kg/plant) were found promising for yield traits.

Evaluation of advance lines: Twelve advanced lines were evaluated during summer and *kharif* seasons. Maximum yield per plant was recorded in VRBTG-28 (2.25 kg) followed by DVBTG-3 (1.87 kg) and VRBTG-23 (1.61 kg). Maximum number of fruits was observed in VRBTG-28 (34.33 fruits/plant) followed by VRBTG-8 (30.67 fruits /plant) and VRBTG-21 (27.33 fruits/plant) (Fig 14).

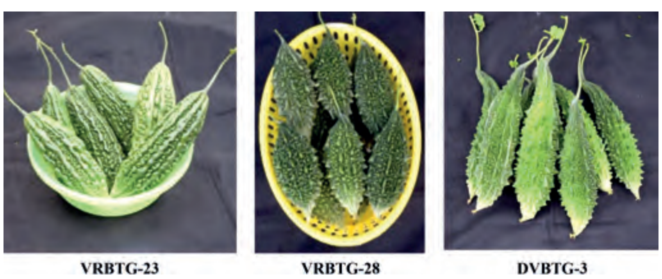


Fig.14: Promising genotypes of bitter gourd

Development and evaluation of gynoecious based hybrids: Gynoecious based hybrids were evaluated during rainy season. On the basis of overall performance Gy-323 x VRBTG-10, Gy-323 x DVBTG-3, Gy-323 x VRBTG-23, in long, Gy-323 x IC-44428, Gy-323 x VRBTG-47-1 in medium and Gy-323 x IC-212504 in small were selected (Fig. 15).

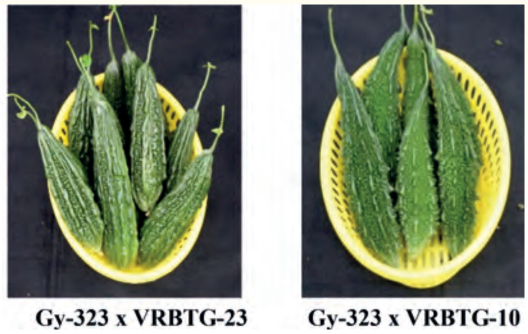


Fig. 15: Promising gynoecious based hybrids

Field screening of bitter gourd against powdery mildew: Total 160 germplasm were screened against powdery mildew under open field condition. Of which, 7 germplasm *viz.*, DVBTG-3, DVBTG-4, DVBTG-5, VRBTG-5-2, VRBTG-47 VBT-1 and VBT-3 showed partial resistance (< 20%).

Advancement of generation: Total 24 F_2, 12 F_3, 08 F_4 and 05 F_5 cross combinations were advanced in to next generation.

Seed enhancement: Released varieties and promising lines of IIVR viz. Kashi Mayuri, Kashi Pratishtha, VRBTG-47 and VRBTG-2-1, DVBTG-3 and VRBTG-23 were maintained and multiplied for multi-location demonstration.

Entries in AICRP (VC) trial for multi-location testing: Two OP varieties VRBTG-23, VRBTG-52 and one F1 hybrid VRBTGH-7 were included in IET of AICRP (VC) trial.

[B] Bottle gourd

Germplasm evaluation: A total of 96 genotypes were evaluated for various horticultural characteristics and seeds were multiplied. VRBG-102 having green colour, pear-shaped fruit, and medium maturity (60 days) was found suitable for cultivation in summer and rainy season.

Evaluation of advanced lines: Ten advanced lines were evaluated for different horticultural traits during summer and kharif seasons. Maximum yield per plant was recorded in VRBG-101 (8.67 kg) followed by VRBG-5 (8.25 kg) and VRBG-2019-4 (7.34 kg). Maximum number of fruits was observed in VRBG-59 (10.33 fruits/plant) followed by VRBG-5 (9.67 fruits /plant) and VRBG-18 (9.19 fruits/plant) (Fig 16).

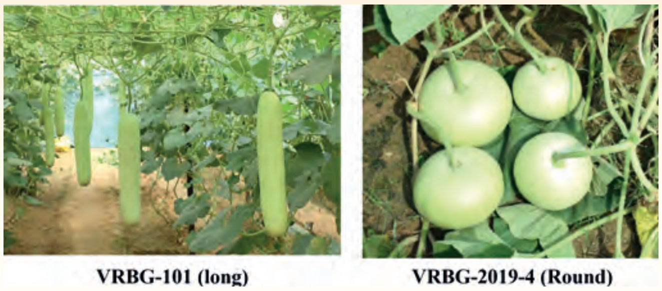


Fig. 16: Promising genotypes of bottle gourd

Development and evaluation of hybrids: A total of 20 F_1 hybrids were evaluated in rainy season 2023, for various horticultural traits. Maximum yield per plant was recorded VRBG-14 x VRBG-5 (11.33 kg/plant) in medium long, followed by VRBG-18 x VRBG-7 (10.15 kg/plant) pyriform shape, VRBG-5 x VRBG-1-1 (9.67 kg/plant) medium long, against the check variety Kashi Bahar (8.55 kg/plant) and NDBGH-4 (7.29 kg/plant).

Evaluation of winter fruited germplasm of bottle gourd: Forty four accession were evaluated for different horticultural traits during the winter season. Maximum yield per plant was recorded VRBG-47-3 (11.90 kg/plant) in round shape followed by VRBG-47 (9.39 kg/plant) in pyriform shape and VRBG-47-2 (8.82 kg/plant).

Field screening of bottle gourd against powdery mildew: Total 96 genotypes were screened for powdery mildew under natural condition. Fourteen VRBG-61, VRBG-47, VRBG-47-1, VRBG-47-3, VRBG-47-4, VRBG-47-6 VRBG- 9-1-1, VRBG-67, SBC/DRB-151, SBC/DRB-12, SBC/DRB-179, SBC/DRB-150, SBC/DRB-205 and SBC/DRB-125 were found partially resistant (<20%).

Advancement of generation: Total of 18 F_2, 10 F_3, 7 F_4 and 5 F_5 cross combinations were advanced to the next generation.

Seed enhancement: Seeds of Kashi Ganga, Kashi Kiran, Kashi Shubhra and parental lines of Kashi Bahar (hybrid), VRBG-101 and VRBG-7 were produced.

Entries for AICRP (VC/ multi-location testing: Two open pollinated varieties VRBG-101, VRBG-7 and two F_1 hybrids VRBGH-8 and VRBGH-9 were submitted for AICRP (VC) IET trial.

Identification of variety Kashi Shubhra (VRBG-14): Under AICRP (VC), bottle gourd variety Kashi Shubhra (VRBG-14) was identified in 2023 for commercial cultivation in Zone IV (U.P., Bihar, Punjab & Jharkhand). It is suitable for rainy and summer season. Fruits are cylindrical, green, attractive and medium long (28-30 cm) Gutka fruit which is suitable for packaging, transportation and export. It is tolerant to downy mildew, powdery mildew and gummy stem blight under field conditions. Yield potential is 60.36 t/ha (Fig. 17).

Fig. 17: Kashi Shubhra (VRBG-14)

[C] Muskmelon

Germplasm maintenance: A total of 190 genotypes of *Cucumis melo*, and 70 accessions of *C. melo* var *agrestris* and *C. callosus* were maintained. Besides, 30 accessions were procured from ICAR-IARI, New Delhi during the year.

Evaluation of promising breeding lines for morpho-horticultural traits: A set of 35 promising advance breeding lines were evaluated for horticultural and quality traits, of which, 15 lines were stable monoecious, and 20 were andro-monoecious type. breeding lines. VRMM-5, VRMM-13, VRMM-47 were identified as promising andromonoecious lines, while VRMM-170, VRMM-225, VRMM-305, VRMM-23-1 were promising monoecious lines (Fig. 18).

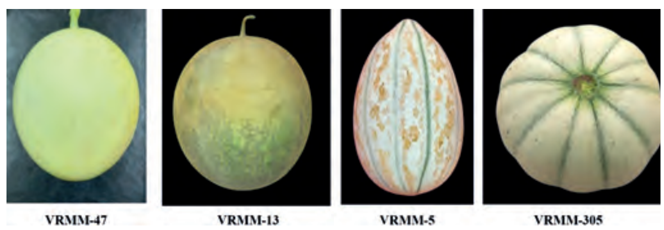


Fig. 18: Promising muskmelon genotypes

Validation of ToLCNDV and melon yellowing disease resistance in melon: Out of 85 germplasm, VRMM-170, VRMM-160, B-159, VRMM-161, VRMM-305, VRMM-130 were found ToLCNDV resistant (0-0.82), whereas VRMM-160, VRMM-161 & VRMM-171 showed resistance against melon yellowing disease (0-1.2).

Development of mapping population for fruit shape: A total of 200 F_2 plants of B-159 × Kashi Madhu grown for evaluation and advanced to F3 generation.

[D] Watermelon

Germplasm characterization and development: Total 62 accessions were characterized in summer and rainy seasons for different horticultural traits. Few new genetic stocks were developed *viz.* VRW-601 (elliptical, yellow skin and yellow flesh colour), VRW-602 (elliptical, dark green skin and red flesh colour), VRW-603 (round, striped with light green and pink flesh colour) and VRW-604 (round, striped with dark green and red flesh colour) (Fig. 19).

Fig. 19: Newly developed genetic stocks

Evaluation of advance lines for yield and quality attributes: Total 15 advanced lines were evaluated for different horticultural traits during summer and kharif seasons. Maximum yield per plant along with high TSS was observed in VRW-53-1 (9.33 kg/plant & 11.67 ^{0}Brix) followed by VRW-55 (8.52 kg/plant & 10.77 ^{0}Brix) and VRW-514 (8.33 kg/plant & 14.67 ^{0}Brix). Two promising advance lines, (VRW-55) and (VRW-53-1) and two hybrids (VRWH-2) and (VRWH-3) were submitted for multi-location testing in of AICRP (VC) trials (Fig. 20).

Fig. 20: Promising genotypes

Development and evaluation of hybrids: Out of total 8 hybrids evaluated during summer and rainy seasons, hybrid VRW-514-1 x VRW-10 was found promising for yield. This hybrid is striped with light green in colour, elliptical shape and has a yield potential of 52-56 t/ha.

Screening of watermelon germplasm for kharif season production: Out of 45 genotypes evaluated during kharif season, VRW-55 (10.69 kg/plant) and VRW-926-1 (8.33 kg/plant) were found promising for yield. These lines were suggested for both summer and kharif seasons.

[E] Cucumber

Germplasm maintenance and evaluation: A total of 162 germplasm were maintained as active germplasm. Total 58 germplasm were evaluated for flowering, yield and related traits. Among the new collected genotypes KKG/VKS/SKT-293, KKG/VKS/SKT-227, KKG/VKS /SKT-207, DC-36-1 and SBC/DRB-146 were found promising for yield and disease resistance.

Development of F_1 combination: A total of 10 F_1 cross combinations were developed utilizing 10 parents selected on the basis of variability and desirability.

Advancement of segregating generation: Selected individuals/crosses were advanced to subsequent generation i.e. 15 combinations in F_3, 12 in F_4, 10 in F_5, 8 in F_6 and 5 families in F_7 were advanced.

Evaluation of advance lines: A total of 9 advance lines along with check Kalyanpur Green were evaluated for yield and its contributing traits in green/mottle green segment. The best performing lines based on the fruit colour, appearance and yield were VRCU-13-01 (1564.27 g/plant) followed VRCU-23 (1519.24 g/plant). Fruits of these lines were non-bitter in taste.

Maintenance of parental lines: The parental lines of hybrid Kashi Nutan were maintained through selfing and sufficient number of seeds including Kashi Nutan was produced.

Maintenance of parthenocarpic lines: A parthenocarpic line VRCUP-20-2 was identified with good yield and maintained.

Initiation of breeding program in Gherkin: Gherkin hybrids namely Blessy, Artor, EQ speed, DON, Secure, Belle, U 447, Ajax, were obtained from the market, and the F_1s were grown for breeding.

Breeding for downy mildew resistance: Two resistant genotypes (IC-572024 and IC-527400) and two susceptible genotypes (Pusa Uday and Kalayanpur Green) were crossed to study the inheritance of resistance against the downy mildew disease.

[F] Pumpkin

Maintenance and evaluation of germplasm lines: A total of 48 germplasm were evaluated for flowering, yield and related traits and maintained through selfing.

Hybridization and advancement of segregating generation: A total of 45 F_1 combinations were developed. Selected 4 combinations in F_5 generations (butternut squash) were advanced.

Evaluation of advance lines: Twelve advance breeding lines were evaluated for important horticultural traits. Maximum number of fruits/plant was observed in VRPK-11-6-5 (5.25) followed by VRPK-10-10 (4.94) and VRPK-303 (4.76). On the basis of overall performance and phenotypic acceptability VRPK-11-6-5, were found promising and selected for multi-location testing.

Development of high carotene inbred lines: Two single crosses hybrids VRPK -19-03 x VRPK09-01 and VRPK -19-04 x VRPK-11-06-05sel-02-01 were developed earlier. Selection was performed for round and flat round shape of fruit in the BC_1F_2 and BC_1F_3.

Multiplication and maintenance of seeds of Kashi Harit and parental lines of Kashi Shishir: Half kg seeds of Kashi Harit variety of pumpkin were produced and SPS were selected for maintenance of the Kashi Harit and both the parents of Kashi Shishir were also maintained.

[G] Sponge gourd

Development and evaluation of F_1 genotypes: A total of 24 F_1 cross combinations were developed, of which top five hybrids were Kashi Jyoti × VRSG-1-21, VRSG 18-10 × VRSG - 3-21, VRSG 17-10 × VRSG-1-21, VRSG-17-10 × VRSG-3-21, VRSG 17-14 × VRSG-1-21, Kashi Vandana × VRSG-1-21 were found promising for various horticultural traits (Fig. 21).

Fig. 21: Sponge gourd hybrids

Generation advancement: Under the generation advancement program, one RILs population of Kashi Shreya x VRSG-7-17 (Aromatic line) advanced from F_6 to F_7 (250 plants).

Maintenance breeding: Four varieties i.e. Kashi Shreya, Kashi Jyoti, Kashi Kalyani and Kashi Vandana are being maintained by producing nucleus seed (1.25 kg each) and parental lines of two hybrids i.e. Kashi Rakshita and Kashi Saumya are being maintained by producing nucleus seed of each 500gm (F) and 300 (M)).

[H] Ridge gourd

Germplasm evaluation: Out of 62 germplasm, 11 lines (VRRG -6, VRRG-7-2, VRRG 13-17, VRRG -17-2016, VRRG – 29, VRRG -5A, VRRG -42-2016, VRRG -37-2016, VRRG -8-10, VRRG -26, VRRG -12-17) were found promising for horticultural traits and showed tolerance against sponge gourd mosaic and downy mildew disease symptoms under field conditions (Fig. 22).

Fig. 22: VRRG-7-2

Development and evaluation of F_1 genotypes: Out of 28 F_1, hybrids i.e. Kashi Shivani × VRRG 7-2, VRRG- 110 × VRRG -112, VRRG- 75-2016 × VRRG - 7-2, VRRG- 75-2016 × VRRG -112, Kashi Nanda × VRRG -112, Kashi Shivani × VRRG -6A, Kashi Shivani × VRRG -112, VRRG-75-2016 × VRRG -6A, VRRG- 7-2016 × VRRG - 5A and VRRG- 110 × VRRG- 6A were found promising for various horticultural traits and showed tolerance against sponge gourd mosaic and downy mildew disease under field conditions (Fig. 23).

Fig. 23: VRRG-110 x VRRG-112

Entries contributed for AICRP (VC) trials: A total of 5 OP improved genotypes of sponge gourd i.e. VRSG-19-5 & VRSG-17-16 in IET, VRSG-19-3 in AVT –I and VRSG-18-10 & VRSG-17-17 in AVT-II and 4 F_1 hybrids namely, VRSGH-10 & VRSGH-11 in IET and VRSGH-8 & VRSGH-9 in AVT-II were conducted under multi-location testing of AICRP (VC) trials. Two OP improved genotypes of ridge gourd i.e. VRRG-1-2016 in AVT-II, and two F_1 hybrids namely, VRRGH-7 in AVT - I and VRRGH-6 in AVT-II were completed under multi-location testing of AICRP (VC) trials.

Generation advancement of ridge gourd: Under the generation advancement program, 15 populations of ridge gourd were advanced from F_9 to F_{10}.

Maintenance breeding and nucleus seeds production: Two varieties i.e. Kashi Shivani (1.25 kg) and Kasha Nanda (0.5 kh) of ridge gourd were maintained and nucleus seeds were produced.

AICRP-VC trials conducted: A total of 8 trials were conducted.

[I] Satputia

Out of 36 germplasm of Satputia 10 i.e. VRS-28-1, VRS-25-1, VRS -17-10, VRS 1-17, VRS 24-2, VRS -3-17, VRS-25, VRS -11 and VRS 24-1 along with Kashi Khusi as check were found promising for horticultural traits and showed tolerance against downy mildew and virus disease under field conditions.

Generation advancement: Under the generation advancement program, 17 populations were advanced from F_5 to F_6.

Maintenance breeding and nucleus seeds production: One variety i.e. Kashi Khushi of satputia is being maintained by producing nucleus seed (1.0 kg).

PROJECT 3: IMPROVEMENT OF LEGUMINOUS VEGETABLE CROPS FOR STRESS TOLERANCE, YIELD AND QUALITY TRAITS (w.e.f 01.04.2023)

Old project names: [1.4: Genetic Improvement of Pea; 1.5: Genetic Improvement of Cowpea; 1.6: Genetic Improvement of Indian bean and French bean] (till 31.03.2023)

[A] Pea

Hybridization programme: 50 crosses utilizing the diverse parents were developed in vegetable pea targeting abiotic stress tolerant traits and quality parameters.

Screening of vegetable pea genotypes for *Fusarium* wilt incidence: Evaluation for *Fusarium* wilt incidence was done under natural field condition as well as in pot condition. Lines such as VRPE-24 (6 %) during the first sowing, VRPE-64 (6%) and VRPE-30 (7%) during the second sowing and VRPE-64 (6%) recorded minimum percent disease incidence as compared to control (25.6%). Artificial screening (pot culture) reported higher incidence varying from (16-32%). Minimum disease incidence in terms of plant mortality was recorded in genotypes VRPE-17 (11.6%), VRPE18 (11.4%), Kashi Ageti (19.5%) as compared to AP-3 (27%) and Arkel (32%).

Screening of vegetable pea breeding lines for rust resistance: A total of 316 genotypes were screened for rust resistance. Out of which, 9 genotypes viz., VRPMR-1100, VRPMR-1101, VRPMR -1103, VRPMR-1104, VRPMR-1105, VRPMR-1201, VRPMR-1202, VRPMR-1301, VRPMR-1302 were categorized as diseases score 1, while 38 other genotypes were categorized with diseases score rating of 3.

Evaluation of promising lines of vegetable pea for high temperature tolerance (30-32^{0}C): Previous year identified lines *viz*., VRPE-29, VRPE-30, VRPE-949,Kashi Purvi (VRPE-105), VRPE-964, VRPE-953, VRPE-955, VRPE-64 and VRPE-66 were revaluated for their yield performance under the high temperature stress condition (at vegetative and reproductive stress: 30-32^{0}C). Lines *viz*., VRPE-29 and VRPE-30 recorded high yield under high temperature stress (avg. day temperature range: 25-32^{0}C), with average pod yield of 40-45 while the genotypes AP-3 (82.33 g), Kashi Purvi (79.40 g) and VRPE-100 (78 g) were among the high yielding genotypes under normal season.

Hybridization for introgression of important genes: A total of 28 cross (including selected backcrosses) were made during the year 2023. These crosses were exclusively targeted for earliness and high temperature tolerant donar parents viz., VRPE-29, VRPE-30, VRPE-949, VRPE-36, VRP-5, VRP-6, Arkel, K. Purvi, Kashi Samrath and VRPE-64.

Sensory evaluation of pea genotype: Total 25 genotypes, comprising both released varieties and select breeding lines were evaluated for underwent organoleptic evaluation, encompassing appearance, aroma, flavor, texture, and overall quality based upon 9-point hedonic scale to access consumer appeal. The lines, including Kashi Ageti, VRPE-25-2, VRPE-16×VRP-22, VRPE-115, VRPE-6×25-2, VRPE-60, VRPE-949, VRPE-955, VRPE-100 and AP-3 received high scores for overall appearance (7 and above; highly favored). Specifically, Kashi Ageti and VRPE-25-2 were noted for their exceptional texture with softness and overall mouthfeel scoring 6.7 and 6.4, respectively. Kashi Ageti (7.7), VRPE-949 (6.6), and VRPE-6 × 25-2 (6.6) were highlighted for their flavorful characteristics. Moreover, VRPE-6 × 25-II, Arkel, AP-3, VRPE-949, and Kashi Ageti exhibited the highest aroma (Fig. 24). In summary, Kashi Ageti, VRPE-949, and VRPE-6× VRPE-25-2 demonstrated commendable sensory traits overall.

Fig. 24: Sensory evaluation of fresh peas pods at hedonic scale (0-9).

Stability and performance of VRPE-921 and VRPE-933 lines carrying *afila* genes in early background: The past hybridization experiments involved *afila* types and early flowering pea cultivars, resulted in development of two advanced breeding lines VRPE-921 and VRPE-933. SPS seeds of the both the genotypes were again sown in lines and selection were carried out for true to type plant. Horticultural characterization of these lines demonstrated a relatively short flowering period of 32–38 days, with a plant height ranging from 45.3-62.5 cm and yield potential of 60-65g/plant.

Maintenance of germplasm lines and released varieties in vegetable pea: A total of 378 germplasm lines were grown and maintained during the cropping season. The pea varieties viz. Kashi Uday, Kashi Nandini, Kashi Ageti, Kashi Mukti, Kashi Samrath, Kashi Shakti, and Kashi Samridhi were also maintained through single plant section approach. In addition a total of 32 pea varieties were also maintained during the season.

Twelve genotypes of vegetable pea were augmented during 2023 for characterization of different horticultural traits more specifically exportable traits. Augmented lines were characterized and promising lines were identified and seeds were maintained for future line of works to be carried out in next year.

Vegetable pea for export purposes: For that purpose, 12 genotypes were evaluated. The genotypes namely VP/23/7 and VP/23/12 were found fulfilling the standard of export in pea i.e. TSS, shelling percentage and pod weight.

[B] Cowpea:

Hydrizaton: 88 crosses were developed in cowpea utilizing bush and pole type diverse parents targeting the earliness, quality traits and abiotic stress tolerance.

Evaluation of cowpea varieties/lines for low temperature (6-10 ^{0}C) tolerance: Total 15 cowpea varieties/ lines were evaluated in different sowing dates (L1: 13.10.2023, L2: 13.11.2023, L3: 13.12.2023 and L4: 13.01.2024). These lines were Kashi Nidhi, Kashi Vishan, Kashi Hara, 262-B, 260-2-1-1-1-1-1-1-1-1, KK x Indira Lal-6-1-1-1, CP-6 x RCU-395-2-2-1-1-1, VRCP-16-7 X BC-244002-2-2-1-1-1, IC-3009 X K. Nidhi, 243-3-1-2-2-1-1, 176-3 x BC-2440022-1-1-1 (bush type) and VRCPP22/1, VRCPP22/2, VRCPP22/3 VRCPP22/4 (pole type). Days taken for 50% seed germination varied between (7-82 -12.64), days to first flower (73.62-79.71), days to first pod setting (78.11 – 82.53), tendril formation (70.56- 75.31 %), flowering (7.78-22.64 %), plant height (72.31-98.67 cm), 10 pod weight (54.98-97.96 g) and pod length varied between (4.53-8.04 cm) over different environments. None of varieties/ lines could perform well with respect to economic yield and other horticultural traits in above four environments (Fig. 25).

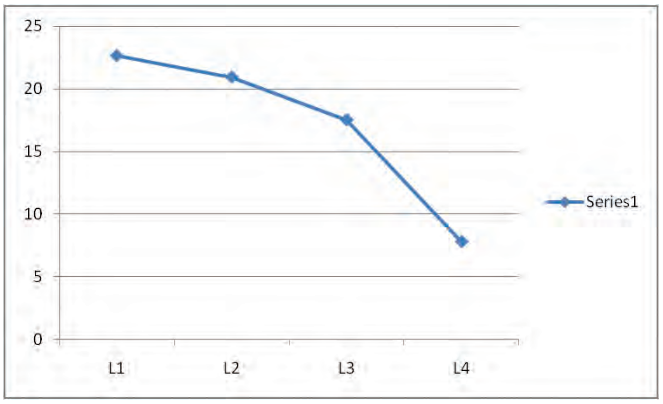


Fig. 25: Reduction in flowering and pod setting % over the different environment (s).

Evaluation of promising advance breeding lines of bush cowpea for yield and related horticultural traits: Three advance breeding lines derived namely INDIRALAL x Kashi Kanchan, INDIRALAL x Kashi Kanchan x Kashi Kanchan and VRCP144-5 x EC528398 x VRCP144-5 with check varieties Kashi Vishan, Kashi Nidhi, Kashi Kanchan, Kashi Unnati, Kashi Gauri and Kashi Shyamal were evaluated for green pod yield and related traits. Maximum number of pods per plant (37.0) and pod yield/plant (410.1 g) was recorded in INDIRALAL x Kashi Kanchan (Fig. 26).

Fig. 26: Field view of bush cowpea – IndiraLal x Kashi Kanchan

Screening of promising advance/ EC lines for CGMV in bush type cowpea: Five lines namely Indira Lal x Kashi Kanchan -1-2-1-1, 243-2-1-1-1-1-1-1-1-1-1, 260-2-1-1-1-1-1-1-1-1, 262 and 262B were evaluated and found less than 20 % infection of CGMV with good yield.

Fig. 27: Bush cowpea genotype 262 B tolerant to CGMV

Characterization of Yardlong bean germplasm for yield and related horticultural traits: Among all the studied yardlong bean genotypes, VRCPP22/1 (554.33 g), VRCPP22/2 (455.33 g) and VRCPP22/3 (461.0 g) have shown significant superiority for yield and related traits (Figs. 28 & 29).

Fig. 28: Yard long bean genotype VRCPP22/1

Fig. 29: Yard long bean genotype VRCPP22/2

[C] French bean

Hybdrization progmamme: 60 crosses in French bean (bush & pole type) were made.

Evaluation of bush type French bean for keeping quality (storability) harvested at edible green pods: Edible green fresh pods of eighteen genotypes of French bean were harvested and evaluated for keeping quality based on weight loss (%) and overall acceptability (1-9 scale: 1-Best, 9-Poor) at ambient room temperature. After 15 days, the weight loss in genotypes ranged from 34-97% with average of 56%. Among evaluated genotypes viz. 2 x 91-1-1-1-1-1, 91 x 2-1-2-5-1-1, 2 x 91-2-1-3-1-1 and Kashi Rajhans were found to be having good shelf life.

Fig. 30: Pod quality after 15 days of storage at ambient temperature, First row 1-6, 2nd row 7-12, third row 13-18.

Characterization of French bean-pole type lines for dual purpose and quality traits: The line VRFBP-3 x Swarn Lata was found to be promising for days to 50% flowering (56.33), 10 pod weight (84.20 g) and pod yield per plant (265.23 g). Line 314 x Scarlet bean found to be promising for number of pods per plant (35.17), plant height (250.33 cm) and number of cluster per plant (4.33). Identified promising lines would be utilized for further improvement programmes.

Characterization of dual purpose pole type French bean for different horticultural traits: Eleven such French bean genotypes were evaluated for horticultural traits. Genotype 02/23/pole was found to be promising for traits days to 50 % flowering (42.67), number of branches per plant (4.33), number of pod per plant (71.33), number of seed per pod (6.67) and pod yield per plant (466.08 g). Genotype VRFBP06 was found to be promising for plant height (110.33 cm). VRFBP018 and EC 972390 were found to be promising for pod length (17.0 cm) and maximum 10 pod weight was recorded in the genotype VRFBP015 (79.0 g). These identified promising genotypes would be utilized in improvement programme for dual purpose pole type French bean.

Fig. 31: Field & pod view of dual purpose pole type French bean genotype 02/23/pole.

Evaluation of dual purpose French bean lines for quality parameters: Ten diverse genotypes of dual purpose French bean were analyzed for parameters which ranged as: moisture content (85.03-89.68 g/100 wbs), ash content (0.57-1.36 dbs), fiber content (9.68 -17.16 dbs), crude protein (18.77-28.57 dbs), crude fat (2.7-3.0 dbs) and carbohydrates (66.43 – 78.71 dbs) g/100 g edible portion of dual purpose French bean. Genotypes namely FB04/23 and FB 08/23 were found to be promising for fiber content (17.16 g/100g) and crude protein content (34.54 g/100g) (Fig. 32).

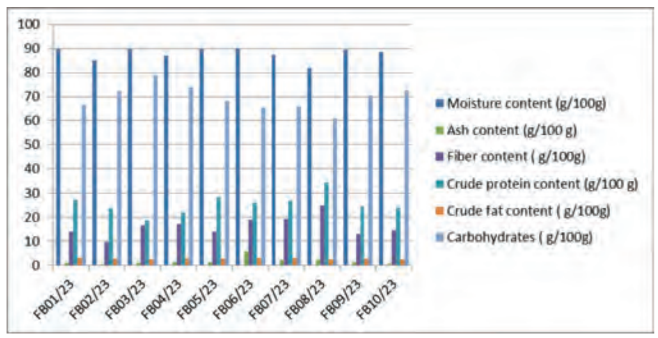


Fig. 32: Range of quality parameters in dual purpose French bean lines.

Screening of varieties/lines against white mould (*Sclerotinia sclerotiorum*) of bush type French bean: Periodical screening of three cultivars and six advance breeding lines namely Kashi Sampann, Kashi Rajhans, Kashi Agrim, F_8 (2 x 91-2-1-3-1-1; 2 x 91-1-1-5-1-1; and 91-1-1-5-1-1), F_7 (95 x Swarna Priya; Geoli Contender -2-1-1), and F_5 (Contegenta X Contender 1-2-1) of French bean indicated that the lines namely Kashi Agrim (5.42% PDI) and three advance breeding lines namely F_8 (2 x 91-2-1-3-1-1; and 2 x 91-1-1-5-1-1), F7 (95 x Swarna Priya) showed minimum disease incidence 9.67, 6.57 and 7.12%, respectively with tolerant reaction and sparse plant canopy character. Lines F5 (Contegenta X Contender 1-2-1), Kashi Sampann and Kashi Rajhans showed resistant reaction (10-20% PDI). However, F7 (Geoli Contender -2-1-1) showed moderately resistant and F8 (2X91-1-1-5-1-1) showed moderately susceptible having highest PDI (30.20) after 75 days of sowing of French bean.

Screening of cowpea genotypes against major insect pests of cowpea: Twenty seven genotypes of cowpea were screened against its major insect pests *viz*. cowpea pod borer (*Maruca vitrata*), flea beetle (*Phyllotreta striolata*) and cowpea leaf blotcher (*Acrocercops* sp.) under open field conditions during rabi season. Genotypes VRCP 224-1-1-2 (17.5% pod damage), VRCP-233-3-1-1 (22.5% pod damage) had lowest pod damage by *M. vitrata*. In contrast, the genotypes VRCP-224-2-1-1, VRCP-215-2-1-2 had more than 60% fruit damage by *M. vitrata* under open field condition. Serious incidence of flea beetles on green leaves were also recorded and lowest flea beetle damage was noted in the genotype 243-3-1-2-1 (30% leaf damage). The genotype VRCP-221-2-2-1, VRCP-215-2-1-2, VRCP-237-1-2-1, VRCP-182-4, VRCP-218-1-1-2, VRCP-228-5-2-3 and VRCP-223-2-1-2 had less than 10% incidence of leaf blotcher.

PROJECT 4: IMPROVEMENT OF OKRA FOR STRESS TOLERANCE, YIELD AND QUALITY TRAITS (w.e.f 01.04.2023)

Old project name: [1.11: Genetic Improvement of Okra] (till 31.03.2023)

Germplasm maintenance: A total of 795 genotypes of cultivated okra were maintained.

Development and evaluation of F_1 hybrids: A total of 105 F_1 hybrids in green fruited segment were evaluated during kharif season for yield and other traits. Some promising hybrid were VRO-236 × VRO-216, VRO-236 × VRO-200, VRO-236 × VRO-219, VRO-200 × VRO-236, and VRO-236 × VRO-201. In red fruited segment, out of 24 hybrids, some promising hybrids were VROR-165×VROR-166 (520 g/plant), VROR-160×VROR-236 (505 g/plant) and VROR-160×VROR-167 (490 g/plant). Moreover, these hybrids expressed high degree of tolerance to YVMV (PDI: 0%) and ELCV (PDI : <1%).

Heterotic effect for anthocyanin content in red okra: Heterotic effect of anthocyanin content was in 24 red fruited hybrids and their parents, which ranged from 3.45-4.18 mg/ 100g with a mean value of 3.80 gm/100g. Maximum heterosis was observed in VROR-160×VROR-167 (19%) followed by VROR-165×VROR-166 (14.70%).

Evaluation of advance lines in green fruited and red fruited segment: A total of 80 advance lines were evaluated during kharif season. Some promising lines such as VRO-236, VRO-213, VRO-216 VRO-235, VRO-220, VRO-218 and VRO-229 were identified for fruit yield (165-185 q/ha), fruit quality and disease resistance. While promising red fruited lines were VROR-166 (390 g/plant, YVMV & OELCV PDI: 0.00 %), VROR-165 (375g/plant; YVMV & OELCV PDI: 0 %), VROR-160 (360g/plant; YVMV & OELCV PDI: 0 %) and VRO-167 (360g/plant; YVMV & OELCV PDI: 0 %).

Development of breeding lines with dwarf ideotype and easy to harvest: A total of 40 genotypes were evaluated for dwarfness, easy to harvest and other traits. Promising dwarf (plant height: 45-50 cm) genotypes were VRO-416-10-1, VRO-416-10-2, VRO-427-10-1, and No. 315. The previously identified genotypes such as VRO-145, VRO-146, VRO-147, VRO-112-1, VRO-200, VRO-201, VRO-202, VRO-203, VRO-204, VRO-205, VRO-208, VRO-209, VRO-210, VRO-219 and VRO-236 were utilized as parent in breeding for easy to harvest fruits.

Development of breeding lines for export purpose: Total 50 genotypes were evaluated for suitability to export purpose based on the fruit length (< 10 cm) and free from seed bulging, with proper seed feeling, devoid of spines but with pubescence with green to dark green. Promising advance lines such as VRO-112, VRO-109-112-2, VRO-109-112-23, and VRO-109-112-4 were identified fulfilling the export standards.

Evaluation of GMS based F_1 hybrids: BC_5F_1 generation in the background of VRO-178, VRO-109, VRO-120, VRO-125 and No.315 were evaluated during summer season and also subsequent generations. Besides stable GMS line VRO (GMS)-178, hybrid VRO(GMS)-178×VRO-236, VRO(GMS)-178×VRO-200 and VRO(GMS) -178×VRO-219 were identified as promising GMS based F_1 hybrids.

Identification of okra breeding lines for organic ecosystem: Total 14 okra genotypes were evaluated for organic system. Maximum yield potential was reported in VRO-219 (131q/ha) followed by VRO-220 (127.50q/ha), VRO-200 (123q/ha) and VRO-236 (119q/ha). The genotypes VRO-236, VRO-200, VRO-216, VRO-219 and VRO-220 recorded least infestation of fruit borer, while all the 200-series lines also exhibited very high degree of YVMV and OELCV tolerance.

Evaluation of okra genotypes for growing under low temperature: A set of 15 genotypes of okra were evaluated under 4 sowing dates (15th July, 16th August, 1st September and 4th October). The genotypes with vigorous plant type under normal growing temperature such as VRO-210, VRO-236, VRO-216 and VRO-235 performed very well under suboptimal temperature as compared to VRO-219, VRO-220, VRO-221 and Kashi Chaman. Under low temperature poor plant vigour, stunted growth, poor growth, low biomass accumulation, non-dehiscent pollen, low pollen variability, poor and parthenocarpic fruit set and distorted abnormal fruit growth reported in okra.

Study of plant defence related enzymes in YVMV & OELCV resistant/susceptible genotypes: An experiment was conducted for estimation of peroxidase, polyphenol oxidase and PAL in a set of 10 resistant and 10 susceptible okra genotypes. Peroxidase, polyphenol oxidase and PAL content in the resistant sample varied from 3.2-5.6 μM H_2O_2 reduced g^{-1} FW min-[1], 4.2-6.1 absorbance min^{-1} g^{-1} FW and 2.0-3.5 μmol t-CA min^{-1} mg^{-1} Protein, respectively. Maximum value for peroxidase (5.6 μM H_2O_2 reduced g^{-1} FW min-[1]), polyphenol oxidase (6.1 absorbance min^{-1} g^{-1} FW) and PAL (3.5 μmol t-CA min^{-1} mg^{-1} Protein) observed in VRO-216, VRO-200 and VRO-200, respectively and these genotypes showed very degree of YVMV and OELCV resistant.

Artificial screening for YVMV and OELCV resistance in wild relative of okra through grafting: Three wild relative of okra *viz. Abelmoschus manihot* (VRmanihot-1), *A. angulosus* (RCM/PK/65) and *A. nova* (RCM/PK/63) which showed high degree of YVMV and OELCV resistance under field condition for multiple years and also through begomo virus-specific primer artificially. Successful grafting union was observed in all the grafted plant; no disease symptoms observed in the grafted *Abelmoschus manihot* (VRmanihot-1), *A. angulosus* (RCM/PK/65) (Fig. 33) and *A. nova* (RCM/PK/63) (Fig. 34), while in grafted susceptible check disease symptoms observed 20 days of grafting.

Fig. 33: RCM/PK/65

Fig. 34: RCM/PK/63

Evaluation of *A. moschatus* × *A. moschatus* subsp. *tuberosus* derived pre-breed population for viral disease resistance and ornamental value: A total of 75 *A. moschatus* × *A. moschatus* subsp. *tuberosus* derived pre-bred population evaluated for YVMV and OELCV resistance and ornamental value and data were recorded for various morphological traits including flower colour and their reaction to YVMV and OELCV infection. There was ample variation for various morphological traits including growth habit, leaf morphology, flower & fruit morphology. The flower colour of these plants ranged from, scarlet red, pink, peach colour, orange, yellow and light yellow and also having ornamental significance (Fig. 35).

Fig. 35: Phenotypic variation in *A. moschatus* × *A. moschatus* subsp. *tuberosus* derived pre-breed population

Screening of Okra Genotypes for resistance against shoot and fruit borer*Earias vitelli*: The field screening results showed that none of the screened genotypes showed resistance to *E. vitella*. The genotypes VRO-236, VRO-235, VRO-213 found to be less affected by *E. vitelli* with 5-10 infestation, while other lines were found susceptible.

PROJECT 5: IMPROVEMENT OF CAULIFLOWER & CARROT FOR STRESS TOLERANCE AND QUALITY TRAITS (w.e.f 01.04.2023)

Old project name: [1.12 Genetic Improvement of Cole crops and Root crops] (till 31.03.2023)

[A] Cauliflower

CMS lines and hybrids in tropical cauliflower: Realizing the importance of male sterility in harnessing heterotic vigour and economize hybrid seed production; 25 CMS-based backcross population of various stages were advanced/maintained. Five CMS lines of various curding temperature (20-30 ˚C) were found to be stable i.e. VRCF-41 for 28-30 ˚C, VRCF-131 & VRCF-132 for 24-28 ˚C, VRCF-110 for 22-25 ˚C, and VRCF-212 for 20-23 ˚C. Moreover, a total of 40 CMS-based cross combinations were made for further evaluation.

Validation of mtDNA marker for Ogura CMS lines in cauliflower: In order to distinguish the fertile/sterile lines of cauliflower at seedling stages and also validate CMS source of lines, 19 mitochondria specific DNA markers (P1 to P19) were screened in 16 genotypes including CMS lines, maintainer lines and commercial hybrids. Markers were specific to orf138 and its related genomic sequence, orf222, orf224, atp6-orf224, orf263 and mitochondrial simple sequence repeat markers. P1 dominant marker with ~450bp amplicon size showed distinct polymorphism between male sterile (presence) and fertile (absence) lines. The primer is specific to orf138 determines Ogura CMS (Fig. 36).

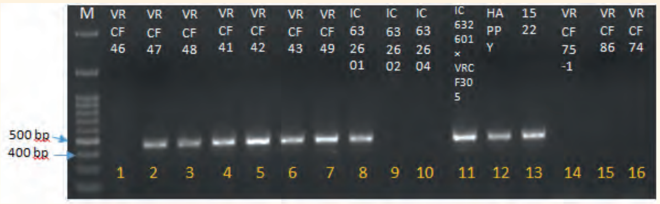


Fig. 36: PCR amplification of polymorphic P1 marker showing amplification in CMS lines(lane 1-8), CMS F1 hybrids (lane 11-13) and absence of amplicon in fertile maintainer lines (lane 9 -10, 14-16).

Evaluation of high temperature tolerant summer cauliflower: Unlike to normal early, mid and late maturing cauliflower; high temperature tolerant summer cauliflower is a new segment in cauliflower. The selfed-seed of high temperature tolerant micro-propagated lines were evaluated during peak summer (Tmax 38-45 °C, Tmin 25-32 °C). Three promising genotypes i.e. VRCF-305, VRCF-318, VRCF-11 and VRCF-25 develops curd during peak summer (mid-May to mid-June 2023) with marketable curd weight of 415.2 g, 435.5 g, 438.6 and 451.2 g; curding frequency of 94%, 92%, 86% and 83%; and maturity period of 55-68 days, 58-69, 63-80 days and 66-85 days after transplanting, respectively.

Evaluation of genotypes/hybrids of tropical cauliflower: Total 54 OP lines and 40 cross-combinations were evaluated at different maturity groups and temperature 20-30 °C for suitability, yield and quality traits (Fig. 37). The following OP genotypes were found to be promising namely VRCF-305, VRCF-309, VRCF-313 & VRCF-35 during 2nd fortnight of October (28-30 °C); VRCF-11, VRCF-111, Kashi Gobhi-25, & VRCF-118 during 1st fortnight of November (24-28 °C); and VRCF-77 & VRCF-192 during 1st fortnight of December (20-23 °C). In the heat tolerant early segment (24-30 °C), the best seven hybrid combinations were VRCF-131×VRCF-305, VRCF-41×VRCF-75-1 & VRCF-131×VRCF-35 during 2nd fortnight of October (28-30 °C); VRCF-110×KG-25 & VRCF-131×VRCF-86 during 1st fortnight of November (24-28 °C); VRCF-132×VRCF-111 during 2nd fortnight of November (22-26 °C) and VRCF-212×VRCF-77 during 1st fortnight of December (20-24 °C). An OP genotype (VRCF-118) and 2 F_1 combinations (VRCFH-53 & VRCFH-4) were sent for multi-location testing for early- and mid-season maturity under varietal/hybrid trials of AICRP-VC.

Fig. 37: Curd bursting in high temperature tolerant line VRCF-305

The maintenance breeding of a notified variety Kashi Gobhi-25, and 5 CMS lines & their maintainers are being done by producing nucleus seed (25-800 g of each). A sum of 95 genotypes (accesions, germplasm, advance lines, variety, etc), including 80 of cauliflower, 8 of cabbage, 5 of broccoli and 2 of kale are being conserved & maintained; and 14 germplasm of early cauliflower shared to BBAU, Lucknow.

Bio-fortification in tropical cauliflower: The population of β-carotene rich lines curding at 22-25 °C temperature have been grouped in four categories depending upon the intensity of curd colour; and the segregating population (orange × white curd) & CMS-based backcross lines have been advanced to next generation. Moreover, to develop glucosinolates rich green coloured genotypes of mid-maturing group, the segregating populations of green × white curd were selected for desired traits and sib-mated for advanced of population.

Evaluation of trap crops for diamondback moth (*Plutella xylostella*): An experiment was conducted to find out the potential trap crops for the diamondback moth. When *P. xylostella* was offered multiple hosts at the same time, numbers of eggs laid on Chinese cabbage and Indian mustard were 12 and 4 times greater than cabbage. The percentage larval survival from egg to pupation was 23.4 % on Indian mustard, 17.6 % on cabbage, and 24.6 % on Chinese cabbage; whereas survival was lower on broccoli (12.6 %) and radish (15.2 %). Based on our findings, it seems that Chinese cabbage may be the best candidate for use as a trap crop for *P. xylostella*.

[B] Carrot

CMS lines and hybrids of tropical carrot: Total 23 backcross population of petaloid-CMS were advanced to various stages in different background of economically important traits such as root colour (red, black, yellow, rainbow, orange, cream & white) and root shape (tapering & blunt end). The following seven CMS lines i.e. VRCAR-211, VRCAR-212, VRCAR-213 & VRCAR-214 of red carrot; VRCAR-252 of black carrot; VRCAR-272 of yellow carrot; and VRCAR-291 of rainbow carrot were stable and uniform to their respective maintainer. Furthermore, 42 cross combinations were made utilizing six testers to evaluate hybrid performance (Fig. 38).

Fig. 38: Umbel of CMS line and its Maintainer (Yellow carrot)

Population improvement for beta-carotene and quality traits in tropical carrot: To develop beta-carotene rich line of tropical carrot, twelve population of a cross (orange × red) with 70-95% flowering were evaluated in 6th selection cycle and advanced to next generation with objective to tropicalize temperate specific traits (orange colour, blunt root, smooth surface & scar-free roots). Further, the seven population relating to the crosses of smooth/blunt orange root and tapered red/black root have been evaluated for red & black coloured smooth/less-tapered root in 3rd selection cycle and the population has been advanced.

Bio-fortification in tropical carrot: The eye-catching coloured carrots have four type of pigments i.e. lycopene in red carrot, beta-carotene in orange carrot, xanthophylls/lutein in yellow carrot and anthocyanins in black/purple carrot. Moreover, rainbow carrot is a category of carrot selectively bred for multiple pigments in single root. By and large, the biofortified rainbow carrot hued with purple pigmentation on root exterior (periderm), and orange, red, purple and yellow pigmentation in the tissues of root interior i.e. cortex and core (phloem, cambium and xylem) which is good source of all four organic pigments in balance amount. The crosses between carotenoid & purple carrots were made to broaden the genetic base of rainbow carrot.

Evaluation of OP genotypes and hybrids of tropical carrot: A total of 81 genotypes of red, black, yellow, orange, cream, white and rainbow carrots, including 39 OP genotypes and 42 cross combinations have been evaluated for yield and quality traits. The following eye-catching tropical carrots were found to be promising for root yield & quality namely VRCAR-86, VRCAR-201 & Kashi Arun for red root (290-325 q/ha); VRCAR-125 & Kashi Krishna for black root (225-250 q/ha); VRCAR-132, VRCAR-135, VRCAR-139 & VRCAR-44 for orange root (180-210 q/ha); VRCAR-153 & VRCAR-203 for yellow root (250-270 q/ha); VRCAR-107-1, VRCAR-171-1 & VRCAR-107-2 for rainbow-type root (265-300 q/ha); and VRCAR-161 for white root. Moreover, to explore the hybrid vigour potential and economize hybrid seed production, 42 CMS-based hybrid combinations were also evaluated for traits of economic interest; and following eight hybrids were found to be promising for yield/quality traits such as VRCAR-214×VRCAR-85, VRCAR-212×VRCAR-201, VRCAR-214×VRCAR-201 & VRCAR-211×Kashi Arun (red root, 10.6-18.1% heterosis); VRCAR-252×VRCAR-125 & VRCAR-252×VRCAR-89-1 (black root, 8.5-13.5% heterosis); VRCAR-241×VRCAR-132 & VRCAR-241×VRCAR-135 (orange root, 14.1-17.3% heterosis); and VRCAR-291×VRCAR-125 (rainbow, 20.8% heterosis).

Maintenance breeding: Maintenance breeding is being carried out to conserve genetic purity of two varieties (Kashi Krishna & Kashi Arun), and seven CMS lines/maintainers by producing nucleus seed (50-3000 g of each) in flexible nylon-net cages. The most promising four CMS-based hybrid combinations (VRCARH-1, VRCARH-2, VRCARH-3 & VRCARH-4) and an OP genotype VRCAR-85 are in multi-location testing under hybrid/varietal trials of AICRP-VC for tropical carrot. A total of 87 genotypes (varieties, promising lines, accessions and germplasm) of seven different coloured carrots (red, black, yellow, orange, rainbow, cream & white) are being conserved.

PROJECT 6: BIOTECHNOLOGICAL INTERVENTIONS FOR MANAGEMENT OF STRESSES, YIELD AND QUALITY IN VEGETABLE CROPS (w.e.f 01.04.2023)

Old project name: [1.13 Biotechnological interventions including transgenics for managing stresses in vegetables] (till 31.03.2023)

In-vitro regeneration of Kashi Amrit tomato: Seeds of Kashi Amrit (DVRT-1) sterilized with 70% ethanol for 1 min followed by two times washing with sterile water, then treated with 0.5% bavistin and 0.1% tween 20 for 15 min followed by washing four times with sterile water and treatment with 4% (v/v) sodium hypochlorite (NaOCl) solution for 10 minute and washing five times with sterile water. The seeds were inoculated on MS half strength media and incubated in dark for two days. The cotyledon explants from seven days old seedlings were cultured on MS medium supplemented with modified vitamins and different concentration of plant growth regulators. Zeatin 1.0 mg/l and BAP 2.0 mg/l were found best among all the tested PGR and media combinations. 1.0 mg/l zeatin gave seven shoots per explants while 2.0 mg/BAP gave five shoots per explants. The highest regeneration frequency reported for 1.0 mg/l zeatin which was 68%. MS medium supplemented with 2.0 mg/BAP displayed 61% regeneration and also displayed poor plant growth. The 2-3 cm long regenerated shoots were transferred to the rooting medium (PGR free MS), after four weeks of growth and development, well rooted and shooted plantlets were removed from the media and the roots were thoroughly washed with sterile water and treated with 0.5% bavistin solution for 15 min. After bavistin treatment the plantlets were transplanted in plastic cups containing a mixture of sterile coco pit and Boro kit in 1:1 ration. After two week of acclimatization the plants were transferred to pots containing soil for further growth and transfer to open field (Fig. 39).

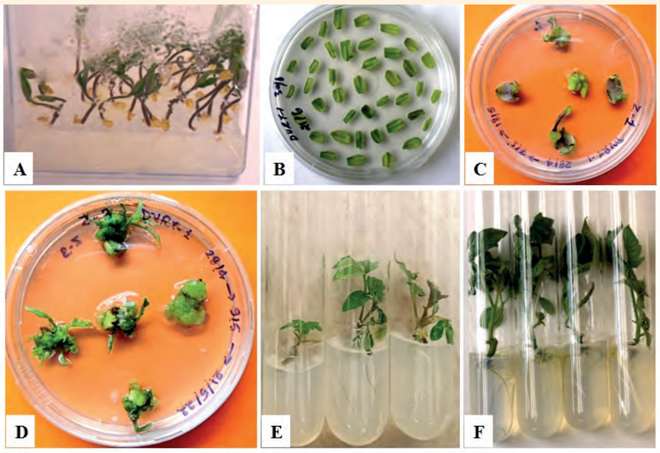


Fig. 39: In-vitro regeneration of Kashi Amrit (DVRT-1); A, aseptic seedlings raised; B, cotyledons explants cultured on media; C-E different stages of regeneration; F, well shooted and rooted regenerated plantlets

RNAi mediated Okra Yellow Vein Mosaic Virus (OYVMV) resistance in Okra: To develop Okra Yellow Vein Mosaic Virus (OYVMV) resistance in Kashi Kranti (VRO-22) okra variety using RNAi technology, seeds were surface sterilized following standard explant protocols. The sterilized seeds were cultured for one day in MS1/2 strength liquid medium for overnight followed by seed coat removal and co-cultured with *Agrobacterium* harboring RNAi construct in dark for two days at 26 ± 2°C. After two days the embryos were washed with sterile washing media (MS ¼ strength liquid media containing 500 mg/l cefotaxime). The embryos were dried with the help of sterile tissue paper and cultured on selection medium (MS media supplemented with 2mg/l BAP and 50 mg/l kanamycin) for shoot regeneration. A total of 1150 embryos were excised and transformed, 83% of embryos responded. With the transformation efficiency of 5%, a total of 48 plantlets were selected for tertiary selection medium. A total of sixteen plantlets are ready for the molecular characterization (Fig. 40).

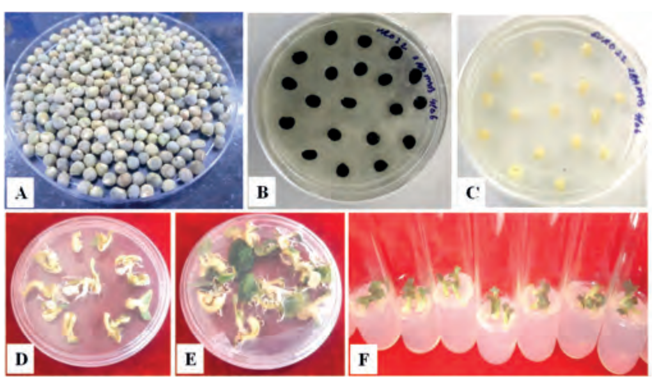


Fig. 40: Development of virus resistance in okra through RNAi: A; seeds of Kashi Kranti (VRO-22), B, embryo excision from sterilized seeds and co-cultivation, C; co-cultivation of embryos; D-E, selection of transformed embryo on primary and secondary selection medium and E plantlets on rooting medium

Genetic stability analysis of in-vitro regenerated heat tolerant cauliflower (VRCR75-1): To confirm genetic stability, randomly chosen regenerated plants and the mother plant were subjected to ISSR analysis under optimized PCR conditions. Each primer yielded a unique set of amplified products. Among the 13 ISSR primers used, 10 produced distinct bands ranging from 350 to 2000 base pairs. The number of bands varied, with 1 band observed in UBC-842 and UBC-843, 2 bands in UBC-835 and UBC-854, 3 bands in UBC-812, UBC-836, UBC-844, and UBC-850, 4 bands in UBC-853, and 5 bands in UBC-815. No ISSR polymorphism was detected between the regenerated plants and the mother plant. The gel profile displayed clear, reproducible amplification products for analysis. The absence of polymorphism indicates genetic stability among the regenerated plants and the mother plant (Fig. 41).

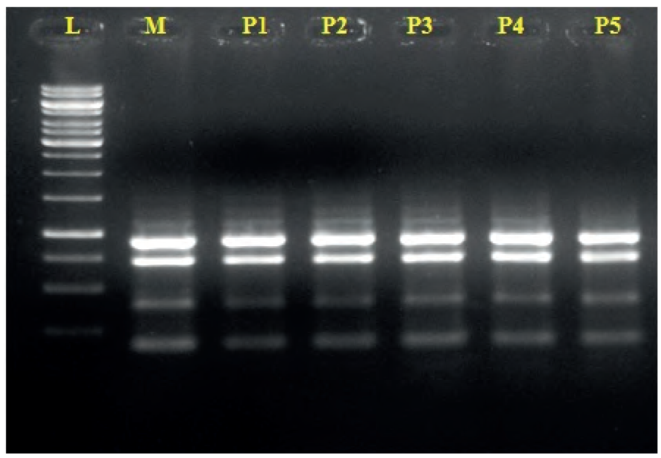


Fig. 41: Genetic stability analysis of regenerated plantlets; ISSR amplification pattern obtained with primer UBC-853. Lane L represents molecular marker (Gene RularTM 1kb Plus DNA Ladder), Lane M DNA from mother plant, and Lane P1–P5 DNA from regenerated plants

Characterization of RPN10 gene in brinjal: cDNA of RPN10 gene in different genotypes of brinjal was amplified and it produced the amplicon of 1.1 kb size. The amplified gene from Kashi Uttam cultivar which is resistant to little leaf of brinjal was sequenced for further analysis. Evolutionary relationship of the RPN10 gene showed that the gene is present in large number of plant species and almost all of them are the hosts for phytoplasma which confirms the association of RPN10 gene with phytoplasma and it is conserved in plant species during the evolution (Fig. 42). For structural studies a very high quality 3-D protein structure was generated and compared with that of Arabidopsis. Presence of vWA and UIM domains and also the similar

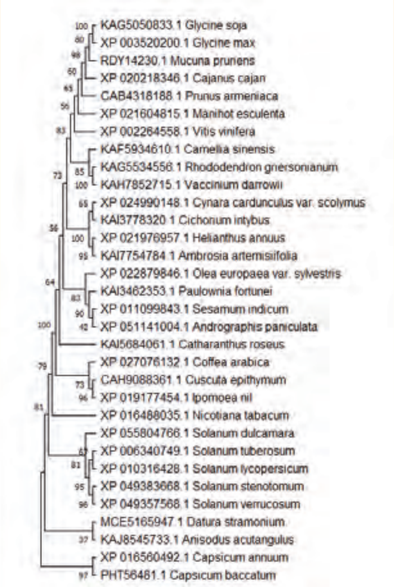


Fig. 42: Phylogenetic tree showing evolutionary relationship of RPN10 protein in different plant species

3-D structure supports that the RPN10 protein in brinjal is the homolog of *Arabidopsis* RPN10, which could act as host susceptibility factor by interacting with the SAP05 effector of phytoplasma (Fig. 43). The RPN10 gene of brinjal is thus the potential candidate for targeting by CRISPR/Cas9 tool to develop LLB resistance brinjal varieties.

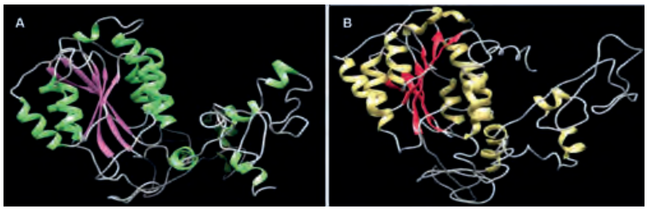


Fig. 43: Structure of RPN10 protein generated by I-TASSER server. A-Arabidopsis, B-Brinjal

Evaluation of trap function of guard cotton in glasshouse conditions using insect-proof mesh: The experiment was conducted in the transgenic net house with three treatments (T1: tomato crop with transgenic cotton as border; T2: tomato crop with non-transgenic cotton (Coker 310) as borders, and T3: sole tomato crop without cotton). Ten pairs of non-viruliferous whitefly per cotton plants were released in each sealed cage and population of whitefly as well as performance of tomato crop was monitored at regular intervals (Fig. 44).

Fig. 44: Experimental setup with insect proof nylon cages. (b): T1 : Tomato crop with transgenic cotton as border

In general, nymph and adult population was equally distributed on upper, middle and lower leaves of cotton. However, in case of cotton, nymph population was higher in lower leaves in T2 treatment than upper and middle leaves. Both adult and nymph population on cotton plants was significantly higher in T2 than T1. In case of tomato, in T3 treatment, the adult and nymph population was significantly lower than T1 and T2 (Fig 45). Number of cotton balls was numerically higher in T1 treatment in comparison to T2 treatment, however difference was statistically non-significant. All the plants in T2 treatment started showing wilting symptom gradually 15 after flowering, and no fruit set in tomato plants was observed in both the replications. Tomato yield was significantly high in T3 than T1. T3 treatment was also superior for yield parameters like fruit length, fruit width and number of fruits per plant. Overall, T3 treatment was best out of the three treatments evaluated.

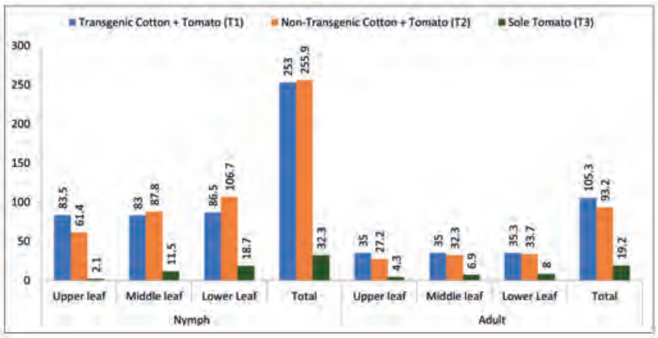


Fig. 45: Nymph and adult whitefly population in tomato

Fruit and shoot borer resistant transgenic brinjal–Cry1Aa3 gene: The generation advancement of homozygous (T10 to T11) plants of three cry1Aa3 transgenic brinjal (cv. Kashi Taru) events (A2, A3, and A7) were performed by growing in a glass house. The generation advancement of Bt-brinjal lines like Pant Rituraj, Uttara, Punjab Barsati, VR-14, IVBL-9, VR-5, EV-1, and EV-4, displaying advanced generation traits including high protein expression and similarity to the recurrent parent, were carefully selected. Subsequent selfing was done in the current season, followed by seed multiplication in a insect proof net house. After 20 days of germination, six consecutive applications of kanamycin sprays (200 mg/l) were administered to detect any potential escape of transgenic traits or low expression of the transgene. Positively, all seedlings survived the kanamycin sprays, demonstrating optimal expression of the transgene. Positive plants from each line were then transplanted into net houses for further evaluation.

Fruit borer resistant transgenic tomato – Cry1Ac gene: Eight transgenic events of tomato plants, cultivar Kashi Vishesh, expressing the Cry1Ac gene were advanced T14 to T15 generation. Seeds from the most promising event, IVTT-5, along with seeds from the other events, were germinated in a glasshouse. Following 30 days of germination, six consecutive applications of kanamycin (200 mg/l) were administered to detect any potential escape of transgenic traits or low expression of the transgene. Encouragingly, all seedlings exhibited survival post-kanamycin spray, indicating optimal expression of the transgene. Subsequently, ten seedlings from each event were transplanted into insect-proof net houses for further evaluation.

Drought, salt and cold stress tolerant transgenic tomatoAtDREB1A: Transgenic tomato lines D41, D53, D76, and D86, which harbor the AtDREB1A gene, were advanced to T12 to T13 generation. Seeds from all events were germinated in a glasshouse and after 30 days of germination, 200 mg/l kanamycin sprayed to detect any potential escape of transgenic traits or low expression of the transgene. Positively, all seedlings survived the kanamycin spray, indicating optimal expression of the transgene. Subsequently, eight seedlings from each event were transplanted into insect-proof net houses.

Drought, salt and heat stress tolerant transgenic tomatoBcZAT12: Transgenic tomato lines ZT1, ZT5, and ZT6, which exhibit tolerance to drought, salt, and high-temperature stress due to the expression of the BcZAT12 gene, were advanced T12 to T13 generation. Seeds from all events were germinated in a glasshouse and after 30 days of germination, 200 mg/l kanamycin sprayed to detect any potential escape of transgenic traits or low expression of the transgene. Encouragingly, all seedlings survived the kanamycin spray, indicating optimal expression of the transgene. Subsequently, eight seedlings from each event were transplanted into insect-proof net house.

Pyramiding of AtDREB1A and BcZAT12 transgenes for abiotic stresses: AtDREB1A and BcZAT12 transgenes pyramided tomato lines were advanced F7 to F8 by selfing. The F8 plants expressing AtDREB1A and BcZAT12 transgenes gene were tested by PCR amplification for both AtDREB1A and BcZAT12 specific primers and scored according to banding patterns. Progenies having both the transgenes were further used for morphological and physiological characterization for generation advancements.

Microbial bioformulations (BC6 & NPK) enhance performance of tomato, chilli and pea against biotic and abiotic stress: Microbial biopriming agents were evaluated for their stress mitigation role in tomato, chilli and pea. *Bacillus* species BV4 and BV7 along with *Azotobacter* were first applied as seed priming agent followed by root dip (conc. 2.6x10^7 CFU). In pot and field trials, tomato (var. Kashi Aman) inoculated with the microbial bioformulations (liquid) showed enhanced plant growth, development and were given moderate tolerance against early blight pathogen and high temperature. Simultaneously, microbial bioformulation BC6 enhanced physicochemical properties of the rhizosphere soils in inoculated pots by 5-8%, in terms of organic matter (OM) and N, P, K and Zn accumulation. Results displayed that the microbial inoculants not only enhanced plant growth and stress tolerance but also improved soil quality by enhancing OM and mineral content. To assess the impact of the microbial inoculations on plant performance, LC-MS based targeted biochemical profiling showed increased accumulation of phenolics like ferulic, chlorogenic, caffeic and protocatechuic acids and flavonoid compounds quercetin, epicatechin and rutin in plant leaves.

Comparative analysis of antioxidant activity (AO) (as ABTS, DPPH and Ferric reducing power assay) of the plant extracts showed enhanced AO activity, thereby indicating potential impact of microbial inoculants on tomato plants. The role of phytovitamins like folate, pantothenate, ascorbate and vitamin B6 was also evaluated on plant health and intrinsic biochemical profile against early blight disease. These phytovitamins were found as biomarkers in untargeted metabolomic studies on wild and cultivated tomato species against *Alternaria solani*. Application of 10-50ppm conc. of phytovitamins as seed treatment enhanced plant growth substantially and helped them withstand high temperature conditions. Looking into the plant growth promoting potential of *Bacillus* and *Azotobacter* species, both powder-based and liquid consortia of *Bacillus* species (BC6) and *Azotobacter* and two species of *Bacillus* (BV4 and BV7) (NPK) bioformulations were developed. These bioformulations were evaluated at institute research farm along with farmer's field at several locations. The formulations promoted healthy growth of seedlings when applied as seed priming followed by soil application in vegetable nurseries of chilli and tomato. Their application as seedling root dip followed by soil application in the tomato crop enhanced plant growth by 12.4%, root enlargement by 8.9%, flowering by 14.2% and fruiting by 6.8%. Further trials are underway to prove their consistent efficacy that will help in the development of commercial bioformulation (Fig. 46).

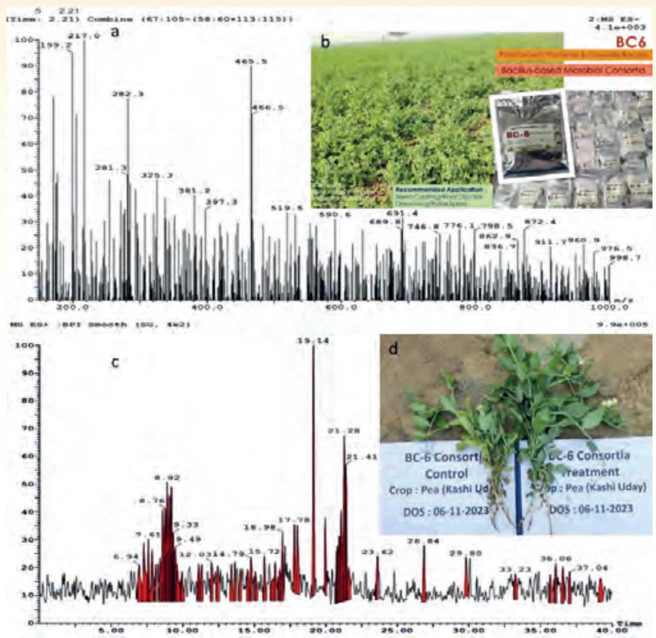


Fig. 46: LC-MS profile of BC6 treated tomato plant leaves (a, c); (inset) talc-based powder BC6 consortium (b) and impact of BC6 on sweet pea in the field condition (d)

DNA Profiling of genotypes: During the year, DNA profiling of 20 varieties, hybrids and parental lines of the hybrids was done. This includes Brinjal (Kashi Uttam) and Kashi Utsav; (IVBHL-22), Cucumber (VRCUH-1), Pea (Kashi Tripti), Okra (VRO-119) , Bakla (Kashi Sampda), Bitter gourd (Kashi Pratiksha), Bottle gourd (Kashi Subhra), Chaulai (Kashi Chaulai-1),Chilli (Kashi Garima), Longmelon (Kashi Vidhi), Palak (Kashi Baramasi), Pointed gourd (Kashi Parval 141), Radish (Kashi Rituraj), Ridge Gourd (VRRG6A), Roundmelon (Kashi Hari),Tomato (Kashi Tapas and Kashi Adbhut), Watermelon (Kashi Mohini), Winged bean (Kashi Annapurna), and Sponge Gourd (Kashi Vandana).

PROJECT 7: SEED MANAGEMENT PERSPECTIVES IN VEGETABLE CROPS (w.e.f 01.04.2023)

Old project names: [2.1: Priming, Coating, ovule conversion and seed enhancement; 2.2: Pollination studies for seed augmentation in vegetables including support of honey bees; 2.3: Drying and storage studies on vegetable seeds (till 31.03.2023)

Screening for salinity tolerance and impact of seed enhancement treatments to mitigate salinity stress at early seedling stage in chilli and cowpea: Salt tolerance in 150 Chilli (*Capsicum annum*) and 50 Cowpea (*Vigna unguiculata*) germplasms were evaluated by subjecting them to varying NaCl concentrations (0, 75, 100, 150, and 200 mM). In chili, cultivars EC-454697, EC-622085, PBC-328 IC-605713, and LCA-434 showed high salt-tolerance, whereas LCA-443, EC-519697, and IC-413713 showed high susceptibility. In cowpea cultivars Kashi Vishan showed highly salt-tolerance, Kashi Unnati, Kashi Gauri, Kashi Kanchan showed moderate

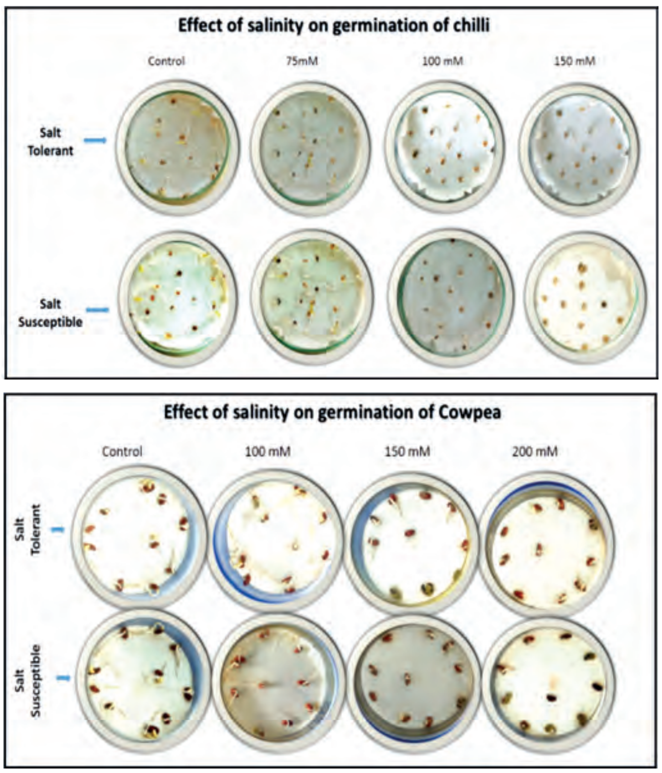


Fig. 47: Effect of salinity on chilli and cowpea seed germination

Fig. 48: Effect of seed priming in cowpea and chilli under salinity stress.

tolerance, whereas Kashi Nidhi, EC-390240, IC-5969, IC-202931, IC-202526, IC-3004, IC-536572, IC-21154, IC-392198 were highly susceptible.

To explore salinity alleviation strategies, susceptible germplasms (EC-519697 for chilli and Kashi Nidhi for cowpea) underwent seed priming treatments. Among the 30 priming agents, mannitol, salicylic acid, and ascorbic acid effectively mitigated salinity stress and enhanced chilli germination and seedling growth. Mannitol (10 mM) and salicylic acid (0.5 mM and 1.0 mM) exhibited the highest germination rates. Ascorbic acid (0.5 mM), IAA (100 ppm), and GA3 (100 ppm) notably improved root and shoot lengths, as well as fresh and dry weights. The Leaf Relative Water Content (LRWC) for cowpea plants varied among treatments. Under saline conditions, LRWC decreased to 73.14% compared to the control (76.77%). Mannitol treatments at 20 mM and 10 mM showed slight increases in LRWC. Overall, mannitol and ascorbic acid treatments moderately improved CMSI, whereas GA_3 showed the most substantial improvement (Figs. 47 & 48).

Standardization of post-harvest ripening duration and fruit retention in summer squash: In summer squash, formation of under developed seed and fruit set inhibition is a major bottleneck during seed production. Present study was to understand the physio-biochemical changes associated with the fruit load management and post-harvest ripening (PHR) in seed production of bushy type (short internodal length) summer squash cv. Kashi Subhangi during winter season. Among different treatments of fruit load (1 fruit/plant, 2 fruit/plant, 3 fruit/plant, 4 fruit/plant and all fruit/plant) and PHR durations (0, 10, 20 30 days), the retention of 2 fruit/plant and PHR of 20-30 days gave the better seed quality and seed yield. Significant change in malondialdehyde (MDA) content, superoxide dismutase (SOD), catalase (CAT), peroxidase (POD), ascorbate peroxidase (APX) and glutathione reductase (GR) enzyme activity was recorded during different fruit retention and PHR treatments, which attributed in differential seed quality (Fig. 49).

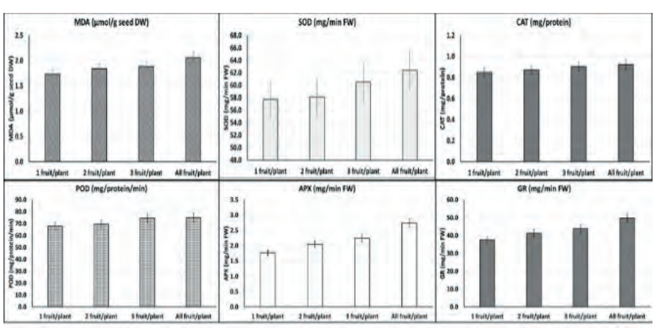


Fig. 49: Physiological changes associated with different fruit load and post-harvest ripening in summer squash

Breeder and TL seed production of important vegetable crops: A total of 22982.70 kg vegetable seeds of ICAR-IIVR varieties of tomato, brinjal, chilli, okra, cowpea, pea, bottle gourd, bitter gourd, pumpkin, cucumber, sponge gourd, ridge gourd, ash gourd, radish, French bean, Indian bean, carrot, cauliflower and Palak etc., were produced at the institute in Varanasi for the seed indenters and farmers. Among the total seeds, 19345.50 kg was truthfully labelled seeds of the open pollinated varieties of IIVR, 47.80 kg F_1 hybrid seeds at IIVR, 34.00 kg F_1 hybrid seed at Sargatia and 3637.20 kg breeder seeds. At the Regional Research Station, Sargatia, a total of 55985.00 kg wheat, paddy, lentil, mustard, arhar and vegetable seed were produced. In addition to different seeds, 128.5 quintals planting material of turmeric and 110.0 quintals elephant foot yam were also produced at ICAR-IIVR-RRS, Sargatia (Tables 1 - 4). Monitoring of breeder seed production plots was carried out for indented crops by the monitoring team consisting of representatives of SSCA, NSC, seed production scientists and respective breeders (Fig. 50). Single plant selection was carried out as a part of maintenance breeding in all the varieties. The germination % of 397 samples were tested at seed testing laboratory for seed quality assurance. A total of 15938 kitchen garden packets of ICAR-IIVR varieties of different vegetables were prepared and distributed among the growers.

Fig. 50: Monitoring of vegetable breeder seed crops by the monitoring team

Table 1: TL seeds produced during 2023 at ICAR-IIVR, Varanasi

S.N.	Vegetable crop	Variety	Quantity (Kg)
1	Chilli	Kashi Abha	49.0
2	Chilli	Kashi Anmol	242.0
3	Tomato	Kashi Chayan	4.0
4	Tomato	kashi Vishesh	6.0
5	Tomato	kashi Aman	74.0
6	Tomato	kashi Adarsh	43.0
7	Tomato	kashi Amrit	0.2
8	Tomato	kashi Anupam	0.5

9	Okra	Kashi Vardan	4.0
10	Okra	Kashi Chaman	690.0
11	Okra	Kashi Pragati	530.0
12	Brinjal	Kashi Uttam	130.0
13	Brinjal	Kashi Taru	0.3
14	Pea	Kashi Nandini	2862.0
15	Pea	Kashi Uday	7169.0
16	Pea	Kashi Mukti	540.0
17	Pea	Kashi Ageti	1730.0
18	Pea	Kashi Shakti	210.0
19	Radish	Kashi Shweta	2.6
20	Radish	Kashi Hansh	3.0
21	Radish	Kashi Ardra	12.0
22	Radish	Kashi Mooli 40	5.5
23	Radish	Kashi Lohit	0.6
24	Carrot	Kashi Arun	20.7
25	Carrot	Kashi Krishna	18.0
26	Cowpea	Kashi Nidhi	2650.0
27	Cowpea	Kashi Kanchan	1040.0
28	Bottle Gourd	Kashi Ganga	132.0
29	Bottle Gourd	Kashi Kundal	37.0
30	Bottle Gourd	Kahi Kriti	10.0
31	Bitter Gourd	Kashi Pratistha	0.3
32	Sponge Gourd	Kashi Divya	20.0
33	Sponge Gourd	Kashi Kalyani	15.0
34	Sponge Gourd	Kashi Jyoti	0.3
35	Sponge Gourd	Kashi Shreya	195.0
36	Sponge Gourd	Kashi Saumya	24.0
37	Palak	All Green	60.0
38	Palak	Kashi Baramasi	210.2
39	Pumpkin	Kashi Harit	70.0
40	French Bean	Kashi Sampann	88.0
41	French Bean	Kashi Rajhans	168.0
42	Indian Bean	Kashi Khusal	190.0
43	Indian Bean	Kashi Haritima	10.0
44	Cauliflower	Kashi Ghobi 25	23.0
45	Summer Squash	Kashi Shubangi	2.0
46	Satputia	Kashi Khushi	40.0
47	Long melon	Kashi santushi	0.3
48	Muskmelon	Kashi Madhu	1.0
49	Ridge Gourd	Kashi Sriram	13.0
	Total		**19345.5**

Table 2: Hybrid seeds produced during 2023 at ICAR-IIVR, Varanasi and RRS, Sargatia

Crop	Variety	Location	Quantity (Kg)
Chilli	Kashi Ratna	ICAR-IIVR, Varanasi	17.70
Brinjal	Kashi Sandesh	ICAR-IIVR, Varanasi	27.00
Cucumber	Kashi Nutan	ICAR-IIVR, Varanasi	3.10
Brinjal	Kashi Sandesh	RRS, Sargatia	28.00
Cucumber	Kashi Nutan	RRS, Sargatia	6.00
	Total		**81.80**

Table 3: Breeder seeds produced during 2023 at ICAR-IIVR, Varanasi

S.N.	Vegetable crop	Variety	Quantity (Kg)
1	Chilli	Kashi Abha	1.0
2	Chilli	Kashi Anmol	8.0
3	Chilli	Kashi Gaurav	0.7
4	Chilli	Kashi Sinduri	1.0
5	Tomato	Kashi Chayan	1.0
6	Tomato	Kashi Vishesh	1.0
7	Tomato	Kashi Aman	4.0
8	Tomato	Kashi Adarsh	2.0
9	Tomato	Kashi Anupam	0.1
10	Okra	Kashi Kranti	80.0
11	Okra	Kashi Lalima	20.0
12	Okra	Kashi Vardan	20.0
13	Okra	Kashi Chaman	50.0
14	Okra	Kashi Pragati	70.0
15	Brinjal	Kashi Taru	0.7
16	Brinjal	Kashi Vijay	0.1
17	Pea	Kashi Nandini	600.0
18	Pea	Kashi Uday	1500.0
19	Pea	Kashi Mukti	500.0
20	Pea	Kashi Ageti	200.0
21	Pea	Kashi Shakti	30.0
22	Pea	Kashi Samridhi	30.0
23	Radish	Kashi Shweta	3.0
24	Radish	Kashi Hansh	2.0
25	Radish	Kashi Ardra	5.0
26	Radish	Kashi Mooli 40	6.5
27	Radish	Kashi Lohit	2.0
28	Carrot	Kashi Arun	3.0
29	Carrot	Kashi Krishna	8.0
30	Cowpea	Kashi Gauri	15.0
31	Cowpea	Kashi Nidhi	150.0
32	Cowpea	Kashi Shyamal	4.0
33	Cowpea	Kashi Kanchan	100.0
34	Cowpea	Kashi Vishan	3.0
35	Bottle Gourd	Kashi Kiran	0.1
36	Bottle Gourd	Kashi Ganga	16.0
37	Bottle Gourd	Kashi Kundal	3.0
38	Bottle Gourd	Kashi Kirti	10.0
39	Bitter Gourd	Kashi Mayuri	6.0
40	Bitter Gourd	Kashi Pratistha	5.0
41	Sponge Gourd	Kashi Divya	10.0
42	Sponge Gourd	Kashi Kalyani	10.0
43	Sponge Gourd	Kashi Shreya	15.0
44	Pumpkin	Kashi Harit	0.3
45	Pumpkin	Kashi Basant	0.2
46	French Bean	Kashi Sampann	10.0

47	French Bean	Kashi Rajhans	50.0
48	French Bean	Kashi Baingani	1.0
49	Indian Bean	Kashi Khuhal	10.0
50	Indian Bean	Kashi Haritima	40.0
51	Ash Gourd	Kashi Dhawal	1.5
52	Cauliflower	Kashi Gobhi 25	2.0
53	Summer Squash	Kashi Shubhangi	1.0
54	Satputia	Kashi Khushi	10.0
55	Long melon	Kashi Santushti	1.0
56	Muskmelon	Kashi Madhu	4.0
57	Ridge Gourd	Kashi Shivani	10.0
	Total		**3637.20**

Table 4: TL seeds and planting material produced during 2023 at RRS, Sargatia

S.N.	Crop	Variety	Quantity (Kg)
1.	Tomato	Kashi Chayan	6.00
2.	Chilli	Kashi Anmol	58.00
3.	Brinjal	Kashi Uttam	64.00
4.	Cowpea	Kashi Nidhi	259.00
		Kashi Kanchan	263.00
5.	Indian Bean	Kashi Bauni Sem-18	369.50
6.	Vegetable Pea	Kashi Uday	178.50
		Kashi Ageti	120.00
7.	French Bean	Kashi Rajhans	48.00
8.	Cauliflower	Kashi Gobhi No-25	35.50
9.	Okra	Kashi Chaman	300.00
		Kashi Pragati	35.50
		Kashi Lalima	90.00
10.	Palak	Kashi Barahmasi	228.00
11.	Radish	Kashi Aardra	406.00
12.	Sponge gourd	Kashi Divya	50.00
a		Kashi Shreya	31.00
13.	Ridge gourd	Kashi Shivani	17.00
14.	Bitter gourd	VRBTG-10	63.50
15.	Pumpkin	Kashi Harit	29.00
16.	Bottle gourd	Kashi Kiran	89.00
		Kashi Ganga	34.50
17.	Ash gourd	Kashi Dhawal	75.00
Total Vegetable seed			**2850.00**
18.	Elephant foot yam	Gajendra	11000.00
19.	Turmeric	Megha Turmeric-1	12850.00
Total Planting Material			**23850.00**
20.	Lentil	IPL-316	728.00
21.	Arhar	Rajendra Arhar-1	1066.00
22.	Mustard	RH-749	800.00
23.	Wheat	HD-2967	6960.00
		DBW-187	10363.00
		DBW-252	6978.00
24.	Paddy	S-52	20370.00 (unprocessed)
		BPT-5204	5870.00 (unprocessed)
	Total		**53135.00**

Standardization of seed germination testing protocol in Basella, Moringa, Chenopodium and Mustard green: Present study was conducted to standardize the suitable substrate medium, temperature, light requirement, duration for first and final count for germination testing of these vegetable crops. The management of seed dormancy present during seed germination also studied. For basella seed germination, between paper method substratum at 25^{0}C was ideal and germination continues till 21st day. For mustard green top of the paper method gave more than 85 percent germination on 6th day and germination continuous upto 11th day. In moringa the germination percentage at 25^{0}C is 51% through between paper method and top of the paper method is 41% and the germination continues till 15th day. Presence of wings and big seed size is the problem for germination. Chenopodium seed exhibit seed dormancy, hence treatments were applied to break the dormancy. Among different treatments, separating the seeds by water flotation technique and hand scarification along with heat treatment of 70^{0}C for 5 min shows maximum germination (66%), followed by KNO_3 @ 1% with 50% seed germination. For chenopodium, top of the paper method with alternating temperature and light was most suitable for germination testing (Fig. 51).

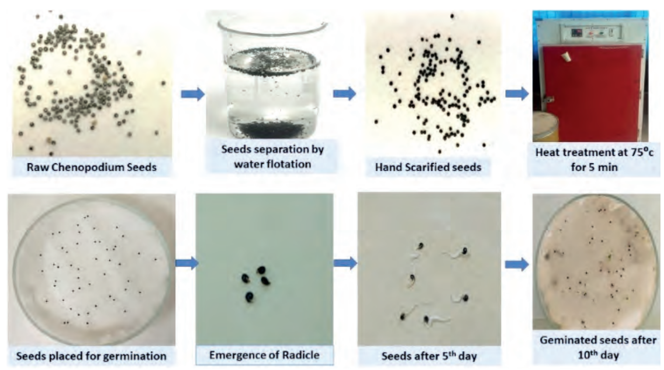


Fig. 51: Management of seed dormancy in chenopodium

Hybrid seed production of gynoecious bitter gourd: Potential of natural pollinators and manually assisted pollination for production of F_1 hybrid seeds of bitter gourd (*Momordica charantia*) hybrid using gynoecious line was evaluated under open field condition during kharif 2023. Bee species of three families i.e. Apidae, Halictidae and Megachilidae, butterflies (Skipper and Plain tiger) and syrphids were found as visitors to bitter gourd flowers. The foraging rate of bees was recorded as the number of flowers visited per minute. Amongst these, *Apis dorsata*, *Apis mellifera*, *Halictus* sp. and *Megachile* sp. were found to be the most frequent visitors (Fig. 52). Irrespective of species, the bee population was maximum at 08:00-10:00 h of the day. The maximum foraging activity of the dominant pollinators was observed at 08:00-10:00 hrs followed by 10:00- 12:00 hrs, whereas the minimum foraging activity was recorded in the afternoon 14:00-16:00 and 16:00-18:00 hours. Based on foraging rate and visitation frequency, *A. dorsata* was the most efficient pollinator of bitter gourd, followed by *A. mellifera*, *Halictus* sp. and *Megachile* sp.

Number of fruits, number of seeds per fruit and average seed weight were significantly different between gynoecious line and monoecious male parent. Pollination efficiency of bees found to be high when compared to manual hands in terms of quality of seeds produced from gynoecous plants. However, manual hands proved to be better for inducing more number of seeds per fruit. Total seed yield per plant depends on the total number of fruits developed and pollination by bees induces the development of more flowers to maturity, thereby ensuring competitive seed yield. Seed yield per plant exhibited significant positive correlation with seed length, shoot length, root length, fresh weight, vigour index I and germination percentage. Fresh seed exhibited seed dormancy, after ripening for 4-6 month improved the seed germination.

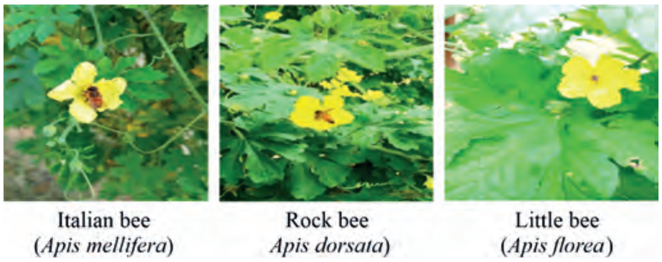


Fig. 52: Different pollinators visiting the bitter gourd flowers

Studies on seed dormancy in bitter gourd: The seed dormancy or non-germinability of freshly harvested seed of bitter gourd in seeds harvested at different pickings was addressed through PHR by storing the freshly harvested seed of bitter gourd variety Kashi Mayuri and Kashi Pratistha (VRBTG-10) at room temperature in air tight box. Seed germination was evaluated at every three-month interval (at 0, 3, 6 month). Although, results showed drastic increment in seed germination with advancement of storage duration. However, differential level of dormancy was observed in seed harvested at different pickings. Seed harvested in early picking showed better seed quality and low level of dormancy as compared to seed harvested in later pickings. Increase in germination after storage may be due to change in physio-biochemical parameters of seed. Hence, water uptake, ROS, MDA content, hydrolytic enzymes activity (amylase and protease) and antioxidant enzymes (SOD, CAT, POD, APX, GSH, GSSG and total glutathion) activity will not be measured in seeds.

Organic seed production of vegetable crops: Organic seed production technology in cowpea cv. Kashi Nidhi, sponge gourd cv. Kashi Shreya, Bottle gourd cv. Kashi Ganga, Okra cv. Kashi Kranti and chilli cv. Kashi Anmol was standardized. During seed production, organic inputs such as FYM, vermi-wash, vermi-compost, Trichoderma, Kashi Bio Mix, BC-6, Indo neem, Kashi Jaiv-Shakti, insect traps etc. were applied. The seed yield and quality of organically produced seed was compared with inorganically produced seed as well as control (without any application) after harvesting of seed. Results showed that plant growth, seed yield and quality of organic crop was almost at par with inorganically grown vegetables (Fig. 53). The root growth analysis showed that root length density and root volume of organically produced vegetables were higher than inorganically produced vegetables, due to the root promoting activity of BC-6.

Fig. 53: Organic seed production of vegetables at ICAR-IIVR, Varanasi

Drying and storage studies on vegetable seeds using zeolite beads: Seed storage study with and without zeolite beads under room temperature (T1 to T5) and controlled condition (T6 to T10) was conducted with the aim of maintaining the viability and vigour of the seed for longer period. Initial observation for seed viability and quality were recoded before storage then further periodic (every three month) evaluation of seed viability and quality were recorded. Results showed that seed stored under cold storage-maintained seed quality and viability relatively for longer duration. However, irrespective of storage environment, seed stored with zeolite beads in 10:1 (seed:beads) maintained the seed quality and viability upto 24 month. Physio-biochemical analysis showed that irrespective of storage environment and crop, significant differences in ROS, antioxidant enzymes and dehydrogenase activity was observed during seed storage. Irrespective of storage container, malondialdehyde (MDA) (lipid peroxidation) and H_2O_2 content was lower and antioxidants was higher as compared to seed stored without beads and in cloth bags. Seed of vegetable soybean stored with zeolite beads for 15 month showed lower fungal infection. Whereas, seed stored without zeolite beads

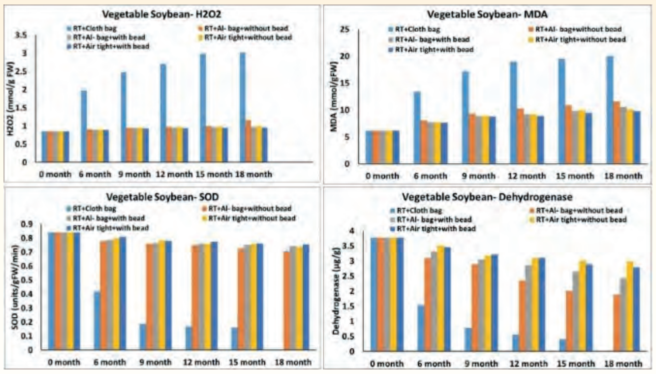


Fig. 54: Physio-biochemical changes associated vegetable soybean during storage

for 15 month showed higher fungal infection and no seed germination, which was due to controlled seed moisture during storage with beads. In conclusion, seed stored with zeolite beads in polythene bag and air tight container maintained the seed viability up to 24 month in all three vegetables (Fig. 54).

Farmers participatory seed production: A total of 1175 kg vegetable seeds of ICAR-IIVR varieties of okra and cowpea were produced on farmers field through farmers participatory seed production approach. Monitoring of seed production plots was carried out by the monitoring team consisting of seed production scientists and respective breeders (Fig. 55).

Fig. 55: Monitoring of vegetable seed crops at farmers field by the monitoring team

AICRP (VC) trials: A total of 4 seed production AICRP (VC) trials were conducted during 2023, namely (1) Fruit load management and post-harvest ripening in cucurbits vegetables for enhancing seed yield and quality (2) Pelleting of vegetable seeds with botanicals and bio control agents for seed enhancement (3) Effect of high temperature treatment on seed dormancy in cucurbits (4) Effect of hydro priming durations on seed quality of stored seeds of vegetables.

PROJECT 8: MAINTENANCE & PROMOTION OF ICAR-IIVR VARIETIES/HYBRIDS (w.e.f. 01.04.2023)

Crop: Tomato and Baby Corn

For conducting frontline demonstration seeds of promising tomato hybrids (VRTH-16-1112, CRPVRTH-16-3 and CRPVRTH-16-70) and baby corn hybrid IIVRBH-1927 were sent to the following KVKs in different agro climatic zones of Uttar Pradesh and farmers in Mirzapur.

S.N.	Agro Climatic Zone of Uttar Pradesh	Krishi Vigyan Kendra
Tomato hybrid: VRTH-16-1112 & Baby corn hybrid: IIVRBH-1927		
1.	Western Plain Zone	KVK, Muzaffarnagar
2.	Western sub-tropical zone	KVK, Hapur
3.	Mid plain zone	KVK, Pratapgarh
4.	Bundelkhand Zone	KVK, Mahoba
5.	North Eastern Plain Zone	KVK, Deoria
6.	Eastern Plain Zone	KVK, Bhadohi
Tomato hybrids: CRPVRTH-16-3 and CRPVRTH-16-70		
7.	Mid plain zone	KVK Lucknow
8.	Bundelkhand zone	KVK Hamirpur
9.	North-eastern plain zone	KVK Kushinagar
10.	Eastern plain zone	KVK Varanasi
11.	Bindhya Zone	KVK Sonbhadra

Crop: Brinjal

For promotion of varieties/ hybrids of brinjal and some promising advance lines MLT, seeds and seedlings were distributed to farmers in Varanasi and adjoining districts. The details are provided in Table below.

Varanasi District:

S.N.	Name of Hybrid/Variety	No of Plants	Area (m²)
1.	Kashi Manohar (IVBHL-20)	6610	2974.5
2.	Kashi Sandesh	7395	3327.75
3.	Kashi Utsav (IVBHL-22)	3560	1602
4.	Kashi Uttam (BR-14)	6040	2718
5.	Kashi Brinjal Green Round (IVBR-17)	2700	1215

6.	IVBHR-17	500	225
7.	IVBHR-19	120	54
8.	IVBL-27	1500	675
9.	IVBL-28	1500	675
10.	IVBL-29	1500	675
11.	IVBR-18	1500	675
12.	IVBR-19	1000	450
13.	Kashi Prakash	20	9
14.	Kashi Vijay (IVBL-23)	100	45
15.	Ram Nagar Giant (Oval)	50	22.5
16.	Ram Nagar Giant (Round)	30	13.5
		34125	15356.25m^2

Adjoining Districts (Mirzapur, Chanduali, Bhadohi):

S. N.	Name of Hybrid/Variety	Seed Quantity (g)	Area (m^2)
1.	Kashi Manohar (IVBHL-20)	13	1316.25
2.	Kashi Sandesh	16	1620
3.	Kashi Utsav (IVBHL-22)	13	1316.25
4.	Kashi Uttam (BR-14)	10	1012.5
5.	Kashi Himani (IVBL-26)	15	1518.75
6.	Kashi Vijay (IVBL-23)	3	303.75
7.	Ram Nagar Giant (Oval)	2	202.5
8.	Ram Nagar Giant (Round)	4	405
9.	IVBHR-19	5	506.25
		81 g	8201.25 m^2

Further, for promotion of varieties/hybrids developed by the institute in Madhya Pradesh and Chhattisgarh, crop-wise program for planting in KVKs in different agro-climatic zones of the states was finalized in collaboration with ICAR-ATARI, Jabalpur. This program shall be executed from zaid season in 2024.

Crop: Okra & Pointed gourd

Maintenance breeding of IIVR released varieties and parental lines of the hybrid in okra and farmer's field trials of the newly Developed varieties: ICAR-IIVR developed varieties viz., Kashi Kranti, Kashi Pragati, Kashi Sathdhari, Kashi Lila, Kashi Vibhuti, Kashi Vardaan, Kashi Chaman, Kashi Lalima, Kashi Sahishnu, Kashi Parakram and Kashi Utkarsh were maintained by producing nucleus seed (1.5 kg each). Parental lines of the hybrid Kashi Bhairov and Kashi Shristi were also maintained by self- pollination. Besides, newly developed Kashi Sahishnu, Kashi Parakram and Kashi Utkarsh were also grown in the farmers field of Varanasi, Mirzapur, Azamgarh, Sitapur district of Uttar Pradesh, Motihari district of Bihar and Purulia district of West Bengal.

Production of planting material and clonal multiplication of selected clones in pointed gourd and maintenance of released variety: About 1500 planting materials of Kashi Alankar, Kashi Suphal, Kashi Parwal-141 and Kashi Amulya were produced and distributed to the farmers of Uttar Pradesh, Bihar and Tripura. All the advance lines of pointed gourd were clonally multiplied to enhance the plant population. Beside this, approximately 100 planting materials were produced for VRPG-103, VRPG-171 and VRPG-173 for farmers field trial. The ICAR-IIVR, Varanasi developed Kashi Alankar, Kashi Suphal, Kashi Parwal-141 and Kashi Amulya were maintained in the mother plant block.

Success story of Kashi Parwal-141: Shri Rajendra Singh Patel from Haripur Village of Baragaon Block, Varanasi has been grew Kashi Parwal-141 since 2019 using the ICAR-IIVR produce planting materials. Initially, he planted this variety in 0.25 ha area during the November month and followed the scientific package of practices for its production such drip irrigation, use of plastic mulch and vertical training system. He also used the different technological interventions as suggested by the Institute's Scientists. Harvesting of fruits started in the month of March and continued up to first week of December. Mr Patel harvested 95 quintals of pointed gourd fruits in the first year which gradually increased to 105 & 110 quintals, respectively in the second and third year. He earned a net profit of Rs. 2,30,000/-, Rs. 2,70,000/- and Rs. 2,90,000/- during 1st, 2nd and 3rd year, respectively after deducting the cost of cultivation around Rs. 1,50,000/-. He described the pointed gourd as suitable crop for sustainable earning from small land holding as it does not exhibit price fluctuation throughout its availability and market price never fall below Rs. 25/- per kg. At present he is an inspirational figure to the farmers who wanted to grow pointed and also spread the cultivation of Kashi Parwal-141 to around 35-40 ha in nearby villages of the Baragaon Block.

Crop: Basella

The three released varieties namely Kashi Poi-1, Lashi Poi-2 and Kashi Poi-3 were been maintained through selfing and sufficient quantity of seeds were harvested. Additionally, a white flower low betalain genotype VBR-48-1 was also maintained through selfing. Two promising lines VRB-2 and VRB-73 with purple pigmented stem was also maintained.

Crop: Amaranth

In amaranth the released varieties Kashi Suhaavani and Kashi Chaulai-1 were maintained through selfing. Additionally, 17 late bolting genotypes were also maintained by growing during the Kharif season of 2023. For green yield the promising genotypes were

VRAM-44 (399.52 q/ha), VRAM-324 (383.98 q/ha), VRAM-17 (376.59 q/ha). The genotype VRAM-324 is under the AVT-I of the AICRP(VC) varietal trial.

Crop: Laipatta

A total of 30 germplasms of Laipatta were grown and maintained by selfing during rabi 2023. In the generation advancement, 176 F_4 progenies were grown and SPS were done for identification of delayed flowering and vigorous growth habit. Based on late flowering a total of 38 were selected and advanced to F_5 while 138 families were rejected. The genotypes VRLP-8 (6518.52 kg/ha), VRLP-16 (7407.41 kg/ha), VRLP-22 (9962.96 kg/ha) and VRLP-23 (8544.44 kg/ha), VRLP-33 (9370.37 kg/ha) were found promising for green yield. The line VRLP-33 entered the AVT-II testing under AICRP (VC).

Crop: Moringa

The 22 moringa selections and two checks (PKM-1 and PKM-2) were evaluated for horticultural traits and fruit yield. The highest fruiting was observed in the genotype VRMO-10 (830 fruits), followed by VRMO-13 (770 fruits), VRMO-9 (730 fruits), VRMO-8 (530 fruits), PKM-2 (710 fruits) and PKM-1 (425 fruits).

Crop: Summer squash (*Cucurbita pepo*)

Maintenance of germplasm: Among the germplasm, only 58 germplasm/genotypes of summer squash were evaluated for yield and contributing traits. The number of fruits per plant ranged from 5.5 (VRSS-20-325) to 11.7 (VRSS 20-324), while average fruit weight ranged from 420.0 g (VRSS -20-320) to 1300.0 g (VRSS 20-362). The fruit length ranged from 8.5cm (VRSS-20-325) to 30.5 cm (VRSS-20-324) and diameter is 6.4 cm (VRSS-20-325) and 13.5 cm (VRSS 20-366).

Evaluation of advance lines: A total of 12 advance lines have been evaluated for yield and its contributing traits in different segment. The best performing line in oval segment is VRSS sel-20-321while in oblong segment is VRSS sel -20-366. Maximum number of female flower was also recorded in VRSS sel-20-131.

Crop: Round melon & Long melon

Sixteen lines of round melon were evaluated for yield and other horticultural traits. Maximum yield per plant was found in VRM-10 (1.15 kg/plant) followed by VRM-12-6 (0.97 kg/plant) and VRM-12.3-1(0.83 kg/plant). Total 20 germplasm of long melon were evaluated for various horticultural traits. Maximum yield per plant was found in VRLM-7-1 (1.33 kg) followed by VRLM-3 (1.09 kg/plant) in the long categories. Two promising advance lines, and VRLM-7-1, VRLM-3 and hybrid (VRLMH-2) were selected for high yield and better fruit quality in both zaid and kharif seasons and further submitted for AICRP (VC) trials.

Crop: Pea and Vegetable Soybean

Demonstration of the improved lines/varieties of pea in the technology park, and at farmer's field: The promising lines of pea viz., VRPE-29, VRPE-30 and VRPE-949 (short duration high temperature lines) along with the released cultivars, Kashi Purvi, Kashi Tripti, Kashi Ageti, Kashi Nandini, Kashi Udai were demonstrated in the technology park of the institute from Oct 2023 to December 2023 in (100 meter square plot each) in around 800 meter square area. The genotype VRPE-29 and VRPE-30 were at par to each other for days to picking (50-55 days) with per plot yield of 12-15 kg. The genotypes VRPE-29 and VRPE-30 were also demonstrated at farmer's field (two farmers) of Varanasi Mr. Subhas Chandra and Ram Ji Ram, Mirjapur.

Germplasm maintenance in Vegetable soybean: A total of 53 vegetable lines were maintained during the season including 40 genotypes and 13 advanced breeding lines.

Crop: Indian bean (Dolichos bean)

Germplasm/Lines maintenance: One hundred forty-six germplasm/lines were sown in the field and harvested seeds of each of them.

Generation Advancement: A total of 36 superior segregates of bush type were selected from 76 single plant selection (SPS) in different generations *viz;* F_{7-8}(15), F_{9-10}(5) and F_{10-11}(16). These segregates were categorized for high yield with DYMV tolerance & high temperature tolerance for vegetable purposes, use for pulse purposes, and cultivation for terrace farming (pot culture).

Seed Multiplication: Eight entries were sown in the field for seed multiplication and produced seeds of respective entries as Kashi Bouni Sem-3(20.75 kg), Kashi Bouni Sem-9 (12.50 kg), Kashi Bouni Sem-14 (17.70 kg), Kashi Bouni Sem-18 (26.20 kg), Kashi Bouni Sem-207 (24.10 kg), Kashi Haritima (3.50 kg), Kashi Khushaal (7.8 kg) and Kashi Sheetal (12.75 kg).

AICRP (VC) Trials: Three trials on pole type conducted and submitted.

Crop: Baby corn

Germplasm maintenance: Eighteen sweet corn inbred and fifty baby corn inbred lines were maintained.

Hybrid seed production: Hybrid seed production of three baby corn hybrids namely SC16 × BC13/IIVRBCH 1613 (10 Kg), IIVRBCH-1927 (10 Kg) and HM-4 was done. In this year, IIVRBCH 1613 was promoted to

AVT-I in the North-eastern Plains Zone (NEPZ or Z3) by AICRP-Maize, Ludhiana.

Crop: Sponge gourd

Promotional activities: A total of 30 pkts each of two newly developed OP varieties of sponge gourd namely, Kashi Kalyani and Kashi Vandana were submitted for field demonstration for popularization through the different KVKs of the Uttar Pradesh. Apart from this, five newly developed F_1 cross combinations of sponge gourd along with two checks were sent to ICAR-IIVR KVK, Sargatia, Kushinagar, ICAR-IIVR KVK, Deoria, ICAR-IIVR KVK, Sant Ravidas Nagar (Bhadohi) and ANDUAT KVK, Azamgarh for its evaluation with aim to obtained data to submit in the proposal of SVRC.

Crop: Water chestnut, Water spinach, French bean, Winged bean and Cowpea

Augmentation and maintenance of germplasm: Five genotypes of water chestnut, 6 genotypes of water spinach, 2 genotypes of French bean and 9 genotypes of cowpea were also augmented and characterized for different horticultural traits and seeds were multiplied for next season improvement programmes.

Fig. 56: Pole type germplasm of Cowpea

Maintenance breeding : Maintenance breeding of lotus (2), water chestnut (10), Water spinach (26), velvet bean (4), vegetable pea (8), French bean (5 varieties, 45 germplasm including pole type) and cowpea (6 varieties and 245 segregating lines, advance lines and germplasm including pole type) were characterized & maintained for various activities.

Vegetable varieties Seed Production: Seeds of vegetables crop varieties Kashi Manu (10.0Kg), Kashi Annapurna (15.0 Kg) were produced and made available to different stakeholders for their end use.

Fig. 57: Maintenance breeding of water spinach var Kashi Manu

Promotional activities undertaken of Newly developed varieties: Promotional activities for newly developed varieties vary depending on the product, target audience, and marketing objectives. Newly developed varieties Kashi Manu (Water spinach) and Kashi Annapurna (Winged bean), French bean and Cowpea varieties were promoted by use of social media platforms (You tube, Facebook), newspapers, Kisan Gosthi, radio talk, TV channels etc. to create awareness about the new varieties. Participation in agricultural trade shows, fairs, and exhibitions to showcase the new varieties to farmers, distributors and other stakeholders. Offering live demonstrations and samples

Fig. 58: Water spinach var Kashi Manu at KVK, Nicobar

Fig. 60: Performance of winged bean var Kashi Annapurna at College of Horticulture, Dantiwada Agri Uni. Sardar Kushinagar, Gujarat

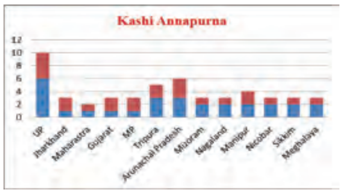


Fig. 59: Promotional activities for Winged bean var Kashi Annapurna in different states.

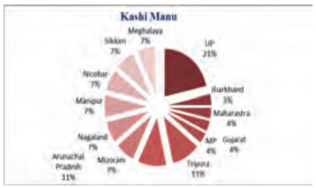


Fig. 61: Promotional activities for water spinach var Kashi Manu conducted in different states.

could generate interest and attract potential buyers. Besides, establishment of demonstration plots in crop experimental area and technology demonstration plots of Institute where farmers observed the performance of the new varieties first hand. Collaborated with ICAR Institutes/ SAUs/CAUs and KVKs to promote the new varieties to their different stakeholders. Offered training sessions, webinars, or workshops to educate stakeholders about the advantages of adopting the new varieties of these crops. Developed press releases and media kits to announce the launch of the new varieties to the press and industry influencers to increase visibility and credibility. Provided comprehensive customer support and technical assistance to farmers interested in adopting the new varieties. By implementing a strategic combination of these promotional activities, effectively generated awareness, interest and drive adoption of newly developed varieties among the target audience.

Newly developed varieties Kashi Manu and Kashi Annapurna were also promoted through progressive farmers (154) of Arunachal Pradesh, Assam, Mizoram, Tripura, Manipur, Meghalaya, Sikkim, Nagaland, Bihar, Jharkhand, Uttarakhand and Uttar Pradesh. Farmers are growing the crop with full enthusiasm.

Fig. 62: Performance of water spinach var Kashi Manu at Farmer's field, Tripura.

Germplasm shared across research Institutes/ organizations/Universities: During 2023, a total of 1732 number of seed pockets of active germplasm (varieties/ lines) in nineteen different vegetable crops were shared among 52 Institutes/universities of the country as per the request received for research and demonstration purpose through Material Transfer Agreement (MTA).

Table: Germplasm shared across research Institutes/organizations/Universities

Crop	Institute/Organization
Amaranthus (55)	Institute of Agricultural Science, Banaras Hindu University, Varanasi (25), School of Agriculture, Graphic Era Hill University, Dehradun, Uttarakhand (30)
Ash Gourd (9)	College of Horticulture, UHS campus,GKVK post, Bengaluru (3), College of Agriculture,Rajmata Vijayaraje Sindhia Krishi Vishwa Vidyalaya, Gwalior, M.P (3), College of Horticulture, University of Horticultural Sciences, Bagalkot (3)
Bitter gourd (53)	K.R.C. College of Horticultue, Arabhavi, Gokak, Karnataka (10), University of Horticultural Sciences, Bagalkot, College of Horticultur, Bagalkot (10), Nalanda College of Horticulture, Noorsarai,Nalanda, Bihar (13), ANDUAT, Kumarganj, Ayodhya, Uttar Pradesh (20)
Bottle gourd (80)	Institute of Agricultural Science, Banaras Hindu University, Varanasi (20), T.D. College, Jaunpur, Hussainabad (12), Lovely Professional University, Phagwara, Punjab, India (12), Integral Institute of Agricultural Science and Technology, Integral University, Kursi Road, Lucknow(18), Banda University of Agriculture and Technology, Banda, UP (18)
Brinjal (170)	UAS, GKVK, Bengaluru (50), Faculty of Horticulture and Forestry, SKUAST-J, Chatha (12), ICAR-Indian Institute of Farming Systems Research, Modipuram, Meerut Uttar Pradesh (2), Kerala Agricultural University, KVK, Kollam, Sadanadapuram (po),Kottarakkara, Kollam, Kerala (1), School of Agricultural Sciences, GH Raisoni University, Saikheda, Chindwara, MP (15), Narayan Institute of Agricultural Sciences, Gopal Narayan Singh University, Jamunar, Sasaram, Bihar (23), School of Agricultural Sciences & Technology, Babasaheb Bhimrao Ambedkar University, Lucknow (20), School of Agriculture, ITM, University, Gwalior, Madhya Pradesh (23), School of Agricultural Sciences and Technology, Babasaheb Bhimrao Ambedkar University, Lucknow (23), ICAR-IIHR, Hesaraghatta, Bengaluru (1)
Cauliflower (14)	School of Agricultural Sciences and Technology, Babasaheb Bhimrao Ambedkar University, Lucknow (14)
Chilli (135)	FOA, SKUAST-Jammu, Main Campus, Chatha (50), SHUATS, Prayagraj, UP (25), GH Raisoni University, Saikheda, Chindwara, Madhya Pradesh (10), School of Agricultural Sciences and Technology, Babasaheb Bhimrao Ambedkar University, Lucknow (25), VOC, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Kilikulam, Vallanad (25)
Cowpea (80)	Institute of Agriculture and Natural Sciences, Deen Dayal Upadhyay Gorakhpur University, Gorakhpur (20), School of Agricultural Sciences and Technology, Babasaheb Bhimrao Ambedkar University, Lucknow (20), School of Agriculture, Graphic Era Hill University, Dehradun, Uttarkhand (20), School of Agricultural Sciences and Technology, Babasaheb Bhimrao Ambedkar University, Lucknow (20)

Cucumber (177)	DIA, Department of Plant Pathology, UAS, GKVK, Bangalore (18), College of Horticulture and Forestry, Kumarganj, Ayodhya (20), SAUA&T, Kanpur, U.P (20), College of Horticulture, S.V.P. University of Agriculture and Technology, Meerut (19), IIAST, Integral University, Lucknow (20), Institute of Agricultural Science, Banaras Hindu University, Varanasi (20), College of Horticulture, Bagalkot (20), College of Horticulture, Babbur, Hiriyur, Chitradurga District, Karanataka (20), School of Agriculture, ITM University, Gwalior (20)
Dolichos bean (32)	College of Agriculture, Tripura, Lembucherra (29), ICAR-Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora, Uttarakhand (3)
French bean (65)	RARS, Hittinahalli farm,Vijayapura (15), Sri Murli Manohar Town P.G. college, Ballia, Uttar Pradesh (15), University of Agricultural Sciences, Bangalore (15), School of Agricultural Sciences & Technology, Babasaheb Bhimrao Ambedkar University, Lucknow (20)
Okra (248)	COH, BUAT, Banda (27), Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan (7), Dr. YS Parmar University of Horticulture and Forestry, Nauni, Solan (7), UAS(B), GKVK, Bangalore (19), IIAST, Integral University, Lucknow (22), Banaras Hindu University, Institute of Agricultural Sciences, BHU, Varanasi (1), ASPEE College of Horticulture, Navsari Agricultural University, Navsari (2), Integral Institute of Agricultural Science and Technology, Integral University, Lucknow (20),Division of Vegetable Science, Faculty of Horticulture and Forestry, SKUAST-J, Chatha, Jammu and Kashmir (20), CSKHPKV, Palampur (20), School of Agriculture, graphic Era Hill University, Dehradun, Uttarakhand (20), University of Horticultural Sciences, Bagalkot, College of Horticulture, Bagalkot (20), School of Agricultural Sciences and Technology, Babasaheb Bhimrao Ambedkar University, Lucknow(20), MPUAT, Udaipur (23)
Vegetable pea (103)	Banda University of Agriculture and Technology, Banda (10), Department of Horticulture, P.G. College of Agriculture, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar (10), ANDUAT, Kumarganj, Ayodhya, Uttar Pradesh (30), Faculty of Horticulture and Forestry, Main Campus Chatha, SKUAST, Jammu (8), SAST, Babasaheb Bhimrao Ambedkar University, Vidya Vihar, Rae Bareli Road, Lucknow, UP (20), CSKHP Agricultural University, Palampur(25)
Pumpkin (36)	Annamalai University, Annamalai Nagar, Chidambaram, Tamil Nadu (17), ANDUAT, Kumarganj, Ayodhya, Uttar Pradesh (19)
Ridge gourd (51)	ANDUAT, Kumarganj, Ayodhya (15), College of Horticulture, Udhyanagiri, Bagalkot (20), Kittur Rani Channamma college of Horticulture, Arabhavi, Mudalagi, Belagavi,Karnataka (16)
Sponge Gourd (74)	Bihar Agricultural University, Sabour, Bhagalpur, Bihar (25), College of Agriculture, Bikaner, Rajasthan (20), Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore-641003, Tamil Nadu (29)
Summer squash (2)	FOH, SKUAT, Kashmir, Shalimar (2)
Tomato (361)	Moolji Jaitha College, Jilha Peth, Near Samarth Colony, Jalgaon (11), Department of Horticulture, Faculty of Agriculture, Annamalai University, Chidambaram, Tamil Nadu (50), CCS HAU Regional Research Station, Uchani, Karnal (5), College of Agriculture, Bikaner, Rajasthan (15), School of Agricultural Sciences and Technology, Babasaheb Bhimrao Ambedkar University, Lucknow (40), Faculty of Horticulture and Forestry, SKUAST-J, Chatha (50), Institute of agricultural Sciences, BHU, Varanasi (1), School of Agriculture, ITM, University, Gwalior, Madhya Pradesh (20), Horticultural Research Station (Vegetables and Flowers), Annamayya (Dist), Andhra Pradesh (5), ANDUAT, Kumarganj, Ayodhya, Uttar Pradesh (25), SGT University, Gurugram (50), S.V. Agricultural College, Tirupati Andhra Pradesh (50), Nagaland University, School of Agricultural Sciences, Medziphema, (30), Floricultural Research Station, Rajendranagar, Hyderabad (5), Vegetable Research Station, Palur, Tamil Nadu Agricultural University, Cuddalore, Tamil Nadu (2), University of Horticultural Sciences, Bagalkot, College of Horticulture, Bagalkot (2)
Yard long bean (7)	Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu (7)
Total 1732 accessions of 19 vegetable crops distributed to 52 organizations	

Exploration and collection of germplasm: In a collaborative exploration program with NBPGR in Gondia, Balaghat, Seoni districts during 1-11 November 2023, a total of 61 accessions comprising of *Abelmoschus ficulneus* (1), *Solanum lycopersicum* subsp. *Cerasiforme* (1), *Solanum melongena* (6), *Abelmoschus esculentus* (1), *Solanum nigrum* (1), *Lagenaria siceraria* (2), *Luffa aegyptiaca* (2), *Luffa hermaphrodita* (1), *Macrytiloma bicolor* (1), *Brassica* spp. (1), *Abelmoschus tuberculatus* (1), *Capsicum annum* (1), *Abelmoschus manihot* var *tetraphyllus* (1), *Crotolaria pallida* (1) and others (3) were collected. Further, IC numbers for 82 accessions collected from the exploration program undertaken in Kutch region and adjoining districts of Gujarat in collaboration with ICAR-NBPGR, New Delhi during 2022-23, were also obtained.

Vegetable Production

MEGA PROGRAMME-3: PRODUCTIVITY ENHANCEMENT THROUGH BETTER RESOURCES MANAGEMENT

PROJECT 3.1: TECHNOLOGIES FOR PROTECTED VEGETABLE PRODUCTION (TILL 31.03.2023)

Nutrient scheduling in tomato based on plant growth phases: To establish a nutrient scheduling strategy based on tomato's growth phases, the NPK content across different phenological stages were analyzed. The highest nitrogen (N) content was observed during the seedling phase, followed by a gradual decrease in subsequent stages, except for a slight increase during the flower opening stage. N content then declined steadily, reaching its lowest point during the ripe fruit phase. A similar trend was observed for phosphorus (P). However, potassium (K) content increased progressively from the seedling to the mature fruit stage, with a slight decrease noted during the ripe fruit phase. Based on tissue analyses, it was estimated that tomato plants remove 357.0 kg/ha of N, 85.0 kg/ha of P, and 527.0 kg/ha of K from the soil. Utilizing nutrient use efficiency data, the actual nutrient requirements were calculated, resulting in the recommended fertilizer doses of 376.0 kg/ha of N, 189.0 kg/ha of P, and 659.0 kg/ha of K. Trials were conducted with five different fertilizer doses: 75%, 100%, 125%, 150%, and 175% of the estimated dose of fertilizers (EDF). Among these, the 125% EDF dose yielded the best results in terms of overall yield and key yield-related characteristics such as cluster number, fruit weight, and size. Additionally, this dose exhibited the highest total soluble solids (TSS) content. However, the 75% EDF dose showed higher antioxidant activity (Table 1 & 2).

PGR - induced parthenocarpy in bitter gourd: In greenhouse environments where insect pollinators are excluded, assisted pollination becomes essential for bitter gourd fruit set. Artificial parthenocarpy, induced by external application of plant growth regulators (PGRs), is commonly used to stimulate fruit set in such situations. In our study, we utilized a combination of plant growth regulators (PGRs) including GA_3, melatonin, putrescine hydrochloride, zeatin, epibrassinolide, and β-naphthoxyacetic acid (β-NOA). These were administered by applying a lanolin paste containing PGRs directly to the pedicels of fully open flowers of cvs. Pusa Rasdar (PR) and Kashi Pratistha (KP). Flowers of control plants were hand-pollinated on the day of anthesis. Despite their smaller size, PGR-Lanolin treated fruits yielded 2.42 kg, which was at par with hand-pollinated fruits (Table 3). The smaller size of PGR-

Fig. 1: Seedlessness induced by the PGR application in bitter gourd. PGR-treated fruits (left) and hand-pollinated control fruits (right).

Table 1: Yield and attributing traits as affected by fertigation in tomato

Treatment	No. of fruit clusters	No. of fruits/ cluster	Avg. Fruit weight (g)	Avg. Fruit length (cm)	Avg. Fruit width (cm)	Yield/ plant (kg)	Yield/ ha (ton)
EDF @ 75%	20.31	5.29	57.38	4.98	4.14	6.16	123.2
EDF @100%	23.77	5.26	53.34	4.74	4.11	6.60	132.4
EDF@125%	33.09	5.64	60.31	4.83	4.34	11.06	221.2
EDF @150%	28.68	6.71	54.16	4.92	4.26	10.42	208.6
EDF @175%	28.32	6.65	53.62	4.76	4.05	10.11	202.2
$CD_{0.05}$	3.114	0.683	8.649	0.188	0.225	0.349	2.318

Table 2: Fruit quality attributes as affected by fertigation in tomato

Fertilizer doses	TSS (°Brix)	Phenol (mg GAE /100 g FW)	Flavonoids (mg QE/100g FW)	Lycopene (mg/100 g FW)	AOX (%)
75% EDF	4.0	76.58	21.52	8.12	92.74
100% EDF	4.3	63.19	20.55	7.33	95.83
125% EDF	4.8	58.99	22.72	6.29	80.18
150% EDF	3.9	56.66	20.87	4.35	77.19
175% EDF	3.7	53.02	19.98	3.87	79.41
$CD_{0.05}$	1.135	4.271	1.719	1.248	7.625

treated fruits may be attributed to a higher female-to-male ratio, resulting in heavy fruit setting and competition for photo-assimilates among developing fruits. However, the treated fruits had fewer seeds (Fig. 1), making them preferable to consumers for cooking, processing, and canning.

Table 3: Effect of hand pollination and PGR application on yield and associated characters

Treatment	No. of Fruits/ plant			Fruit weight (g)			Yield/ plant (kg)			Fruit TSS (^{0}Brix)			Vitamin C (mg/100g)		
	KP	PR	Mean	KP	PR	Mean	KP	PR	Mean	KP	PR	Mean	KP	PR	Mean
PGR-Lanolin	74.47	38.53	56.50	36.39	55.13	45.76	2.71	2.12	2.42	3.75	2.53	3.14	84.86	79.38	82.12
Hand pollination	40.89	28.19	34.54	62.85	80.57	71.71	2.57	2.51	2.54	2.9	2.33	2.62	70.17	71.67	70.92
Mean	61.86	34.15	48.01	44.90	64.66	54.78	2.59	2.24	2.41	3.63	2.61	3.12	80.18	77.83	79.00
$CD_{0.05}$	V= 5.743 T= 3.972 VxT=7.941			V= 12.479 T= 18.551 VxT= 21.458			V= 0.381 T= 0.295 VxT= 0.397			V= 0.674 T= 0.496 VxT= 0.688			V= 5.293 T= 4.848 VxT= 5.356		

Generally, the effects of a pre-harvest treatment given for fruit set and increased parthenocarpic fruit do not show influence on the fruit firmness. However, we observed that the treated fruit of both Pusa Rasdar and Kashi Pratistha showed higher firmness over control at all storage days after harvest. Firmness values showed sharpest decline after 24 hours of ambient storage in both cultivars. On the final day, both were not fit for consumption. However, Pusa Rasdar showed loss of firmness on last day by about 30 folds while Kashi Pratistha by 5 folds in comparison to values at harvest (Fig. 2).

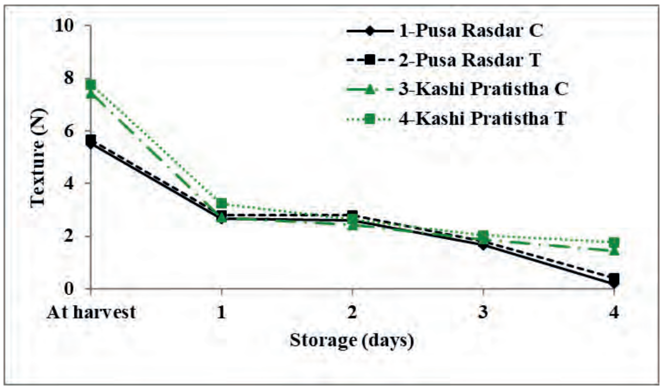


Fig. 2: Variation in fruit firmness as affected by PGR-application in bitter gourd.

PROJECT 3.10: AGRONOMIC BIO-FORTIFICATION STUDIES IN VEGETABLE CROPS (TILL 31.03.2023)

Preparation and evaluation of crop group specific micronutrient formulations: Kashi Sookshma Shakti Plus: Four micronutrient liquid formulations (Micromix A, Micromix B, Micromix C and Micromix D) comprising of mixture of plant essential micronutrients and plant growth regulators, were prepared and evaluated for their effect on pea and french bean crop growth and yield under field conditions at ICAR-Indian Institute of Vegetable Research, Varanasi. The efficacy of these formulations was compared with Veg. Special from ICAR-IIHR, Bengaluru and a commercially available formulation. Micromix C proved better, recording the maximum yield and quality attributes in pea and French bean. Apart from the yield and its attributing characters, Micromix C registered higher values for growth and quality parameters. It enhanced approximately 13.39% and 11.93% yield in pea and french bean, respectively as compared to control condition.The best performing formulation was christened as ''Kashi Sookshma-Shakti Plus''. Kashi Sookshma-Shakti Plus (liquid micronutrient formulation) was prepared using vermiwash as its base/carrier. It contains micronutrient mixture (Zn, Fe, Mn, Cu, B and Mo) and plant growth regulator (GA_3 and NAA).

PROJECT 3.11: DEVELOPMENT OF AGRO-TECHNIQUES FOR ORGANIC FARMING IN VEGETABLE CROPS (TILL 31.03.2023)

Performance of *Rabi* season crops: During *Rabi* season, 2022-23, tomato, cauliflower, pea and brinjal were cultivated, which were harvested during January to March, 2023. The results of the experiments are presented hereunder:

Performance of cauliflower as influenced by vermicompost (VC) prepared from different substrates and mulching: The performance of cauliflower crop was assessed under five organic manures along with one control of inorganic fertilizer under non-mulch and mulch condition. The five organic manure treatments consisted of vermicompost from three different substrates, FYM and NADEP compost, applied at the rate of 200kg N/ha. The results revealed that the highest yield (331.45q/ha), and the maximum average curd weight (1.504kg), was obtained under weed mat mulching with 200 Kg N/ha. Among organic manures, the maximum yield was recorded with VC from radish residue followed by pea straw. Inorganic N application @ 200kg/ha recorded yield of 289.83q/ha (Table 4).

Table 4: Effect of vermicompost of different substrate on yield of cauliflower under mulch and non-mulch condition

Treatment	No. of curds / ha	Yield (q/ha)	Average curd weight (g)
Weed mat	21697.14	331.45	1504.60
No mulch	21658.83	294.60	1337.81
CD (p=0.05)	NS	42.21	112.4
VC of *neem* leaves	22265.63	289.30	1299.45
VC of radish residues	23177.08	331.69	1380.45
VC of pea straw	22512.42	324.31	1440.58
NADEP	22819.51	291.86	1278.99
FYM	22472.17	319.49	1475.90
Inorganic control	22571.11	289.83	1283.94
No manure	15928.00	144.70	906.82
CD (p=0.05)	NS	37.53	159.40

Performance of tomato crop as influenced by vermicompost prepared from different substrate: Three experiments were conducted on tomato to develop nutrient management schedule under organic farming**.** The response of five organic manures along with one inorganic control was studied on the performance of two tomato cultivars under mulching condition. The five organic manure treatments consisted of vermicompost prepared from three different substrates, FYM and NADEP compost, applied to supply 200kg N/ha. The result revealed that mulching increased the yield significantly by 48.33% over non-mulch. Highest yield was realized by application of NADEP compost but it was at par with inorganic fertilizer and FYM. NADEP and FYM were found to be better source for tomato over vermicompost. Under no mulch condition, all the organic sources were at par, however, inorganic treatment recorded significantly higher yield over organic treatment. Under mulching, NADEP and FYM recorded significantly higher yield over rest of the organic sources as well as inorganic treatment. Under mulching, Kashi Aman was at par with Kashi Adarsh while under non-mulch condition, Kashi Adarsh was significantly superior over Kashi Aman (Table 5).

Effect of humic acid spray on yield of tomato varieties: The effect of humic acid spray in combination with organic manures was studied on the yield of two tomato varieties. There were two spray schedules of humic acid, *viz.*, Hum-1: Humic acid spray @ 5ml/l at 30, 45, 60 75, 90 and 105 DAT and Hum-2: Humic acid spray @ 5ml/l at 30, 45, 60 DAT. Dose of nitrogen supplied was 200kg/ha through NADEP, FYM and VC. The result revealed that spray of humic acid increased tomato yield over control. Both the spray schedules were found to be equally effective. Among different sources of manure, application of N through FYM and NADEP compost was found superior over VC in tomato. Both the varieties performed at par. Kashi Aman performed better under VC while Kashi Adarsh was better under NADEP and FYM. The response of humic acid was more pronounced under NADEP and FYM in both the varieties (Table 6).

Effect of biopriming of tomato seed with microbes on yield as influenced by application of different organic manures: The three bio priming treatments were, T1- bio priming with *Trichoderma* + M44, T2= bio priming with M44 and T3- No inoculation. The result revealed that bio priming with *Trichoderma* + M44 increased the tomato yield significantly over no inoculation. Seed inoculation with microbial consortium improved yield of tomato under mulch and non-mulch condition (Fig. 3).

Table 5: Effect of organic manures on productivity (q/ha) of tomato varieties under mulch and non-mulch condition

Treatment	No mulch			Weed mat mulching			Mean
	Aman	Adarsh	Mean	Aman	Adarsh	Mean	
VC Radish	174.03	324.44	249.24	464.04	424.44	444.24	346.74
VC Pea	194.17	264.03	229.10	398.89	390.07	394.48	311.79
VC Neem	201.34	239.93	220.64	392.08	367.12	379.60	300.12
NADEP	208.96	257.45	233.21	578.77	571.36	575.06	404.14
FYM	204.44	234.17	219.31	574.39	537.76	556.07	387.69
Inorganic (control)	278.40	336.30	307.35	468.60	479.40	474.00	390.68
Mean	210.22	276.05		479.46	461.69		
Mean (Mulching)	243.14			470.58			
Mean (Variety)	Aman	327.42	Adarsh	347.41			
CD (p=0.05)							
Mulching (M)	Source (M, manure)	Variety (V)	M x S	M x V	S x V	M x S x V	Mulching
52.12	32.43	NS	43.3	46.76	NS	58.32	52.12

Table 6: Effect of humic acid application on productivity (q/ha) of tomato varieties under mulch condition with organic manures

Treatments	VC		NADEP		FYM		Mean
	Aman	Adarsh	Aman	Adarsh	Aman	Adarsh	
Humic-1	439.24	394.17	550.47	578.26	559.2	627.43	524.80
Humic-2	423.69	407.26	545.21	620.7	558.06	514.06	511.50
Control (No spray)	392.08	340.07	423.69	465.76	497.74	495.49	435.81
Mean	418.34	380.50	506.46	554.91	538.33	545.66	
Mean (Source)	399.42		530.68		558.66		
Mean (V)	Aman	498.82	Adarsh	493.69			
CD (p=0.05)	Source of manure (S)	Humic acid (H)	Variety (V)	S x H	S x V	V X H	S x V x H
	54.64	61.32	NS	52.32	42.12	NS	64.34

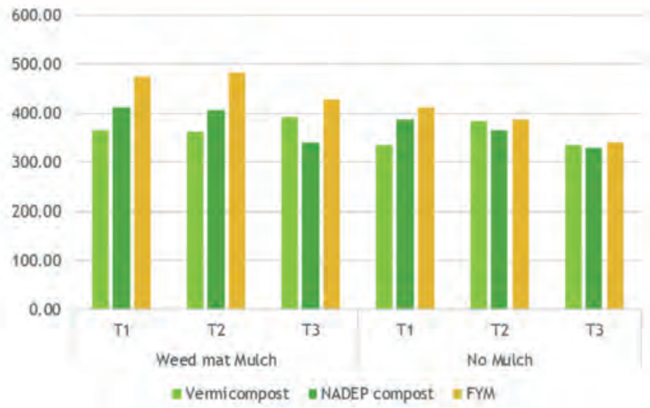


Fig. 3: Effect of bio priming of seed with microbial consortia on tomato yield under different organic manures and mulching

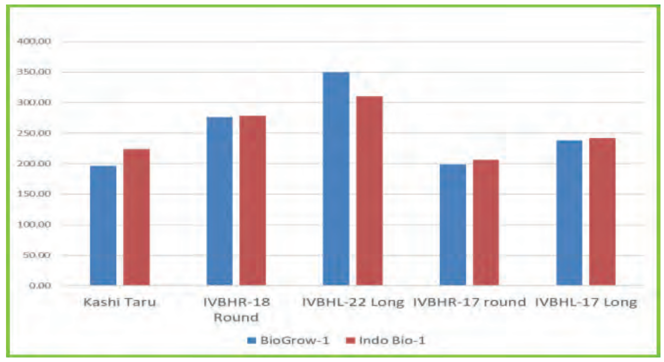


Fig. 4: Evaluation of brinjal advance lines under organic farming

Performance of brinjal: Five brinjal advance lines were assessed under organic farming for their suitability with two sources of inoculation Bio Grow-1 and Indo Bio-1, applied in conjunction with organic manure NADEP compost @20t/ha + VC @2.5t/ha. The result revealed that hybrid IVBHL-22 long performed better than rest of the lines with highest yield of 349q/ha. There was no significant difference between the two sources of microbial consortia. However, the inoculation improved the yield by 7-11% in different brinjal advance lines over control (Fig. 4).

Performance of pea: The vegetable pea was grown under three variable rates of three organic manures. The highest yield of vegetable pea was recorded under application of NADEP compost @ 15t/ha, which was significantly higher than rest of the organic treatments except FYM@25t/ha (Table 7).

Table 7: Effect of organic manures on pea yield

Treatment	Yield (q/ha)	No. of pods /plant	Grains/ pod	Grain wt./ pod (g)	Cost of cul. (Rs/ha)	Total return (Rs/ha)	Net return (Rs/ha)	B:C ratio
FYM 15 t /ha	97.8	8.4	8.8	7.5	76050	176040	99990	2.31
FYM 20 t /ha	99.4	9.6	8.6	7.6	80200	178920	98720	2.23
FYM 25 t /ha	103.0	9.8	8.6	7.9	84350	185400	101050	2.20
VC 5 t /ha	95.3	7.6	8.1	6.5	86350	171540	85190	1.99
VC 7.5 t /ha	92.8	9.8	8.0	7.0	97725	167040	69315	1.71
VC 10 t /ha	88.2	12.1	8.4	7.6	109100	158760	49660	1.46
NADEP 15 t /ha	115.1	11.5	8.3	7.8	77850	207180	129330	2.66
NADEP 20 t /ha	98.2	13.4	8.0	7.7	82600	176760	94160	2.14
NADEP 25 t /ha	101.1	11.8	8.1	7.7	87350	181980	94630	2.08
FYM + NADEP	109.6	10.4	8.7	8.3	83275	197280	114005	2.37
FYM +VC	100.6	8.8	8.7	8.9	81400	181080	99680	2.22
NADEP +VC	91.5	9.8	8.2	7.9	84475	164700	80225	1.95
Inorganic	87.3	10.4	8.7	8.3	70915	157140	86225	2.22
CD (p=0.05)	18.2	2.2	NS	1.03				

Effect on soil properties: Among organic manure treatments, highest organic carbon content of soil (0.54%) and lowest bulk density (1.32) was noted with application of 200Kg N/ha through FYM. The organic carbon content of soil was 0.44% and bulk density (1.48) under inorganic treatment (Fig. 5).

There was significant increase in available nitrogen, phosphorous and potassium content of soil due to application of different organic manures over inorganic treatment (Table 8).

Table 8: Available nutrient in soil as influenced by organic manure treatments

Treatments	Available soil nutrient (Kg/ha)		
	N	P	K
200kg N /ha VC Radish	255.5	22.7	247.6
200 kg N/ha VC Neem	244.2	22.7	239.8
200 kg N/ha VC Pea	256.5	24.0	251.9
200 kg N/ha NADEP	278.1	24.8	269.6
200 kg N/ha FYM	279.1	23.0	266.5
Inorganic	224.1	21.3	256.5
CD (p=0.05)	18.2	2.6	12.7

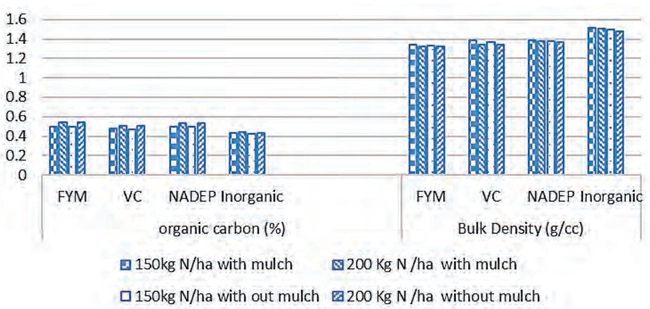


Fig. 5: Organic carbon content and bulk density of soil as influenced by organic treatments

Effect on soil microflora: Bacterial count was significantly higher in soils treated with NADEP as compared to those treated with inorganic fertilizers. Similarly, fungal count in plots treated with NADEP compost @25 t/ha (19.0x104±3.61) was significantly higher than those treated with inorganic fertilizer alone (11.0x104±1.0). The maximum microbial activity was observed with application of NADEP compost @ 200 kg N/ha (Table 9).

Quality parameters of vegetables: The quality of vegetables in terms of vitamin C content was better under organic system as compared to inorganic system. In cauliflower, the ascorbic acid, antioxidant and total phenol content was higher than the inorganic treatment. The quality of tomato was improved under organic farming as compared to inorganic treatment (Table 10 & 11).

Natural farming (NF) in vegetables: A pilot project on natural farming in vegetable crop was started since *Rabi* season 2021. During *Rabi* 2022-23, under natural farming, two crops cauliflower and tomato were grown. These crops were harvested during January to March, 2023.

The crops were grown under natural farming in plots of 600 m^2 in ridge and furrow system. The crop was mulched with paddy straw @ 7.5 t/ha, *Jeevamrit* was sprayed at 15 days interval, and irrigation was given in alternate furrows. The 25 days old seedlings of cauliflower variety Megha and tomato variety Kashi Aman were transplanted on 25.10.22. The results revealed that in cauliflower the survival percentage of seedlings was 84.5 and 94.2%, average curd weight 356.6g and 1005g, average yield 86.45 and 262.4 q/ha and average duration of crop was 94 and 82 days under natural and organic farming, respectively. In tomato, the survival percentage of seedling was 89.8 and 91.4%, number of plants/ha was 24285 and 26285, yield 73.78 and 223.6 q/ha, average fruit weight 36.32 and 66.4 g and fruits per plant 8.32 and 17.3 under natural and organic farming, respectively. There was significant improvement in microbial population as well as microbial activity in soil due to natural farming.

Indian beans, water spinach and pea were also evaluated under natural farming during *Rabi* season 2022-23. The crops harvested during January to March, 2023 are presented here under;

Table 9: Microbial activity under organic farming

Treatment	Dehydrogenase activity (µg TPF/ day/g of soil)	Fluorescein diacetate (FDA) activity (µg fluorescein/g/hr)	Acid phosphatases (µg p-nitrophenol/ hr/g)	Alkaline phosphatases (µg p-nitrophenol/ hr/g)
200 kg N/ha VC radish	115.04±5.79	2.38±0.3	77.38±5.83	370.15±9.13
200 kg N/ha FYM	136.69±8.65	2.57±0.25	91.18±7.03	379.23±9.55
200 kg N/ha VC Neem	113.55±7.81	2.35±0.19	145.82±5.48	320.73±12.15
200 kg N/ha VC Pea	128.53±4.37	2.38±0.11	150.62±4.32	329.03±10.82
150 kg N/ha NADEP	173.87±15.79	3.19±0.25	169.29±3.71	446.73±6.26
Inorganic	98.04±5.66	2.65±0.07	77.38±7.29	244.70±12.66
LSD (5%)	14.47	0.40	9.36	16.70

Table 10: Quality parameters of cauliflower curd as influenced by treatments

Treatments	MC (%)	DM (%)	Phenol (mg GAE/100 g FW)	Antioxidant (%)	Ascorbic acid (mg/100g FW)
VC of radish + mulching	91.9	8.1	33.33	22.5	42.30
VC of neem leaves + mulching	91.8	8.2	34.21	24.2	36.30
VC of pea straw + mulching	92.0	8.0	38.22	23.3	33.20
FYM + mulching	92.0	8.0	34.55	23.5	33.30
NADEP + mulching	92.0	8.0	30.71	26.2	30.20
VC of neem leaves No mulch	91.9	8.1	28.88	21.7	29.70
VC of radish No mulch	90.8	9.2	28.32	23.9	37.20
VC of pea straw No mulch	92.1	7.9	37.81	21.4	41.28
NADEP + No mulch	90.9	9.1	24.67	25.6	38.34
FYM + No mulch	92.2	7.8	30.98	24.8	36.72
Inorganic +No mulch	91.9	8.1	20.75	19.6	22.42
Inorganic +Mulching	92.3	7.7	26.05	20.8	24.71

Table 11: Quality parameters of tomato as influenced by treatments

Treatment	MC (%)	Ascorbic acid (mg/100g FW)	Titratable acidity (%)	Lycopene (mg/100 g FW)	TSS (°B)	Radical scavenging capacity (%)
VC of radish+ mulching	94.59	17.67	0.63	4.04	4.5	91.66
VC of neem leaves + mulching	94.26	18.75	0.64	4.42	4.4	85.72
VC of pea straw + mulching	94.23	18.36	0.79	3.39	4.4	91.57
FYM + mulching	93.95	17.31	0.61	4.37	4.5	93.42
NADEP + mulching	93.73	17.27	0.62	3.81	4.3	90.86
VC of neem leaves No mulch	94.02	17.31	0.77	3.10	4.5	83.24
VC of radish No mulch	94.34	17.33	0.56	3.74	4.4	94.23
VC of pea straw No mulch	93.85	15.67	0.70	3.12	4.5	91.22
NADEP + No mulch	93.40	16.77	0.59	4.06	4.5	90.21
FYM + No mulch	94.23	17.75	0.80	4.17	4.7	88.76
Inorganic + No mulch	94.88	15.84	0.63	3.24	4.5	86.25
Inorganic + Mulching	91.19	14.72	0.53	2.84	3.9	76.24

In Indian beans, drastic reduction in yield was observed under natural farming during first year. However, with application of FYM @ 5 t/ha, there was improvement in yield (Table 12). Similarly, in water spinach and vegetable pea, application of FYM under natural farming improved the yield.

Performance of summer season- 2023 crops: During summer season, pumpkin and bottle gourd were grown under five treatments and three replications. The perusal of the figure revealed that application of FYM@ 3 t/ha + neem cake @ 5 t/ha under weed mat mulching produced highest yield and number of fruits/ha was significantly higher than inorganic treatment. In bottle gourd highest yield and number of fruits was noted with application of FYM @ 30 t/ha and vermicompost @ 5 t/ha under weed mat mulching (Fig. 6 & 7).

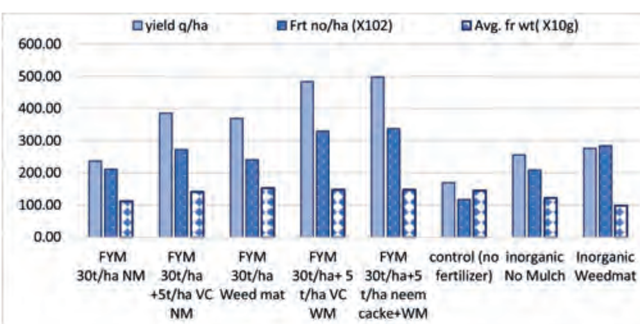


Fig. 6: Effect of organic treatments on fruit yield, number and weight in pumpkin during summer season

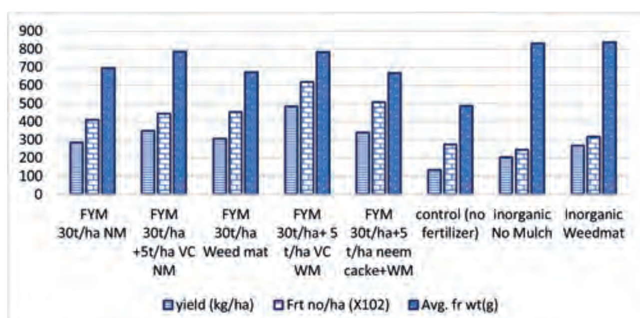


Fig. 7: Effect of organic treatments on fruit yield number and weight in bottle gourd during summer season

Table 12: Green pod yield of Indian beans (q/ha)

Crop/ Variety	Treatment			
	NF	FYM 5 t/ha + NF	OF with 40 kg N/ha (FYM)	Chemical @30-60-30 kg NPK / ha
Kashi Bauni Sem 18	61.97	81.40	139.05	141.4
Kashi Bauni Sem 3	67.94	79.49	124.70	143.7
	NF	FYM 5 t/ha + NF	OF with 40 kg N/ha (FYM)	Chemical @ 40-20-20 kg NPK / ha
Water spinach	67.4	112.8	128.4	138.6
	NF	FYM 5 t/ha + NF	OF with 40 kg N/ha (FYM)	Chemical @40-60-40 kg NPK/ha
Kashi Uday	35.24	77.07	86.17	79.31

PROJECT 3.12: IMPROVING WATER PRODUCTIVITY OF VEGETABLE CROP SEQUENCES THROUGH DRIP IRRIGATION SYSTEM (TILL 31.03.2023)

Drip irrigation study was carried out in okra during spring-summer 2023. Treatment comprised of drip irrigation at 100% ET with twice daily, once daily or at alternate day. Two types of mulches i.e., black–silver and pea-straw were also applied with un-mulched as control. Experimental findings revealed that drip irrigation scheduling and mulching significantly enhanced most of the growth and yield parameters of okra. Maximum fruit yield (279 g/plant and 285.66 q/ha) was reported in drip irrigation twice daily at 100% ET with black-silver much. This irrigation and mulch combination registered 107.63% higher yields than the un-mulched furrow irrigated plants. Maximum WUE of 8.33 q/ha/cm was reported with drip irrigation at alternate day with black-silver much followed by pea straw much (6.91 q/ha/cm). As compared to un-mulched furrow irrigated plant (control), 56.5% and 33.6% higher yields were obtained in black-silver and pea straw mulches, respectively.

PROJECT 3.13: ENHANCING PRODUCTIVITY, QUALITY AND TOLERANCE TO BIOTIC AND ABIOTIC STRESSES IN VEGETABLES BY GRAFTING TECHNOLOGY (TILL 31.03.2023)

Optimization of Brimato production: For optimized production of brimato (Fig. 8), three scions of tomato and three scions of brinjal were evaluated in field. The maximum number of fruits in tomato were noticed in K. Aman x K. Sandesh (53.67) and Vani x K. Uttam (52.67) combinations, whereas in brinjal it was maximum in K. Aman x K. Manohar (22.33) and K. Chayan x K. Manohar (21.00). Overall, the maximum yields of 5.98 kg/plant (tomato 3.60 kg and brinjal 2.38 kg) were reported when Kashi Aman and Kashi Sandesh were grafted over IC 111056 rootstock (Table 13).

Standardization of grafting technique in Pomato: In pomato (Fig. 8), two cultivars of potato *i.e.*, Kufri Bahar (white) and Kufri Sinduri (red) were used as rootstocks while Kashi Aman tomato was used as scion. Tomato was grafted over potato sprouts with single, double or triple scions. Maximum yield of 3.79 kg/plant (2.88 kg tomato and 0.91 kg potato) was obtained when two

Table 13: Stionic effect of brinjal and tomato for fruit production in brimato

Brimato scion combinations	No. of fruits/plant		Fruit yield (kg/plant)		Total yields (kg/plant)
	Tomato	*Brinjal*	*Tomato*	*Brinjal*	
K. Aman x K. Sandesh	53.67	6.67	3.60	2.38	5.98
K. Aman x K. Uttam	47.67	6.00	2.94	2.26	5.20
K. Aman x K. Manohar	49.33	22.33	3.06	2.32	5.38
K. Aman x K. Vijay	48.67	17.33	2.94	1.75	4.69
K. Chayan x K. Sandesh	38.33	7.33	2.90	2.58	5.48
K. Chayan x K. Uttam	40.00	4.67	2.89	1.45	4.34
K. Chayan x K. Manohar	41.00	21.00	3.01	2.04	5.05
K. Chayan x K. Vijay	38.67	15.67	2.78	1.44	4.22
Vani x K. Sandesh	49.33	3.33	2.91	0.85	3.76
Vani x K. Uttam	52.67	2.33	3.20	0.68	3.88
Vani x K. Manohar	43.67	7.33	2.80	0.80	3.60
Vani x K. Vijay	43.33	5.33	2.81	0.48	3.29
SEm±	1.56	2.05	0.07	0.22	0.25
$CD_{0.05}$	4.17	5.35	0.18	0.58	0.64

Fig. 8: A view of Brimato and Pomato plants

scions of Kashi Aman was grafted onto white potato (Table 14).

revealed VRO 128 and VROR 160 as drought stress tolerant genotypes. VROR 160 and VRO 128 show a comparatively lesser reduction in yield under drought stress (9.7%) in contrast to the control (10.5 %). It was unveiled that VRO 128 and VROR 160 enhanced water uptake through increased root volume and root length, respectively under drought stress. Hence, the study exhibited that VRO 128 and VROR 160 have the potential for inclusion in breeding programs to produce drought-tolerant varieties due to their resilience to drought conditions and their strong genetic capacity for enhanced performance under drought stress.

Table 14: Effect of potato rootstock and tomato scion quantity on pomato production

Rootstock/scion combination	No. of fruits/ plant	No. of tubers/ plant	Fruit yield (kg/ plant)	Tuber yield (kg/ plant)	Total yield (kg/ plant)
Kuf. Bahar/ K. Aman with single scion	50.00	12.33	2.08	0.630	2.710
Kuf. Bahar/ K. Aman with double scion	64.33	14.00	2.88	0.910	3.790
Kuf. Bahar/ K. Aman with triple scion	54.00	21.67	2.67	0.706	3.376
Kuf. Sinduri/ K. Aman with single scion	49.33	11.67	2.12	0.464	2.584
Kuf. Sinduri/ K. Aman with double scion	61.00	12.33	2.39	0.562	2.952
Kuf. Sinduri/ K. Aman with triple scion	58.67	11.33	2.34	0.473	2.813
SEm±	2.49	1.60	0.13	0.07	0.19
$CD_{0.05}$	6.79	4.37	0.35	0.19	0.51

PROJECT 3.17: BIOREGULATOR INDUCED DROUGHT STRESS TOLERANCE IN OKRA (*ABELMOSCHUS ESCULENTUS*) (TILL 31.03.2023)

Screening of okra genotypes for drought stress tolerance under pot condition: Twenty-four genotypes of okra were evaluated for their drought tolerance (moisture deficit) ability through a pot experiment during the *summer* season of 2023. Pots of each genotype were divided into two sets, i.e., control (C) and drought (D) treatments accounting for 03 replicates per genotype. The two sets were watered at 100% field capacity (FC) daily upto 20 DAS and after that water stress treatment was imposed. After 20 days of growth the control (C) set was irrigated with 100 % of FC whereas under drought stress (D) set was irrigated with 50% FC for 50 days. After 50 days of moisture stress treatment, the effect of drought stress on morpho-physiological, biochemical and yield characteristics of okra genotypes were evaluated including photosynthesis rate, chlorophyll content, antioxidant activity (specifically peroxidase and catalase), lipid peroxidation, as well as the synthesis of proline and hydrogen peroxide content. The hierarchical clustering of genotypes based on morpho-physiological, biochemical and yield characteristics

PROJECT 4.4: INFLUENCE OF POLYAMINES ON POSTHARVEST SENESCENCE AND QUALITY OF HIGH VALUE VEGETABLES (TILL 31.03.2023)

The capsicum fruits were treated with anti-senescence molecules spermidine (T2) and spermine @ 1.5 mM (T3) before harvest followed by application of bilayer edible coating (1% chitosan and 0.5% carboxy methyl cellulose) and storage at 10°C. It was observed that weight loss increased with progression in storage. On 10th day, control fruit showed 2.25% loss compared to 1.15% in SPM treated and chitosan-CMC coated fruit. On the final day, 13.96% loss was recorded in control. Till 30 days, the rate of weight loss was almost double in untreated fruit. Confirming with the weight loss trend, a steady decline in moisture content which is a major indicator of loss of surface glossiness, fruit texture and tissue crunch was observed (Fig. 10). Lower moisture losses in treated bell pepper fruits could be attributed to the lower respiration rates, moisture barrier properties of chitosan *i.e.*, micro-structural changes on the coated fruit surface (Fig. 9), regulation of water vapour, and gas exchange and anti-senescence properties of polyamines. Radical scavenging capacity was found to peak at mid storage period followed by a gradual decline to reach values similar to initial activity. Steady decline in total phenolics content followed by increase during the last

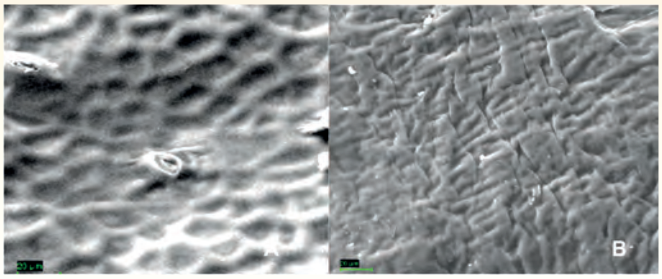


Fig. 9: Micro-structural change observed in surface of uncoated (A) and bilayer edible coated fruit (B)

20 days of storage was noted. Maximum ascorbic acid (46 mg/100 g) was observed on the initial day of storage.

T3 and control showed 12% and 29% loss, respectively in ascorbic acid on the last day of storage over initial value. Lowest ascorbic acid was observed in control fruit on 30 days of storage. Chlorophyll content was found to decline gradually over the storage period in all the treatments. About 39% decline in chlorophyll content was recorded on the final day. Flavonoid content range between 4.66 to 6.35 mg QE/100 g fw. About 20-26% decline in total flavonoids content was observed during storage. Marked rise in catalase activity was observed on 30th day of storage. About 1.7 fold higher catalase activity in T3 was observed over control on 30th day (Fig. 10). Overall, 1.5mM spermine and bilayer coating of chitosan 1% and CMC 0.5% were found most optimum for quality preservation and shelf life extension.

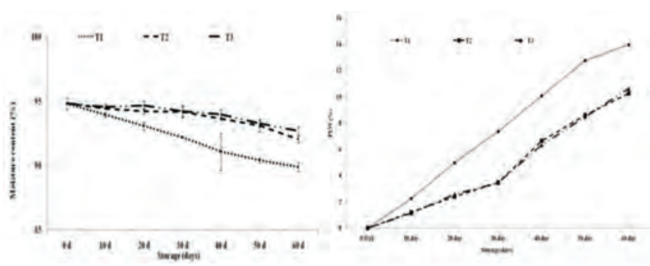


Fig. 10: Changes in moisture content (%) and weight loss (%) during storage

MEGA PROGRAMME 5: PRIORITIZATION OF R&D NEEDS AND IMPACT ANALYSIS OF TECHNOLOGIES DEVELOPED BY ICAR-IIVR

PROJECT 5.4: EMPOWERING RURAL YOUTH FOR VEGETABLE BASED ENTREPRENEURSHIP (TILL 31.03.2023)

During the last phase of the project, all the data collected from 350 beneficiaries on entrepreneurial behaviour pattern was analysed before and after conduction of the EDPs and the result was follows; risk taking behaviour 31.29% before and 55.46% after, hope of success 46.37% before and 77.34% after, persistence 28.81% before and 39.28% after, use of feedback 62.62% before and 75.69% after. Likewise self confidence 52.18% and 77.76%, knowledgibility 50.36% and 79.11%, persuability 39.97% and 50.69%, managibility 38.55% and 47.51%, innovativeness 33.00% and 55.13% and achievement motivation 56.64% and 81.30% were assessed before and after situation. Apart from that institutional marketing model for promoting oyster mushroom was established, real time technical support provided to promote vegetable seedling business model and opportunities explored to promote vegetable juice for small scale entrepreneurship.

PROJECT 5.5: ECONOMIC IMPACT ASSESSMENT OF IIVR DEVELOPED TECHNOLOGIES (TILL 31.03.2023)

Total estimated area coverage under varieties developed by ICAR-IIVR, Varanasi on the basis of total truthfully labelled and breeder seed sold during the year 2021-22 has been analysed. The total breeder seed sold during the year 2021-22 was 2709.00 kg. of 14 crops and 29 varieties and total truthfully labelled seed sold during the year 2021-22 was 14239.01 Kg. of 23 crops and 62 varieties. The total estimated area coverage (ha) under varieties developed by Institute was about 1,33,133 ha in the country during the year 2021-22 including 23 vegetable crops and 62 varieties. The institute variety has spread in 161 districts in 27 states and 3 UTs in the country. The estimated incremental gain in production due to the adoption of ICAR- IIVR vegetable varieties was 112.67 thousand tons and the incremental gain in income with ICAR- IIVR varieties was estimated to Rs. 239.41 crores during the year 2021-22.

PROJECT 5.6: DEVELOPMENT AND PROMOTION OF NUTRI-GARDEN MODULE FOR RURAL HOUSEHOLDS (TILL 31.03.2023)

Trials of kitchen garden modules were conducted for validation of the module. Apart from sensitizing rural people, particularly women through training and demonstrations, trials of 02 nutri-garden modules for small family size were conducted in different cropping season at ICAR-IIVR research farm in an area of 100 m^2 and 150 m^2 with three replications to study its impact on vegetable consumption. Trials conducted in 100 m^2 area fetched a total of 210.54 kg leafy vegetables and 359.44 kg other green vegetables with daily availability of 0.58 kg leafy vegetables while 0.98 kg other green vegetables, which is sufficient for a family size of 5-6 members. In 150 m^2 area, total vegetables fetched were 271.61 kg leafy vegetables and 498.89 kg other green vegetables with daily availability of 0.74 kg leafy vegetables and 1.37 kg other green vegetables, which is sufficient for a family size of 7-8 members.

PROJECT 1: PRECISION FARMING IN HIGH VALUE VEGETABLE CROPS (W.E.F 01.04.2023)

Soilless substrate-based cucumber production: Soilless vegetable production systems based on substrates have emerged as a promising alternative to conventional soil-based agriculture, especially in areas where soil quality is poor or there is limited arable land, such as urban regions. Spent mushroom substrate, previously considered an environmental hazard, can now be repurposed as a growing substrate for cultivating vegetables. These spent mushroom wastes were either composted or used as such to assess their suitability as growing media for soilless cucumber (cv. Y-225) production in the greenhouse (Fig. 11). Among the various treatments, BMS (Button mushroom spent) treatment showed highest fruit length (16.93 cm), fruit width (4.31 cm), fruit weight (177.46 g), and yield per plant (1.87 kg) compared to other treatments, while cocopeat + CRB7 + *Trichoderma* treatment showed the second highest yield per plant (1.83 kg). BMS compost and OMS (oyster mushroom spent) compost showed relatively lower yields per plant compared to other treatments. Overall, the BMS treatment exhibited superior performance in terms of fruit characteristics and yield, followed by cocopeat + CRB7 + *Trichoderma* treatment, while cocopeat treatment showed moderate results (Table 15).

Fig. 11: Mushroom spent being utilized as substrate for soilless cultivation of cucumber

Upon quality assessment, it was noted that cocopeat + *Actinomycetes* treatment exhibited the highest texture (2.712 N), while Oyster Mushroom Spent noted the highest chlorophyll content (549.02 µg/g FW), and Button Mushroom Spent registered the highest total phenolic content (26.77 mg GAE/100 g FW) among the treatments. Overall, BMS treatment demonstrated superior performance in RSA, TSS, and total phenolic content compared to other treatments. BMS Compost treatment showed high ascorbic acid content (Table 16).

Table 15: Yield of parthenocarpic cucumber as affected by different growing media

S. No.	Growing media	Fruit length (cm)	Fruit width (cm)	Fruit weight (g)	Yield/ plant (kg)
1.	Button Mushroom Spent Compost	15.52	3.68	130.58	1.11
2.	Button Mushroom Spent (BMS)	16.93	4.31	177.46	1.87
3.	Oyster Mushroom Spent Compost	15.92	3.28	137.33	1.28
4.	Oyster Mushroom Spent (OMS)	15.70	3.52	130.78	1.45
5.	Cocopeat + CRB7 + *Trichoderma*	15.73	3.57	137.83	1.83
6.	Cocopeat + Actinomycetes	15.49	3.50	157.67	1.41
7.	Cocopeat	15.80	3.63	157.51	1.29
8.	$CD_{0.05}$	2.975	1.594	30.668	0.349

Table 16: Fruit quality characteristics of cucumber as influenced by different soilless media

S. No.	Treatment	Texture (N)	Chlorophyll (µg/gFW)	TPC (mg GAE/100 g FW)	Flavonoids (mg QE/100g FW)	Ascorbic acid (mg/100 g FW)	RSA (%)	TSS (°Brix)
1	BMS Compost	1.78±0.11	277.6±11.9	20.0±1.6	1.6±0.0	22.1±1.8	79.1±2.1	3.9±0.1
2	BMS	2.15±0.08	344.0±17.6	26.2±1.7	2.5±0.02	10.9±0.7	82.4±1.5	4.5±0.2
3	OMS Compost	2.36±0.02	382.3±16.0	26.8±1.1	2.2±0.01	11.3±1.1	76.2±1.3	4.0±0.03
4	OMS	2.44±0.21	549.0±22.9	23.3±0.3	2.2±0.03	7.5±0.7	76.9±0.9	3.8±0.03
5	Cocopeat + CRB7 + Trichoderma	2.47±0.12	277.0±4.8	17.6±0.2	1.7±0.0	7.9±0.8	76.2±1.2	2.8±0.03
6	Cocopeat + Actinomycetes	2.71±0.08	278.9±4.8	18.8±0.8	1.9±0.05	10.9±0.7	77.9±0.4	2.8±0.07
7	Cocopeat	2.45±0.04	190.2±11.8	24.8±2.3	2.1±0.02	10.8±1.4	77.8±0.1	2.9±0.03

PROJECT 2: HARNESSING GRAFTING TECHNIQUES AND BIOREGULATORS TO IMPROVE VEGETABLE CROPS RESILIENCE AGAINST ABIOTIC STRESSES (W.E.F 01.04.2023)

Assessment of waterlogging tolerance in cucurbits: A pot experiment was conducted to evaluate the waterlogging tolerance level between the cucurbit's species. Eight types of cucurbits *viz.*, ridge gourd (Kashi Shivani), bottle gourd (Kashi Ganga), sponge gourd (Kashi Shreya), pumpkin (Kashi Basant), ash gourd (Kashi Dhaval), acidmelon x snapmelon (Summerfit), watermelon (Sahara) and cucumber (Kalyanpur Green) plants were subjected to waterlogging treatment for 72 hours after 18 days of transplanting (Fig. 12). Plant leaf samples were collected before waterlogging treatment as well as immediately after the stress period. Furthermore, plant survival rate was recorded 6 days after waterlogging treatment. Our results showed that the total chlorophyll and carotenoid contents significantly decreased with waterlogging treatment among all the cucurbits. Accordingly, a significant increase in the activity of antioxidant enzymes was noted in the leaves of all the cucurbits exposed to waterlogging treatment. Thus, our results suggest that the plant increases the activity of the antioxidative enzymes to adapt to waterlogging stress, which could keep intracellular oxidative homeostasis. The results showed that waterlogging treatment considerably increased the MDA content (92.94%) and hydrogen peroxide content (44.23%) in cucumber plants, which were significantly higher than others (Fig. 13). The content of proline (40.12%) and phenol (35.65%) were found highest in pumpkin after 72 hours of waterlogging treatment. Severe waterlogging stress effect was noticed on cucumber as all the plants were not able to survive (survival rate = NIL) due to waterlogging stress injury (Fig. 14). Secondly, bottle gourd was also found to be sensitive for waterlogging stress with only 20% survival rate after waterlogging stress treatment. Conversely, there was 100% survival rate in ridge gourd, sponge gourd, pumpkin, ash gourd, acidmelon x snapmelon (Summerfit) and watermelon (Sahara) plants after waterlogging treatment. We also found that waterlogging treatment induces the formation of adventitious roots formation in pumpkin.

Fig. 12: Waterlogging treatment of cucurbits

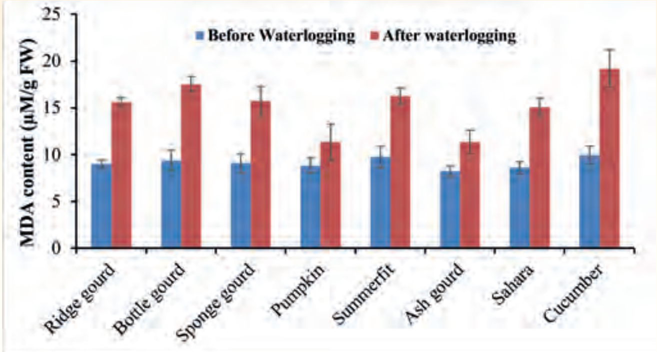


Fig. 13: Lipid peroxidation changes (MDA content) in the cucurbits before and after waterlogging stress treatment. Lipid peroxidation changes (MDA content) in the cucurbits before and after waterlogging stress treatment.

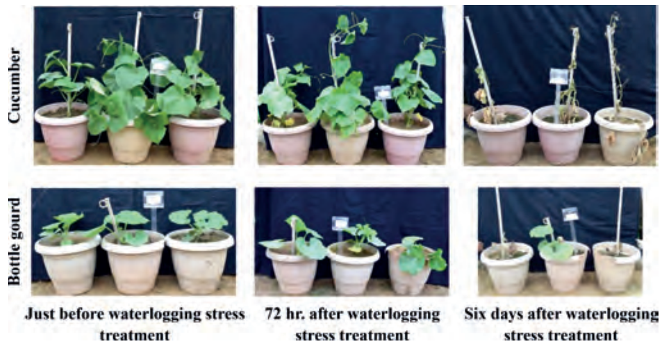


Fig. 14: Growth of cucumber and bottle gourd plants before and after waterlogging treatment.

Assessment of salinity stress tolerance in cucurbits based on physiological and biochemical attributes: Plants of *Cucurbitaceae* family are salt-sensitive. A pot experiment was conducted at ICAR-IIVR, Varanasi to evaluate the salinity tolerance level within the species. Nine types of cucurbits *viz.*, ridge gourd (Kashi Shivani), bottle gourd (Kashi Ganga), sponge gourd (Kashi Shreya), pumpkin (Kashi Basant), ash gourd (Kashi Dhaval), acidmelon x snapmelon (Summerfit), watermelon (Sahara), satputia (Kashi Khushi) and cucumber were subjected to two levels of salinity stress treatment (3 dSm^{-1} and 6 dSm^{-1} irrigation water). Different morpho-physio-biochemical and ionic attributes were recorded after 60 days of salt stress treatment. Least oxidative stress was detected in ash gourd and pumpkin as they showed lowest malondialdehyde (MDA) and hydrogen peroxide under salinity stress as compared to other species. Furthermore, there were also least reduction in membrane stability index (MSI) and chlorophyll content in ash gourd (26.13% and 27.88%) and pumpkin (24.18% and 32.77%) under 6 dSm^{-1} salt treatment condition as compared to control. Activities of catalase and peroxidase enzymes were significantly higher in ash gourd (27.22µM H_2O_2 reduced g^{-1} FW min^{-1} and 14.21 µM tetra-guaiacol formed g^{-1} FW min^{-1}, respectively) and pumpkin (25.15 µM H_2O_2

reduced g^{-1} FW min^{-1} and 11.22 µM tetra-guaiacol formed g^{-1} FW min^{-1}, respectively) as compared to other species under salt stress (6 dS m^{-1}) conditions. Ash gourd and pumpkin also showed highest fold change of proline (4.57 and 3.81-fold) and phenol (3.27 and 3.55-fold) accumulation under 6 dSm^{-1} salt stress condition compared to control. Pumpkin showed highest increase in K^+ (2.66-fold in leaves and 6.13-fold in roots) and Ca^{2+} (2.58-fold in leaves and 7.27-fold in roots) uptake followed by bottle gourd and ash gourd under salinity stress (6 dSm^{-1}) as compared to control condition. However, highest increase in Na^+ uptake was recorded in cucumber (3.1-fold in leaves and 3.8-fold in roots) plants followed by sponge gourd and ridge gourd at salinity stress (6 dSm^{-1}) as compared to control condition (Fig. 15).

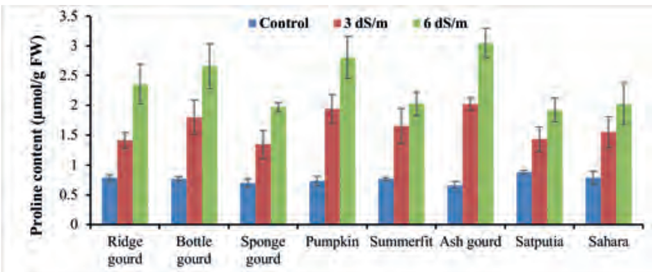


Fig. 15: Proline content (µmol/g FW) in cucurbitaceae family plants under different treatment conditions.

Physiological and biochemical aspects of compatibility in grafted cucumber under salinity stress

A high yielding variety of cucumber (Kalyanpur Green) grafted on different cucurbits rootstocks (ridge gourd var. Kashi Shivani, bottle gourd var. Kashi Ganga, sponge gourd var. Kashi Shreya, pumpkin var. Kashi Basant, ash gourd var. Kashi Dhaval and acidmelon x snapmelon var. Summerfit) were evaluated for their tolerance under salinity stress (3 dSm^{-1} and 6 dSm^{-1} irrigation water) as compared to non-grafted plants. Increasing salinity concentrations (3 to 6 dSm^{-1}) significantly ($P < 0.05$) reduced the morphological parameters (shoot length, shoot dry biomass and root length) in non-grafted and grafted cucumber plants. Cucumber plants grafted onto ash gourd showed least decrease in shoot dry weight (29.3%) and root length (27.14%) under saline environment (6 dSm^{-1}) compared to non-grafted ones (Fig. 16). Under saline growing environment (6 dSm^{-1}), the maximum photosynthetic rate (1.4-fold) and stomatal conductance (1.1-fold) was noted in cucumber plants grafted onto ash gourd relative to non-grafted ones. Furthermore, the maximum superoxide dismutase (SOD), catalase (CAT), peroxidase (POD) and total phenolic content (TPC) were noted in cucumber plants grafted on ash gourd under the highest saline growing conditions (6 dSm^{-1}). The cucumber plants grafted on ash gourd exhibited 29%, 33.1%, 28.5% and 25.9% enhancement in SOD, CAT, POD and TPC respectively, compared to non-grafted ones under 6 dSm^{-1}. It was observed that enhancement in salinity stress (3-6 dSm^{-1}) significantly ($P < 0.05$) but negatively affected K^+ and Ca^{2+} content, while positively enhanced Na^+ content in leaves and roots of non-grafted and grafted cucumber plants. The cucumber plants grafted on pumpkin exhibited higher uptake of K^+ (2.16-fold in leaves and 4.33-fold in roots) and Ca^{2+} (2.03-fold and 5.11-fold) than non-grafted ones under salinity stress (6 dSm^{-1}). However, minimum Na^+ uptake (1.12-fold in leaves and 3.5-fold in roots) was noted in cucumber plant grafted onto ash gourd under salinity stress (6.0 dSm^{-1}). The maximum Na^+ uptake was recorded in non-grafted cucumber plants (3.8-fold in leaves and 4.23-fold in roots) followed by cucumber plants grafted onto sponge gourd at a salinity level of 6 dSm^{-1}.

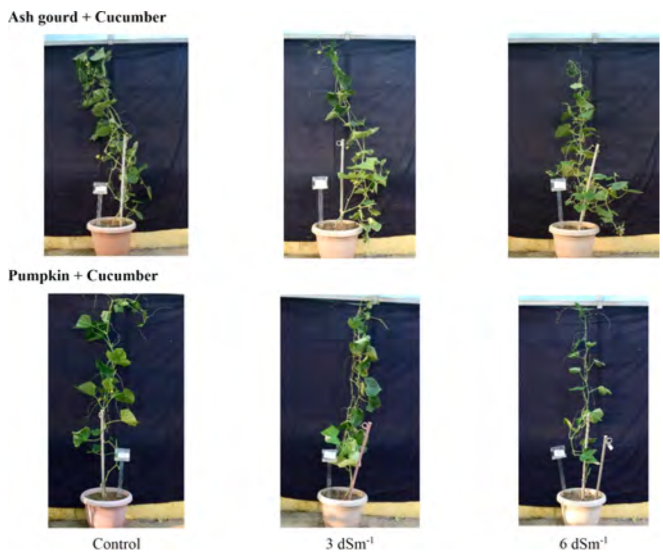


Fig. 16: Cucumber plants grafted on Ash gourd (a) and Pumpkin (b) under different treatment conditions.

Screening of okra genotypes for drought stress tolerance at seedling stage: Twenty-four genotypes of okra were obtained from the Division of Vegetable Improvement, ICAR-IIVR, Varanasi to study the effect of drought at seedling stage. Seeds were sterilized for five minutes in 10% sodium hypochlorite and germinated in a germinator (temperature -25±2°C). Germinated seeds with emerged radicles were sown into protray containing pre-sterilized soilrite and subsequently kept into naturally ventilated polyhouse (Fig. 17). Osmotic stress was applied to the plants by adding 18% (w/v) PEG 6000 solution. Protray of each genotype were divided into two sets, i.e., control (C) and drought (D) treatments. Drought (osmotic) stress was applied to the

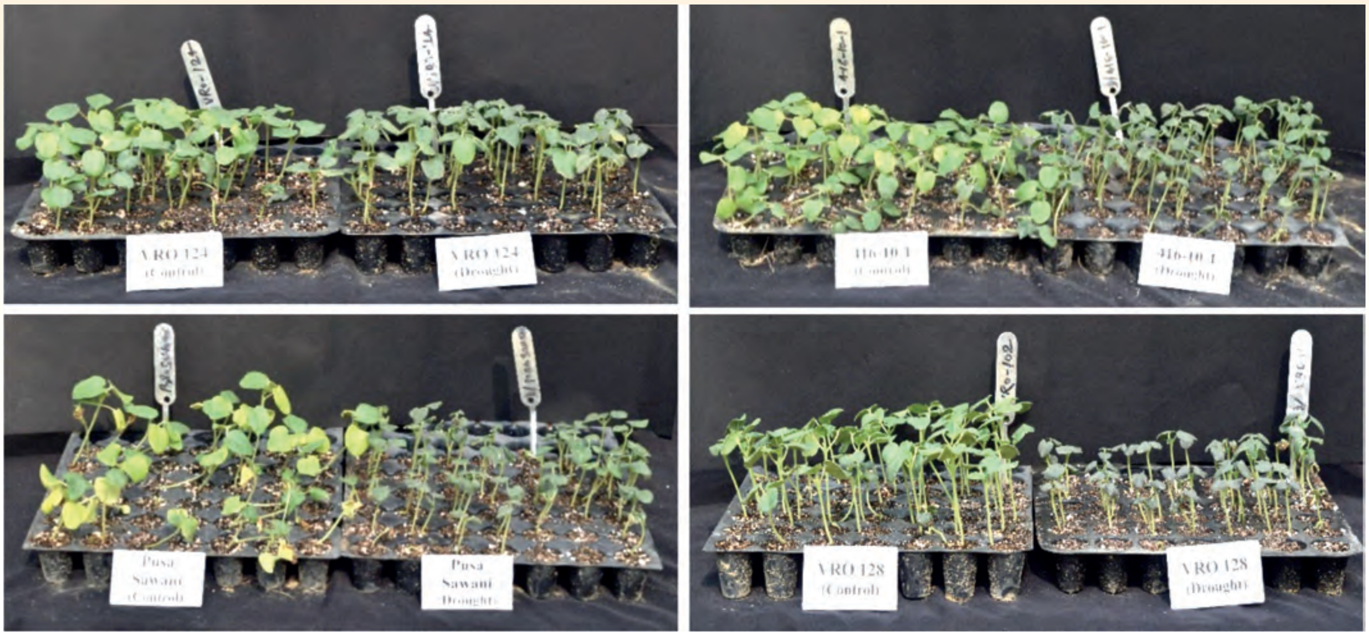


Fig. 17: A view of okra genotypes grown under protray.

plants by adding 18% PEG solution. Both the sets were allowed to grow for 30 days and irrigated at regular interval along with Hoagland solution. The growth parameters root and shoot lengths were significantly affected by drought stress. Across the genotypes, Pusa Sawani (52.47%) showed least reduction in root length followed by VRO 124 (56.28%) under drought stress whereas VRO 105 (2.21%) showed least reduction in shoot length followed by VRO 114 (2.81%). VROB 178 (4.10%) followed by VRO 105 (7.45%) showed least percent reduction in shoot dry weight (g). Pusa Sawani (20.63%) followed by VRO 160 (41.66%) showed least reduction in root dry weight (g). Cluster analysis based on morphological, physiological and biochemical traits revealed that Pusa Sawani, VRO 416-01-1, VRO 124 and VRO 128 are drought stress tolerant genotypes.

PROJECT 3: DEVELOPMENT OF TECHNOLOGIES FOR PRODUCTION OF VEGETABLES UNDER ORGANIC FARMING (W.E.F. 01.04.2023)

Screening of okra genotype for organic farming during *Kharif* season: In this experiment, fourteen genotypes were screened for yield performance and other agronomic traits under organic farming.

Table 17: Yield of okra lines under organic farming

Advance lines	Total yield (t/ha)	Marketable yield (t/ha)	Non Marketable yield (t/ha)	% damage
VRO-210	8.74	5.43	3.31	37.85
VRO-201	6.90	4.96	1.94	28.07
VRO-217	9.43	8.37	1.06	11.26
VRO-216	6.08	2.71	3.36	55.34
VRO-200	10.94	8.56	2.38	21.73
VRO-236	6.57	5.01	1.56	23.77
Kashi Utkarsh	7.73	6.18	1.55	20.06
VRO-220	7.99	5.13	2.85	35.71
VRO-219	8.62	7.01	1.62	18.74
VRO-204	6.62	5.19	1.43	21.54
Kashi Parakram	11.08	7.96	3.12	28.17
VRO-232	6.12	4.31	1.81	29.61
Kashi Chaman	8.76	6.73	2.03	23.15
VRO-227	6.17	5.89	0.28	4.53
CD(P=0.05)				

The perusal of the table revealed that the highest yield was recorded in variety Kashi Parakram (11.08t/ha) followed by VRO-200 (10.94t/ha). Fruit damage due to insects was observed to the tune of 4.53 to 37.85%. Highest marketable yield was noted in VRO-200 (8.56t/ha) followed by VRO-217 and Kashi Parakram (Table 17). The maximum number of fruits per plant was noted in Kashi Parakram followed by VRO-200, while fruit weight per plant and plant height was the maximum in Kashi Parakram. There was no significant difference in genotypes tested with regards to CCI and NDVI values.

Optimization of the productivity of okra under organic farming: In order to maximize okra productivity and also to assess the influence of various organic nutrient sources on yield, nutrient uptake, use efficiency and soil health, an experiment was conducted with seven treatments and three replications in RBD design.

The perusal of the table revealed that inorganic fertilizer treatment gave highest yield as well as maximum marketable yield in okra. Among organic treatments, the highest yield was recorded with the application of 200 kg N/ha through FYM+ microbial consortia inoculation. However, all the other organic treatments were at par. The average fruit weight per plant was maximum in inorganic treatment. Among organic treatments, the highest fruit weight per plant was noted with application of FYM. Similar trend was observed among organic treatments with respect to other yield parameters (Table 18).

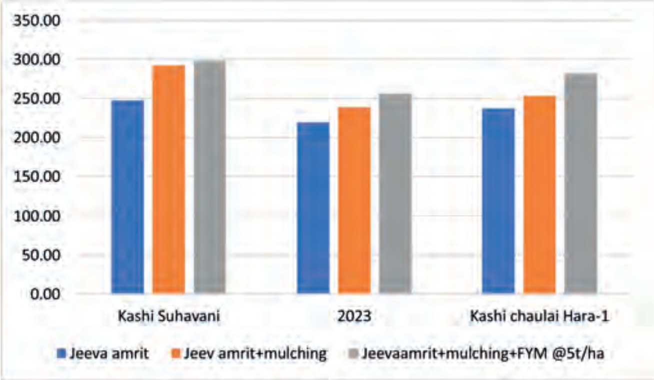


Fig. 18: Evaluation of amaranth varieties under natural farming during *Kharif* season

PROJECT 4: EXPLORATION OF VEGETABLES FOR PROCESSING AMENABILITY, BIOACTIVE POTENTIAL AND DEVELOPMENT OF VALUE-ADDED PRODUCTS (W.E.F 01.04.2023)

Bitter gourd

Bitter gourd is a widely cultivated vegetable grown for its immature fruit and popular for its nutraceutical properties. However, its postharvest life is marred by short storability potential due to rapid tissue softening, weight loss, colour changes from green to yellow in pericarp and white to red in inner tissues and seed hardening. Thus, there is need to identify genotypes with higher inherent bioactive compounds and firmness values. Maximum total phenolics content were recorded in VBT-100 (194.9 mg GAE/100g FW) followed by VBT-61, IC44438, HABG-21, VBT-21 and VBT-58 (171.37, 168.62, 161.80, 157.34 and 153.71 mg GAE/100 g FW, respectively) bitter gourd genotypes.

Lower phenolics content was observed in genotypes VBT-99, VRBTGH-27, VBT-53 and VRBTGH-8. Higher

Table 18: Yield of okra as influenced by organic treatments

Treatment	Total yield (t/ha)	Marketable yield (t/ha)	Non-marketable yield (t/ha)	Fruit weight/ plant	Number of fruits/ plant	Average fruit weight (g)
200kg N FYM	109.12	89.48	19.64	156.98	15.51	10.12
200 kg N VC	94.32	75.93	18.39	133.21	12.88	10.34
200kg N FYM + MI	110.32	88.48	21.84	155.22	13.82	11.23
200 kg N VC + MI	97.32	75.81	21.51	133.00	14.27	9.32
100Kg N FYM+100Kg N VC	107.12	85.80	21.32	150.53	14.85	10.14
100Kg N FYM+100Kg N VC+ MI	108.32	85.03	23.29	149.18	13.18	11.32
Inorganic	128.32	111.64	16.68	195.86	16.13	12.14
CD P=0.05)	17.79	13.47	3.67	20.56	1.58	1.15

Evaluation of vegetable crops under natural farming: During *Kharif* season, amaranth varieties were evaluated for yield and quality under natural farming with three treatments. It is evident from the Fig. 18 that amaranth variety "Kashi Suhavani" performed better than variety "Kashi 2023" but was at par with "Kashi Hara Chaulai". Among the treatment, application of *Jeevaamrit* along with mulching improved yield significantly as compared to sole application of *Jeevaamrit*. Application of *Ghan Jeevaamrit* also improved the yield (Fig. 18).

firmness values were recorded in SBC/DRB-129 (4.93N), SBC/DRB-223-1 (4.44N), KP/DRB/MISC-21-19 (4.13N), VRBTGH-14 (4.12N), VBT-53 (4.06N) and VRBTG-4-1 (4.03N). The firmness of genotypes VBT-6, VBT-21, DRBTG-4, VRBTGH-5(G), VRBTG-23-1 and DVBTG-4-1-2 was observed to be ~50% lesser in comparison to SBC/DRB-129 (Fig. 19).

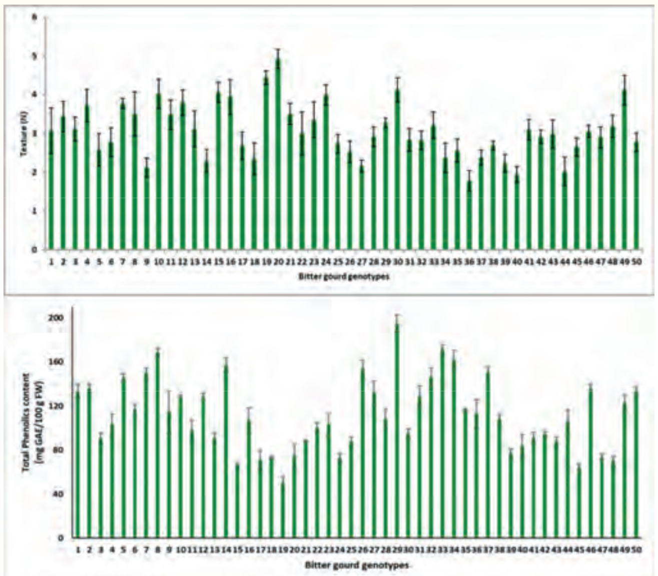


Fig. 19: Textural characteristics and Total phenolics content of different bitter gourd genotypes

Indian bean

In the present study, fifty-two genotypes of Indian bean were analyzed for texture and bioactive compounds content. Significant variation was observed in these genotypes. The recorded variation showed about 6.0 and 5.3-fold variation, respectively in total phenolics content and texture of the studied genotypes. It also identified potential accessions like VRDB-01, HADB-3, VRSEM-37, VRSEM-902, VRSEM-765 and VRSEM-5 as phenolic rich lines for use in breeding programs for biofortification and development of nutritionally superior varieties. Lower phenolics content was observed in VRSEM-830, VRSEM-843 and HADB-5. VRSEM-836 (5.78N), VRSEM-415(5.75N), VRSEM-842 (5.04N) and VRSEM-741 (5.02N) showed high firmness values at harvest. The lowest firmness was recorded in VRSEM-61 (1.09N) (Fig. 20). Texture is an important attribute determining the consumer acceptability of a variety. Softer varieties may have edge as having high preference for taste while firmer varieties may be marked as suitable for long distance transportation and storage. This is useful for indicating the potential postharvest life due to higher firmness content.

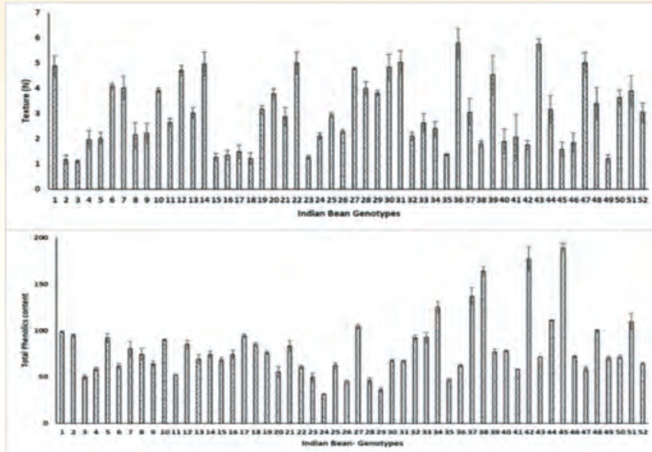


Fig. 20: Textural characteristics and Total Phenolics content of different Lablab bean genotypes

Chilli

Chilli is a major commercial crop of India. In India, particularly the preference of spicy foods is quite high and the trend is showing an increase in worldwide markets too as seen from rising chilli export market. Generally, fresh chillies export requires blemish free, 10-12 cm long chillies with dark green colour, longer colour retention, freshness as indicated by crispness and high moisture content and lower weight loss. However, the chilli genotypes show quick deterioration by weight loss leading to reduced turgidity, changes in colour and shriveling. This study aimed to select genotypes suitable for long distance transportation due to their high turgidity, higher firmness values and retention of green colour for longer time during ambient storage.

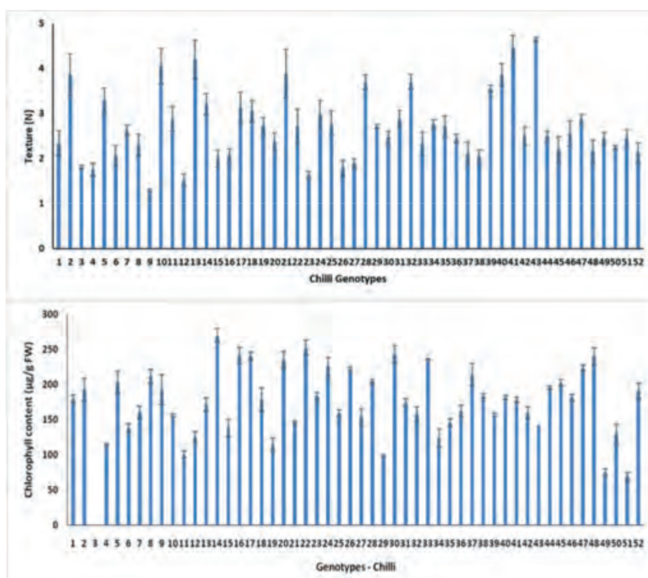


Fig. 21: Textural characteristics and Chlorophyll content of different chilli genotypes

Kashi Gaurav (270.61µg/g fw), A7xF5112, VRC-14, IIVRC-19194, IIVRC-22125 and Kashi Garima were found to have higher chlorophyll values at harvest. However, IIVRC-18057, IC119455, Pant C1, Punjab Lal and Pusa Jwala showed lower values. IIVRC-22100, IIVRC-18131, Kashi Surkh, IIVRC-18131 and IIVRC-18160 showed higher firmness values which showed their potential for possibly higher storability and marketability. Kashi Ratna (1.79N) and IIVRC-18004 (1.51N) showed lower firmness (Fig. 21). The loss in smooth glossy texture and changes in colour from green to red were observed in different genotypes. Chilli genotype "IIVRC- 18057" showed potential in preference ranking test for purchase on the last day of storage.

Fig. 22: Antioxidant rich cherry tomato raisins

Cherry tomato raisins

Cherry tomatoes quickly soften at room temperature; thereby, displaying a limited postharvest life. These are rich in carotenoids, natural sugars and acidity. Here, the process was standardized for preparation of low cost osmotically dried cherry tomatoes infused in sugar solution (Fig. 22). The final TSS of cherry tomato raisins was 53°Brix. The product was dried to 18-25% moisture content to attain slightly fleshy raisin like mouthfeel. The shelf life was extended to 3 months by the use of only class I preservative. It is a novel food product rich in antioxidants, which may find high acceptability among consumers, particularly children as a sweet dessert (Fig. 23).

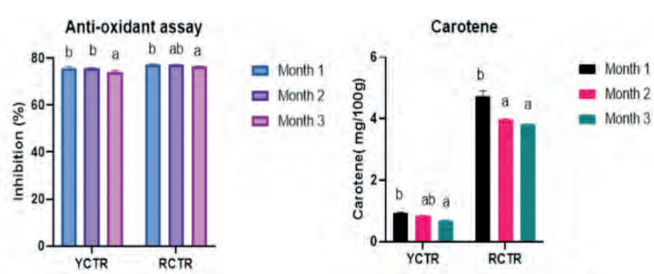
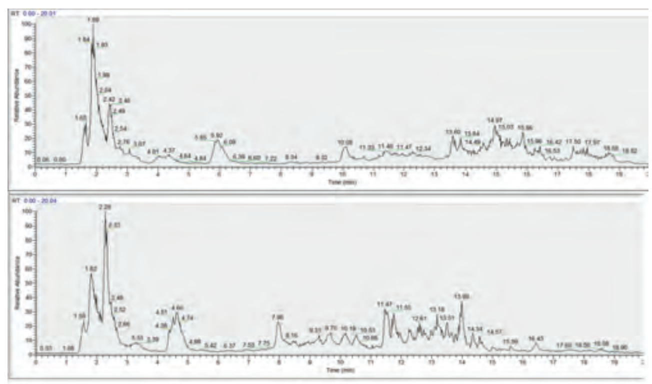


Fig. 23: Carotene and antioxidant inhibition during storage in cherry tomato raisin

Bottle gourd

Phenolic compounds are important contributors to antioxidant capacity thereby neutralizing free radicals and minimizing cellular damage. The peel and pulp samples of bottle gourd cultivar "Kashi Ganga" were assessed by LC-MS/MS to identify the different phenolics compound present in them. Samples were ultrasonically extracted with acidified methanol/water followed by centrifugation, evaporation to dryness, reconstitution and filtration. The sample extracts were injected into a DionexUltimate 3000 Ultra High Performance (UHP) LC that was coupled with a Q-ExactiveOrbitrap MS. Coumaric acid, ferulic acid, kaempferol, luteolin, vanillic acid, 3-hydroxybenzoic acid, caffeic acid, cinnamic acid, gentisic acid, isoquercitrin, luteolin, myricitrin, oleanolic acid, quercitrin, protocatechuic acid and salicylic acid were identified in both the peel and pulp of bottle gourd samples (Fig. 24). Development of nutritionally dense, economically viable and sustainable food products with health benefits is vital towards strengthening efforts for curbing malnutrition and hunger. The bottle gourd peel powder can be integrated as a functional ingredient in popular food matrix like biscuits, cake and muffins.



TIC of Bottle Gourd Pulp (A) and Peel (B) Samples

Fig. 24: TIC of bottle gourd pulp (A) and peel (B) samples

Plasma activated water assisted decontamination of okra and enhancement of proteins in okra seeds: Efficiency of novel method of decontamination dielectric barrier discharge (DBD) and plasma activated water (PAW) treatments were analysed for shelf-life extension of okra pods. DBD treatment exhibited a higher log reduction (1.56 ± 0.25 log cfu/g) in microbial count in cold conditions followed by PAW treatment (1.43± 0.16 log cfu/g). A substantial reduction was observed in the decay rate and browning enzyme activities (polyphenol oxidase and phenyl ammonia lyase) in case of treated samples as compared to control samples. An increase in colour retention (chlorophyll content) and total phenolic content (TPC) was observed in treated samples during storage in both conditions. This study established that the plasma activated water treatment can extend the shelf life of okra from 9 days in ambient condition (25±3^{0}C) to 15 days under cold temperature (10±1^{0}C) storage conditions. It was also established that the shelf life of okra can be increased to 10 days in ambient condition (25±3^{0}C) to 16 days under cold temperature (10±1^{0}C) storage conditions after DBD treatment. The quality attributes examined in this study pointed out that cold plasma treatment can be used as a novel decontamination technique for the shelf-life extension of okra. PAW treatment of okra seed facilitated higher protein yield, and extracted protein exhibited better antioxidant properties and increased water absorption property. A characteristic finger print region for protein and polyhydroxyl group was observed at 3000 nm with increase in peak absorbance with treatment. Highest peak was observed in okra seed protein obtained from PAW assisted germination (OPPAW) followed by okra seed protein obtained from RO water assisted germination (OPRO), suggesting intermolecular bonded O-H stretching and N-C stretching.

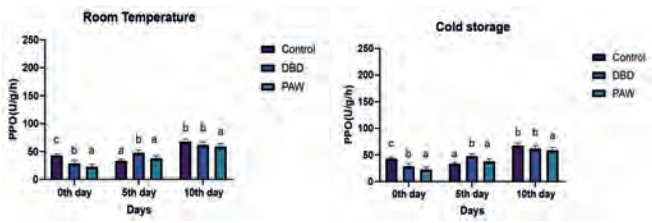


Fig. 25: Effect of decontamination on polyphenol oxidase enzyme

The study concluded that okra seed proteins extracted from PAW assisted germination of okra seed, had higher yield and purity. Also, this protein has a potential to be used as a novel ingredients in functional food preparation (Fig. 25, 26 & 27).

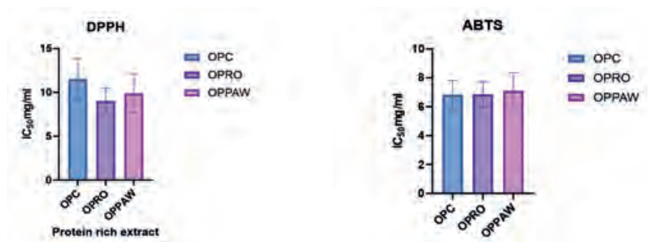


Fig. 26: Antioxidant profile of okra seed protein

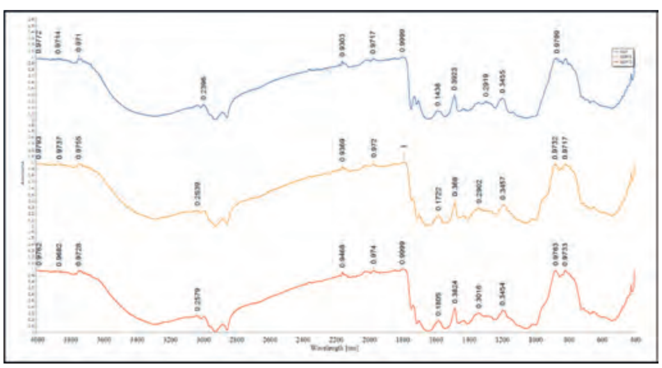


Fig. 27: FTIR-spectra of okra seed protein (bottom curve: OPC-okra seed protein obtained from okra seed as control; middle curve: OPRO-okra seed protein obtained from RO water assisted germination and top curve: OPPAW-okra seed protein obtained from PAW assisted germination

PROJECT 5: VALIDATION AND ECONOMIC IMPACT OF TECHNOLOGIES DEVELOPED AT ICAR-IIVR (W.E.F 01.04.2023)

Technology validation confirms that component technologies can be incorporated into a complete system solution and that system performance and operation are met under anticipated operating scenarios. At the research institutions, scientists come up with many innovative technologies, but these technologies are developed under laboratory or research farm conditions and need validation at the farmer's field under real situation. In the first year of the project, two important technologies were selected for validation at farmers' field conditions. They were (i) pheromone trap for fruit and shoot borer in brinjal and (ii) seed treatment with *Trichoderma* for getting healthy seedling of cucurbitaceous crops. Treatments were formulated along with the inventors of the technologies for comparative studies (Fig 28 & Fig 29).

Fig. 28: Demonstration of pheromone trap to control brinjal fruit and shoot borer at farmer's field

Fig. 29: Demonstration of *Trichoderma* seed treatment in pumpkin at farmer's field

Economic impact assessment of "Kashi Anmol" variety of chilli was done using economic surplus model and partial budgeting techniques. The approximate spread of area under Kashi Anmol variety was estimated at 163695.95 ha during 2005-06 to 2021-22 covering a total of 165 districts in 26 states (calculated from the sale of both TL and breeder seeds data). The average chilli area in the country was 391,667 ha. during TE 2020-21. The annual average area under Kashi Anmol variety of chilli in the country was 9629.17 hectares, which was around 2.46% of total chilli area in the country. The estimated results of economic surplus model (ESM) showed that there was producer surplus of Rs. 11.94 crores, consumer surplus of Rs. 18.94 crores and total economic surplus of Rs. 30.88 crores generated from the variety. The Internal Rate of Return (IRR) was 79% and Benefit Cost Ratio (BCR) 81.22 in the present technology (Table 19). The share of producer surplus and consumer surplus in total surplus was 39:61. The total cost of cultivation of Kashi Anmol variety of chilli was Rs. 221,529 per hectare and the share of fixed and variable cost in Kashi Anmol variety of chilli was 16:84 in total cost of cultivation. The net return from Kashi Anmol variety of chilli was Rs. 2,77,971 per hectare. Cost of production for Kashi Anmol variety of chilli was Rs. 11.98 per kg. The BC ratio was 2.26 for Kashi Anmol variety of chilli grown by the farmers. Cost of cultivation according to various cost concepts reveals that all the costs were higher in cultivation of local variety of chilli over Kashi Anmol. The cost A1 was higher by around 2.61% in cultivation of local variety of chilli over Kashi Anmol. Similarly, the cost C2 was higher by around 2.08% in cultivation of local variety of chilli over Kashi Anmol. The costs reduction and additional returns incurred in Kashi Anmol production over local variety reveals that the increment in profit realization in Kashi Anmol production was Rs. 64,710/ha. The cost on seed, fertilizers, plant protection chemicals, human labour etc. mainly contributed to the reduction in cost of Kashi Anmol production. The added return in Kashi Anmol was attributed mainly through the increased productivity and higher price realization over local variety. It can be concluded from the partial budgeting analysis that the adoption of Kashi Anmol variety of chilli production technology would provide an additional profit to the farmers.

Table 19: Economic surplus of chilli var. Kashi Anmol

S. No.	Cost Benefit Analysis (Rs. crores)	
1.	Net Present Value (NPV)	30.50
2.	Net Present Benefit (NPB)	30.88
3.	Net Present Cost (NPC)	0.38
4.	Internal Rate of Return (IRR)	79 %
5.	Benefit Cost Ratio (BCR)	81.22
Distribution of Economic Surplus (Rs. crores)		
6.	Producer surplus	11.94
7.	Consumer surplus	18.94
8.	Total Economic surplus	30.88

Vegetable Protection

MEGA PROGRAMME 6: INTEGRATED PLANT HEALTH MANAGEMENT

PROJECT 6.1: BIO-INTENSIVE MANAGEMENT OF MAJOR INSECT PESTS OF VEGETABLES IN THE CURRENT SCENARIO OF WEATHER CHANGE (till 31.03.2023)

Evaluation of different pest management modules in tomato: Different pest management modules were evaluated against the major insect pests of tomato (cv. Kashi Aman). Low pest population was observed during the experimental period. Among the three tested modules; M1= Bio-intensive pest management module, M2= Chemical pest management module, M3= Integrated pest management module, minimum fruit damage (4.63%), whitefly/leaf (0.53), Jassids/leaf (0.13), aphids/leaf (0.006) was recorded with chemical pest management module (M2) *i.e.*, Spraying of Imidacloprid 17.8 SL1ml/l at 30DAT, Spiromesifen 22.9 SC 1.25 ml/l at 50 DAT and Indoxacarb 14.5 SC 1ml/l at 70 DAT against 10.23% fruit damage, 10.16 whitfly/leaf, 2.59 Jassids/leaf, and 0.006 aphids/leaf. Further, higher spider (0.88/ plant) and predatory mirid bug population (1.00/ plant) were recorded with Bio-intensive pest management module**.** (M3)

Efficacy of some newer insecticides against black thrips in chilli: Significant differences were obtained among the different insecticides molecules tested under field conditions. Broflanilide 300 SC @ 0.4 ml/l and Fluxametamide 10 EC @ 1.5 ml/l were found highly effective against black thrips, *Thrips parvispinus* giving 100.0 and 99.07 percent reduction over untreated control, respectively. However, Lambda-cyhalothrin 5% EC @ 1ml/l was found least effective giving only 45.47 percent reduction over untreated control after first spray. Fluxametamide 10 EC @ 1.5 ml/l and Broflanilide 300 SC @ 0.2 ml/l were found highly effective against black thrips after the second spray application giving 100 and 98.94 percent reduction over untreated control. However, Lambda-cyhalothrin 5% EC @ 1ml/l was found least effective giving 45.47 and 40.46 percent reduction over untreated control after first and second spray, respectively (Table 1).

PROJECT 6.2: TOXICOLOGICAL INVESTIGATIONS ON THE NOVEL INSECTICIDE MOLECULES AND PLANT ORIGIN INSECTICIDES AGAINST MAJOR INSECT PESTS OF VEGETABLES (till 31.03.2023)

Sublethal effects of spinetoram and cyantraniliprole on diamond back moth, *Plutella xylostella*: The sublethal concentrations (LC_{10} and LC_{25}) of spinetoram showed significant reduction in pupation rate, pupal weight and adult emergence of *P. xylostella*. The fecundity of F1 generation was significantly lower in LC_{25} (117.85 eggs/female) and LC_{10} (121.34 eggs/female) treated group than untreated control (145.32 eggs/female).

Table: 1 Efficacy of some newer insecticides against black thrips in chilli

Treatments	Mean no. of black thrips/flower											
	First Spray						Second Spray					
	PTC	1st DAS	5th DAS	10th DAS	Mean	PROC	PTC	1st DAS	5th DAS	10th DAS	Mean	PROC
Fluxametamide10 EC @ 0.8 ml/l	4.33	0.00	0.00	0.33	0.11	99.07	1.67	0.33	0.00	0.00	0.11	98.14
Fluxametamide10 EC @ 1.5 ml/l	4.00	0.00	0.00	0.33	0.11	99.07	1.00	0.00	0.00	0.00	0.00	100.00
Broflanilide300 SC @ 0.2 ml/l	6.33	1.00	0.33	1.33	0.89	92.44	1.00	0.00	0.00	0.33	0.11	98.94
Broflanilide300 SC @ 0.4 ml/l	6.67	0.00	0.00	0.00	0.00	100.00	1.67	0.00	0.00	1.33	0.44	95.74
Spinosad 45 % SC @ 0.25 ml/l	6.67	3.00	4.67	4.00	3.89	66.98	5.33	4.33	4.00	3.33	3.89	62.34
Spinetoram @ 1 ml/l	4.00	2.33	2.67	3.33	2.78	76.40	4.67	1.33	2.33	3.67	2.44	76.38
Lambda-cyhalothrin 5% EC@ 1ml/l	4.67	6.00	10.33	10.00	8.78	45.47	10.33	11.33	10.00	10.33	10.55	40.46
Control	4.33	10.00	12.00	13.33	11.78	-	12.67	9.67	10.00	11.33	10.33	-
CD (5%)	1.59	1.67	1.59	1.78	1.68		1.35	1.09	1.29	0.97	1.15	
S. Em ±	0.54	0.57	0.54	0.60	0.55		0.46	0.37	0.44	0.33	0.38	

The effects of sub lethal concentrations of Cyantraniliprole 10.26 OD applied at LC_{25} and LC_{10} on the biological characteristics of the diamond back moth, *P. xylostella* were investigated, which showed the extended development time of larvae, reduced larval weight, pupation rate, pupal weight, adult emergence, oviposition period, fecundity and fertility and higher number of malformed adults with the increased concentration of the insecticide.

Evaluation of botanicals for the management of *Maruca vitrata* in cowpea: Different botanicals were evaluated for their efficacy against pod borer, *M. vitrata* in vegetable cowpea. Among them, Neem oil was found the most effective in controlling the *M. vitrata* larval population and showed 65.57 and 67.14 percent reduction over control during flowering and pod formation stage, respectively (Table 2).

PTC-Pre-Treatment Count, NS-Non-Significant, *Mean immature and adult population per five plants after three sprays. Data are means of three replications. Means in the same column followed by different letters differ significantly (P < 0.05) on the basis Duncan's Multiple Range Test.

Bio-efficacy of different novel biorational molecules against sucking pest's complex in okra: Newer molecules like Tolfenpyrad 15% EC @ 2 ml/L showed 83.61 and 70.12 percent reduction over control (PROC) of jassid and whitefly, respectively. Flupyradifurone 17.09% SC @ 2.5 ml/L also showed higher efficacy with 62.90 and 82.17 PROC of jassid and whitefly, respectively (Table 3).

Table 2: Field evaluation of botanicals for management of pod borer, *Maruca vitrata* in cowpea

Treatment	Dose	*Maruca vitrata* in flowers		*Maruca vitrata* in pods		Flower damage	Pod damage	Percent protection over control		Green pod yield
	ml/l	PTC	mean	PTC	mean	(%)	(%)	flower	pods	q/ha
Neem oil	3	12.57a	7.13bcd	17.97a	9.73bcd	11.63bc	12.60b	65.57	67.14	128.73d
Garlic oil	3	12.40a	7.63cd	18.33a	10.53cd	15.20cd	17.53c	62.67	65.15	118.27c
Annonin	3	12.67a	8.23d	18.07a	11.67de	18.43dc	18.30c	60.58	60.84	116.27c
Eucalyptus oil	3	12.57a	8.93d	18.20a	13.53e	21.37c	20.6.0c	56.89	54.90	101.77b
Cypermethrin 25 EC	2	12.77a	4.70ab	18.10a	6.80ab	7.37a	7.27ab	77.67	77.22	149.97f
control	-	13.47a	21.73e	18.60a	30.00f	39.67f	38.03d	-	-	49.70a
LSD at 5%	-	NS	2.01	NS	1.67	1.98	2.92	-	-	3.69
F value	-	0.53	53.373	0.697	66.179	69.107	44.739	-	-	267.922
P value	-	0.799	<0.001	0.674	<0.001	<0.001	<0.001	-	-	<0.0001

Table 3. Bio-efficacy of different novel bioratoinal molecules against sucking pests complex in okra

Treatments	Jassid / leaf			Whitefly / leaf		
	Before spray	After spray	PROC	Before spray	After spray	PROC
T1	14.69	8.92	83.61	18.69	8.49	55.41
T2	13.68	3.87	62.90	20.89	3.28	82.77
T3	15.07	2.70	83.61	19.63	5.69	70.12
T4	16.14	6.11	62.90	20.07	6.95	63.50
T5	15.98	7.39	55.13	17.96	7.89	58.56
T6	13.82	4.95	69.95	19.67	4.46	76.58
T7	1446	12.97	21.25	20.61	14.09	26.00
T8	16.69	16.47	-	20.37	19.04	-
Sem (±)	-	0.19	-	-	0.23	-
LSD (5%)	-	0.57	-	-	0.61	-

Treatment details

T1: Spiromesifen 22.90% SC @ 1 ml/L; T2: Flupyradifurone 17.09% SC @ 2.5 ml/L T3: Tolfenpyrad 15% EC @ 2 ml/L;
T4: Acetamiprid 20% SP @ 0.15 g/L T5: Pyriproxifen 10% EC @ 1.67 ml/L; T6: Dinotefuran 20% SG @ 0.3 g/L
T7: Imidacloprid 17.8% SL @ 0.20 ml / L; T8: Control

PROJECT 6.3: BIOLOGICAL CONTROL OF MAJOR INSECT PESTS OF VEGETABLE CROPS (till 31.03.2023)

Collection & identification of bioagents from major vegetable insect pests: Fall army worm, *Spodoptera frugiperda* (J. E. Smith) (Noctuidae: Lepidoptera) was reported as a pest of maize in India. Recently its infestation was observed in baby corn and sweet corn grown at the experimental farm of IIVR, Varanasi (Fig. 1). A gregarious koibobiont larval endoparasitoid *Cotesia ruficrus* Haliday (Braconidae: Hymenoptera) was recovered from Fall Army Worm feeding on baby corn (Fig. 2). Percent parasitization varied from 15.4 to 22.6. Insect DNA barcoding was done and submitted at NCBI (Accession No. OR227848).

Fig. 1: (a) Fall army worm, *Spodoptera frugiperda* feeding on whorl of baby corn, (b) Adult *Cotesia ruficrus* recovered from larva of *S. frugiperda*

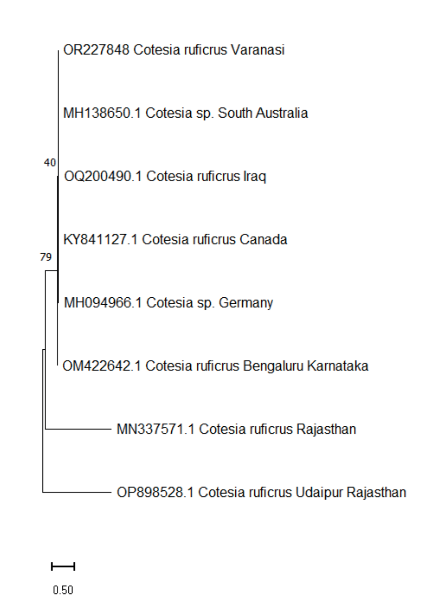


Fig. 2: Evolutionary relationship of *Cotesia ruficrus. Cotesia ruficrus* Varanasi denotes the thrips collected from Varanasi. The evolutionary history was inferred using the Neighbor-Joining method with 1000 bootstrap replicates. The evolutionary distances were computed using the Maximum Composite Likelihood method and are in the units of the number of base substitutions per site.

Compatibility and synergism of major neonicotinoids with different entomopathogenic fungi (EPF) against *Aphis craccivora*: The black bean aphid, *Aphis craccivora* Koch., is a sap sucking insect that feeds on leguminous vegetable crops. Both nymphs and adults drain sap from young shoots, tender fruits, apical buds and devitalizing the plants. To control this sucking pests, different entomopathogenic fungi *viz*., *Beauveria bassiana*, *Metarhizium anisopliae*, and *Lecanicillium lecanii* were tested alone and half of their recommended doses with neonicotinoids insecticides (Imidacloprid 17.8% SL, Thiamethoxam 25% WG and Acetamiprid 20% SP) against *A. craccivora*. The white halo fungus, *L. lecanii* had the lowest median lethal time (46.60 h) to kill 50% of the test population, followed by *B. bassiana* (47.89 h) and *M. anisopliae* (48.27 h). Similarly, among the neonicotinoids examined, Acetamiprid was the most toxic (LT_{50} = 28.78 h). The combination of *L. lecanii* + Acetamiprid at half of their recommended doses was found to be the most effective, leading to the lowest median lethal time of 22.67 h, followed by *B. bassiana* + Acetamiprid (23.29 h). Combination of the EPF like *B. bassiana*, *M. anisopliae*, and *L. lecanii* with neonicotinoids at half of their recommended concentrations are not only compatible but also synergistic in action and could be a viable green ecofriendly option in the management of *A. craccivora*.

Table 3: Median lethal time of EPF and neonicotinoid insecticides alone and their combinations at half of the recommended doses against *A. craccivora* during 2023

Insecticides	Heterogenity		Regression Equation (Y=)	LT_{50} (hr)	Fiducial Limit	Co-toxicity coefficient w.r.t.	
	df	χ^2				EPF	Neonicotinoid
Beauveria bassiana	3	4.479	4.641X – 2.798	47.89	52.94 – 43.34	--	--
Metarhizium anisopliae	3	0.226	5.389X – 4.074	48.27	52.68 – 44.23	--	--
Lecanicillium lecanii	3	1.569	5.123X – 3.547	46.60	51.13 – 42.47	--	--
Imidacloprid 17.8% SL	4	1.381	4.399X – 1.424	28.85	33.89 – 24.56	--	--
Thiamethoxam 25% WG	3	0.476	5.066X – 2.424	29.21	33.79 – 25.25	--	--
Acetamiprid 20%SP	4	0.182	3.526X – 0.146	28.78	35.28 – 23.48	--	--

B. bassiana + Imidacloprid	5	5.291	2.646X + 1.277	25.51	30.85 – 21.09	1.88	1.13
M. anisopliae + Imidacloprid	4	0.183	4.341X – 1.159	26.25	31.63 – 21.78	1.82	1.10
L. lecanii + Imidacloprid	4	5.729	2.418X + 1.628	24.81	30.42 – 20.23	1.93	1.16
B. bassiana + Thiamethoxam	4	1.829	2.597X + 1.424	23.80	28.62 – 19.80	2.03	1.23
M. anisopliae + Thiamethoxam	4	4.475	2.549X + 1.379	26.11	32.05 – 21.60	1.85	1.12
L. lecanii + Thiamethoxam	4	6.332	2.575X + 1.497	22.93	27.67 – 19.01	2.11	1.27
B. bassiana + Acetamiprid	4	6.043	2.546X + 1.518	23.29	28.17 – 19.26	1.99	1.24
M. anisopliae + Acetamiprid	4	6.005	2.576X + 1.445	24.01	29.14 – 19.79	1.94	1.20
L. lecanii + Acetamiprid	4	1.265	3.003X + 0.898	22.67	26.60 – 19.33	2.06	1.27

$$\text{Co-toxicity co-efficient w.r.t. EPF} = \frac{LT_{50}\text{ value of entomopathogenic fungi alone}}{LT_{50}\text{ values of insecticide and EPF mixture}}$$

$$\text{Co-toxicity co-efficient w.r.t. neonicotinoids} = \frac{LT_{50}\text{ value of neonicotinoid insecticide alone}}{LT_{50}\text{ values of insecticide and EPF mixture}}$$

Values of CTC > 1 indicated they are compatible and synergistic in action with each other and when CTC < 1 showed that they are not compatible and antagonistic in action

PROJECT 6.4: DEVELOPMENT OF EFFECTIVE INTEGRATED MANAGEMENT PACKAGE FOR IMPORTANT FUNGAL DISEASES OF VEGETABLE CROPS (till 31.03.2023)

A field experiment was conducted cv. with eight integrated packages for eco-friendly management of fungal diseases of brinjal variety Kashi Uttam (round) using truthfully labelled seeds of institute. Soil solarisation on nursery beds, Nylon net 40 mesh covering of nursery beds and green manuring in main field are common for all the treatments. The details of eight modules are given below:

T1 Chemical Module-I: Seed treatment by captan 70% WP + hexaconazole 5%@ 0.25% during sowing. Seedling root dipping in captan +hexaconazole @ 0.25% during transplanting. Spray mancozeb 75% WP @ 0.25% at 55 DAT. Spray of carbendazim @0.1% at fruit initiation stage 70 after first spray. Spray of carbendazim @ 0.1% 100 DAT. Spray of mancozeb @ 0.25% at fruit maturity.

T2 Chemical module-II: Seed treatment by carbendazim @ 0.25% during sowing. Seedling root dipping in carbendazim @0.1% for 30 minutes during transplanting. Spray carbendazim @0.1% 55 DAT. Drench CoC @0.3% 70 DAT. Drench carbendazim @ 0.1% at 90 DAT. Spray of tebuconazole @ 0.1% at fruiting stage. Last spray of mancozeb @ 0.25% at fruit maturity.

T3 Integrated Disease Management (IDM)-I: Seed treatment by *T. asperellum* @1%. Seedling root dipping @ 1% by *T. asperellum* 10 minutes during transplanting. Drenching of *T. asperellum* @1% 4 times at 20 days interval. Spray of carbendazim @0.1% thrice at 15 days interval started 70 DAT.

T4 IDM-II: Seed treatment by TCV-1 @1%. Seedling root dipping TCV-1 @1% for 10 minutes during transplanting. Drenching of TCV-1 @ 1% 4 times at 20 days interval. Spray of mancozeb @0.25% thrice at 15 days interval sarted 70 DAT.

T5 IDM-III: Nursery soil application by TVBG @100g/ m^2 area. Slurry root treatment by TVBG with compost during transplanting. Drenching of 10g TVBG 4 times at 20 days interval. Foliar spray of tebuconazole @0.1% thrice at 15 days interval started 70 DAT.

T6 IDM-VI: Seed treatment by *T. asperellum* @ 0.5% + CRB-7@ 0.5%. Seedling root dipping *T. asperellum* @ 0.5% + CRB-7@ 0.5%. Drenching of *T. asperellum* @ 0.5% + CRB-7 @ 0.5% @ 1% 4 times at 20 days interval. Spray of tebuconazole @0.1% alternated by mancozeb @0.2% at 15 days interval started 70 DAT twice.

T7 Good Agricultural Practices (GAP)

T8 Control

Use of Phomopsis-free selected seeds for sowing.

Calculation of cost benefit ratio for brinjal: As per revised labour rate on 3.4.2023 @Rs.429/-, Average marketable yield 300 q/ha, Average sale rate Rs. 1500/ quintal, Spray @1000 litre water, Drenching @2000 litre, Seedling root dip @5 l/ha. Carbendazim Rs.1740/kg, Captan+hexaconazole-2100/kg, Tebuconazole-3700/ litre, Mancozeb 410/kg, Copper oxychloride-850/kg, Micronutrient-395/litre. Spray/drench 4 labor/ha, Rouguing 4 labors/ha, Phomopsis free seed selection 1 labour, IIVR *Trichoderma* sale rate Rs. @150/kg.

On the basis of cost benefit ratio the chemical module-1 was best with maximum CB ratio of 1: 1.6 for the management of fungal diseases and yield of brinjal in variety Kashi Uttam. The next best module was IDM-II with C:B ration of 1: 1.5 which may be recommended considering safe and pesticide residue-free brinjal.

Table 4: Recommendations of different management modules based cost benefit ratio of brinjal variety Kashi Uttam

Modules	Marketable yield (q/ha)	Gross income (Rs.)	Total cost of Production (Rs.)	Disease management cost	Net benefit (Rs.)	C:B ratio
T1-CM-1	204.35	306525	188128	12394	118398	1: 1.6
T2-CM-2	177.12	265680	198794	23060	66886	1: 1.3
T3-IDM-I	149.81	224715	205086	29352	19629	1: 1.1
T4-IDM-II	199.18	298770	202941	27207	95829	1: 1.5
T5-IDM-III	165.11	247665	210970	35236	36695	1: 1.2
T6-IDM-IV	186.84	280260	206250	30516	74010	1: 1.4
T7-GAP	172.27	258405	196407	20673	61998	1: 1.3
T8-Control	158.26	237390	175734	-	61656	1: 1.3

Mass production and quality status of fungal bioagents: Talc based multiplication of different biocontrol agents were carried out and the quality of the product was insured by quantification of viable spores by plating on PDRBA. The fungal bioagent *Trichoderma* colony was very high and above the desirable level indicating very good quality of the product. *Trchoderma asperellum* talc based produce was 114 kg, TTV2 - 13 kg, TCV2 - 33 kg and TCV1 - 2 kg.

Table 5: Viable spores of resident biaoagents in talcum formulations

Bioagents	Properties	CFU/g of talc formulation
Trichoderma asperellum	Antagonist+ Growth promoter	8.3 x 10^7
TTV-2	Antagonist+ Growth promoter	9.7 x 0^7
TCV-2	Antagonist+ Growth promoter	7.4 x10^7
TCV-1	Antagonist+ Growth promoter	6.7 x10^7
TTV-1	Antagonist+ Growth promoter	9.3 x 0^7
TVBG	Antagonist+ Growth promoter	8.5 x10^7
BATF-43-1	Antagonist+ Growth promoter	9.8 x10^7

Efficacy of *Trichoderma asperellum* against different pathogens: In dual culture method, the pathogen culture bit is placed on half of a plate and the bioagent *Trichoderma asperellum* is placed in the other half of the same plate. Pathogen *Pythium apahanidermatum* (Okra) *Sclerotium rolfsii* (Bottle gourd) *Rhizoctonia solani* (Cowpea) *Phomopsis vexans* (Brinjal) *Macrophomina phaseolina* (Cowpea) *Macrophomina phaseolina* (Cucumber) *Fusarium oxysporum* f.sp. *lycopersici* are tested against *Trichoderma asperellum* on PDA. Antagonistic observation as inhibition of radial growth of the test pathogen was recorded after 8 days of incubation. It was antagonistic to all the test pathogen with strongest antagonistic to *Macrophomina phaseolina* and *Phythium aphanidermatum* with more than 80% inhibition. Differential response of *T. asperellum* was recorded on two isolates of *Macrophomina phaseolina* isolated from cucumber and cowpea (Fig. 3).

Table 6: *In vitro* bioefficacy of *Trichoderma asperellum* on different soil pathogen

Pathogen	Mean Pathogen Inhibition (%)
Pythium aphanidermatum	80.92
Sclerotium rolfsii	71.38
Rhizoctonia solani	69.23
Phomopsis vexans	77.77
Macrophomina phaseolina	65.53
Macrophomina phaseolina	84.61
Fusarium oxysporium f.sp. *lycopersici*	66.66
CD	3.16
CV	3.29

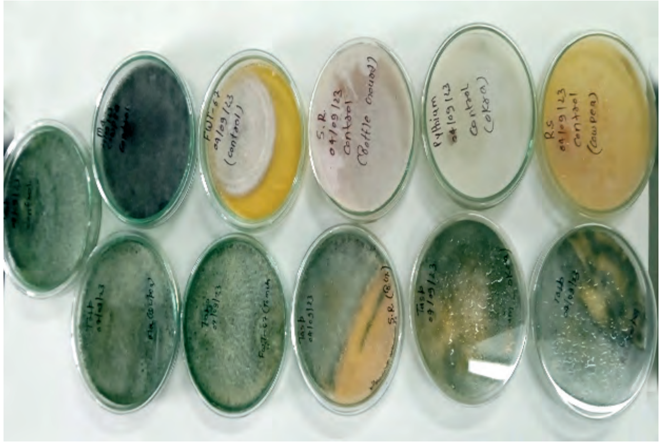


Fig. 3: Evaluation of *Trichoderma asperellum* against different pathogens

Efficacy of garlic based botanical fungicide against different pathogens: Poisoned food technique was used to evaluate toxicity of a garlic based botanical fungicide against several pathogens. The test dose was 3000 ppm (0.3%). The pathogen were *Pythium apahanidermatum* (Okra) *Sclerotium rolfsii* (Bottle gourd) *Rhizoctonia solani* (Cowpea) *Phomopsis vexans* (Brinjal) *Macrophomina phaseolina* (Cowpea) *Macrophomina phaseolina* (Cucumber) *Fusarium oxysporum* f.sp. *lycopersici.* The poisoned PDA culture media was inoculated by 10 mm bits of test pathogen. The inhibited radial growth of the pathogen was recorded after 10 days of incubation and compared with the control Petriplates (Fig. 4).

Table 7: *In vitro* bioefficacy of botanical fungicides on different soil pathogen

Target Pathogen	Average Inhibition (%)
Pythium aphanidermatum	88.88
Slcerotium rolfsii	0.1
Rhizoctonia solani	75.88
Phomopsis vexans	75.05
Macrophomina phaseolina	21.11
Macrophomina phaseolina	87.22
Fusarium oxysporum f.sp *lycopersici* (FWT-67)	18.75
CD	4.63
CV	7.18

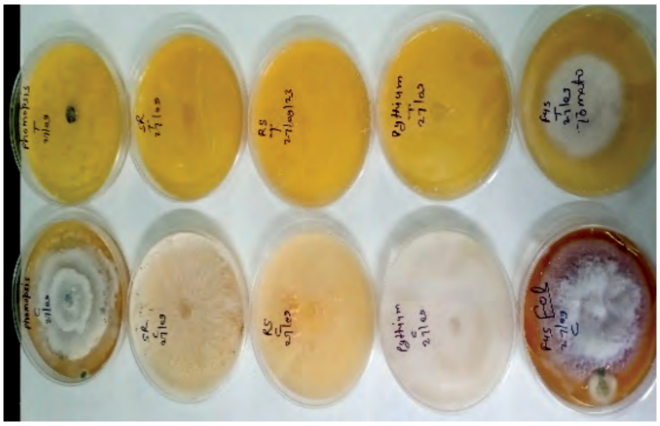


Fig. 4: *In vitro* screening of botanicals against different pathogens

Fungicide residue analysis in tomato: An experiment was conducted to find out the residue level of different fungicides at different days of harvesting in tomato fruits as well as its field soil. Two sprays of fungicides were carried out at Fifteen days interval. After the second spraying, fruit samples were collected on days 0 (2 hours after spraying), 1, 3, 5, 7 and 10th day along with soil samples for the terminal residue analysis. Tebuconazole residue in tomato fruit and soil were estimated using gas chromatography equipped with micro electron capture detector (µECD, ^{63}Ni). The percent recovery at 0.01, 0.02, 0.05, 0.10 and 0.50 mgkg^{-1} were 85.00 to 94.00% in tomato and 81.67 to 89.67% in soil. The half-life was 3.75 and 1.35 days for RD and DD, respectively. Dietary exposures of the residues were less than MPI of 0.48 mg person^{-1} day^{-1} on all the sampling days for both doses. The terminal residue in soil was found below LOQ for both the doses.

Evaluation of *Actinomyces* sp. strain N1.2 in pot experiments using bioformulation coated brinjal and chilli seeds: Pot, nursery and field evaluation of *Actinomyces* sp strain N1.2 was continued for 4th year using brinjal cv. (Kashi Taru) and chilli cv. (Kashi Anmol) crops. Seeds were treated with N1.2 talc bioformulation @ 10 g/kg seeds, followed by root dipping in 5 g/lit N1.2 + 5 g/lit CRB7 for 15 min, and drenching of N1.2 bioformulation 10 gram/litre thrice at 7 days interval gave the best results in term of % seed germination (+23%), decrease in post emergence damping off (-43%), root/stem length (+33%/+31%) and fresh/dry weight (+47%/+53%) when compared with the control.

Evaluation of *Actinomyces* sp. strain N1.2 in Nursery experiments using bioformulation coated brinjal and chilli seeds: Brinjal (Kashi Taru) and Chilli (Kashi Anmol) seeds treated with N1.2 bioformulation (10 gram/kg seed) followed by drenching of N1.2 bioformulation @ 10g/lit thrice at 7 days interval gave the best results in term of % seed germination (24% & 33%), and decreasing in post emergence damping off (-44% & -35%) with compared to the control (Table 9)

Evaluation of *Actinomyces* sp. strain N1.2 in field experiments using bioformulation coated brinjal seeds: Combined application *Actinomyces* sp. strain N1.2 with CRB-7 as root dipping (15 min) followed by drenching 15 days after transplantation thrice at 20 days interval gave the best yield of the brinjal (Kashi Taru) in the field trial experiment, while yield was only slightly higher than control when combined with *T. asperellum*. Findings show that *Actinomyces* sp strain N1.2 is compatible with CRB-7 as both being Gram +ve bacteria but not with *T. asperellum* (fungus) based formulation (Table 10).

Table 8: Effect of fungicides on foliar stage late blight severity percentage

Treatment	Dose (RD)	Dose (DD)	Mean RD PDI	Mean DD PDI	Marketable yield (q/ha)
T1 Tebuconazole 25.9% EC	0.1%	0.2%	11.67	11.67	314.72
T2 Carbendazim 50% WP	0.05%	0.1%	13.33	10.0	365.39
T3 Azoxystrobin 23% SC	0.1%	0.2%	8.33	8.33	398.75
T4 Control	-	-	15.0	11.67	243.93
CD			3.1	3.3	27.5
CV			20.9	21.8	19.6

Table 9: Nursery experimental data of Chilli (cv. Kashi Anmol) and Brinjal (cv. Kashi Taru) seeds treated with *Actinomyces* sp. N1.2 talc

Treatment	Avg. % seed germination	Avg. % of Post emergence damping off	Avg. Root length (cm)	Avg. Stem length (cm)	Fresh Weight /5 plants (g)	Dry Weight/5 plants (g)
Chilli (Kashi Anmol)						
N1.2 (10 gram/kg seed), Root dipping (N1.2+CRB-7 for 15 minute) Drenching (N1.2, 10 gram/litre) thrice at 7 days interval	70.33 (+24.41)	8.96 (- 44.45%)	5.63 (+36.31)	23.03 (+34.44)	15.6 (+57.58)	3.1 (+63.18)
Control	56.53	16.13	4.13	17.13	9.9	1.9
Brijal (Kashi Taru)						
N1.2 (10 gram/kg seed), Root dipping (N1.2+CRB-7 for 15 minute) Drenching (N1.2, 10 gram/litre) thrice at 7 days interval	63.13 (+33.38)	3.83 (-35.41)	4.83 (+30.89)	13.33 (+42.11)	8.33 (+38.14)	1.03 (+41.10)
Control	47.33	5.93	3.69	9.38	6.03	0.73

Table 10: Field evaluation of *Actinomyces* sp. strain N1.2 with other bioagents on Brinjal (Kashi Taru)

Treatment	Treatment Details	Yield (q/ha)
T1	Root dipping (15 min) & drenching – 10g/lit N1.2 formulation 15 DAT thrice at 20 days interval	6.89
T2	Root dipping (15 min) & drenching – 10g/lit CRB-7 formulation 15 DAT thrice at 20 days interval	6.03
T3	Root dipping (15 min) & drenching – 10g/lit *T. asperellum* formulation 15 DAT thrice at 20 days interval	5.83
T4	T1 & T2	7.13
T5	T1 & T3	6.32
T6	T2 & T3	6.49
T7	T1, T2 & T3	5.73
T8	Control	5.39
SD		0.59
%CV		9.55
CV		0.10

PROJECT 6.5: BIOPROSPECTING OF MICROORGANISMS ASSOCIATED WITH VEGETABLES AGAINST PLANT PATHOGENS (till 31.03.2023)

Molecular identification of an entomopathogenic fungus *Cordyceps javanica* isolated from whiteflies infesting brinjal, on the basis ITS region and Elongation factor 1α gene, showed 100% similarity with isolates of previously reported *C. javanica* and their antagonistic efficacy was proven as a potential entomopathogenic fungus which is not yet reported so far from India. Genome sequences of *Cordyceps javanica*-OR178304 (ITS) and OR180509 (TEF) of an entomopathogenic fungus was deposited in NCBI, USA (Fig. 5).

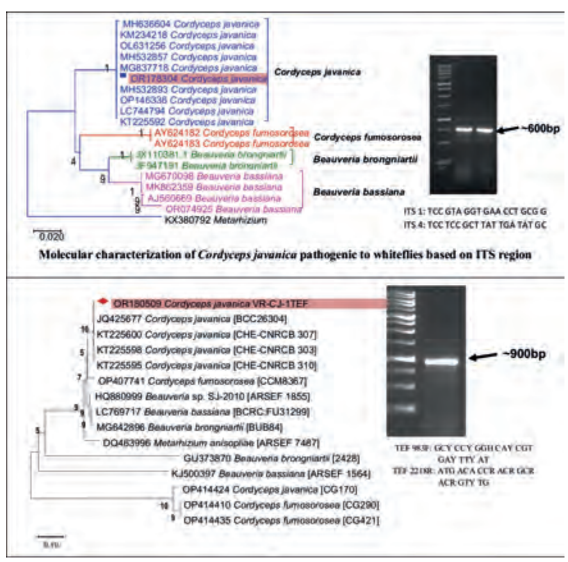


Fig. 5: Characterization of *Codyceps javanica* pathogenic to whiteflies based on Elongation factor 1α gene

Pooled, three years (2021, 2022 and 2023) field evaluation data of five different types of potential bioagents namely *Trichoderma asperellum*, TCV-2, TTV-2 @ 10g/kg seed, *Bacillus subtilis* (CRB-7) @5g/kg seed, Consortia of

T. asperellum + *B. subtilis* (CRB-7) along with a chemical fungicide Captan @2.5g/kg of seed were evaluated for their biocontrol potential of soilborne diseases namely white rot (*Sclerotinia sclerotiorum*), *Fusarium oxysporum* f. sp. *pisi* (root rot), *Rhizoctonia solani* (damping off) and *Sclerotium rolfsii* (collar rot) and plant growth promotion in pea and cabbage. The seed treatment with consortia formulation - *T. asperellum* + *B. subtilis* @ 10g/kg seed showed highest vigour index (2070) followed by CRB-7 (1922), *T. asperellum* (1899) as compared to control (1752) and minimum root rot/wilt incidence (4.62%) followed by *T. asperellum* (4.79%) compared to control (14.29%) were recorded. Similarly, seed treatment with consortia formulation - *T. asperellum* + *B. subtilis* showed minimum incidence of fruit rot (5.67%), followed by *Bacillus subtilis* (6.42%) as compared to control (32%) in pea. Moreover, seed treatment with *T. asperellum* + *B.* subtilis @ 10g/kg seed also recorded highest benefit cost ratio (B:C) and green pea yield (2.42, 45.73 q/ha) followed by *Bacillus subtilis* (2.41, 42.67) as compared to control (35.42 q/ha).

In cabbage seedlings root dip treatment and drenching at the time of earthing @10g/L showed highly effective in induction of plant growth in term of average canopy (cm) and average weight of the heads and minimizes the infestation of damping off/root rot and bottom rot disease. Highest canopy and weight of head was recorded in *T. asperellum* treated seedlings (76 cm, 1.33kg) followed by *Trichoderma* species isolate TCV-2 (68 cm, 1.26 kg), Consortia formulation of *T. asperellum* + *B. subtillis*-CRB-7 (66 cm, 1.24 kg) as compared to control (64 cm, 1.10kg) and Captan (60 cm, 1.04 kg). Highest benefit cost ratio and yield was also recorded in seedlings of cabbage treated with *Trichoderma asperellum* (2.56:1, 167.78 q/ha) was recorded maximum followed by *Trichoderma* species-TTV-2 (2.55:1, 163.44 q/ha) and Consortia formulation of *T. asperellum* + *Bacillus subtilis* (2.54.1, 162.85 q/ha) as compared to control (143.59 q/ha).

Using pre-standardize protocol 180 kg of talc-based bioagent was prepared in our laboratory using *Actinomyces* strain N1.2. Colony forming unit (CFU) count was reported to be 2.3 x 10^9 per gram of talc bioagent. 18 kg of bioagent was distributed to the farmers, 35 kg to the scientists of ICAR-IIVR, 76 kg to AICRP-VC and seed production unit of ICAR-IIVR and 3 kg to ICAR-IIVR regional station Sargatia. Further 48 kg of bioagent (12 kg to each center) was sent to Krishi Vigyan Kendra (KVK) of Bhadohi, Kushinagar, Deoria and Lucknow. As per the data collected by KVK, Bhadohi, the farmer (Shri Ishwar Datt Chaubey, vill. Chaubeypur, District -Bhadohi, Uttar Pradesh), sowed field Pea (Variety- IPFD 12-2) in the area of 0.1875 ha, and sprayed *Actinomyces* formulation (10g/Litre) twice, alonwith single dose of fungicide during frost season, and achieved the Green pod harvest - 102 kg (Grain yield - 300 kg), while straw obtained has been kept for making compost.

PROJECT 6.6: MANAGEMENT OF IMPORTANT BACTERIAL DISEASES OF VEGETABLE CROPS (till 31.03.2023)

Screening of bacterial wilt, bacterial blight and little leaf resistant germplasm of solanaceous vegetable crops under sick plot and field: Forty one isolates of bacterial blight pathogen, *Xanthomonas compestris* pv *vesictoria* from tomato; 2 isolates of bacterial black rot pathogen *Xanthomonas compestris* pv *compestris* from cabbage, 2 isolates of *Erwinia spp.* from cauliflower and summar squash and 3 isolates of bacterial wilt pathogen *R. Solanacearum* from brinjal and chilli were established. Based on the cultural, morphological characteristics, sugar oxidation test and cross pathogenicity test bacterial wilt isolates were confirmed as race 1/ biovar III of *R. pseudosolanacearum* which caused the wilt on solanaceous vegetables.

Among tested cultigens of solanaceous vegetable crops *viz.* brinjal (*S. gilo, IC*-354557, *S. incanum, S. lanciatum, S.aethiopicum, Surya, S. torvum,* IC-111056), Chilli (T-135, Punjab Lal, Andman chilli) and tomato (Punjab Chuhara, EC-520078) were recorded as bacterial wilt resistant cultigens under sick plot. Total 178 cultigens of tomato were screened against *Xanthomonas* blight out of which VRTH-16-3 and VRTH -16-5 were found moderately resistant. Similarly, 46 cultigens (germplasm/ varieties/ hybrids) of brinjal were screened against little leaf of brinjal. Among tested germplasm/varieties IVBHR-17, IVBR-20, IVBHL-20, 22, 26, 23, IVBL-23 and 25 were found highly resistant against little leaf of brinjal.

Evaluation of different management modules against major bacterial disease of tomato: Among different modules, chemical and biological module applied at 20 days after transplanting of tomato (ev. VRT-50), four subsequent sprays done at 20 days interval which recorded highest yield (34.85 t/ha) as compare to control (23.12 t/ ha). The lowest *Xanthomonas* leaf blight percent disease index (PDI) (8.0) recorded with Chemical and biological module in compare to control (20.0) (Table 11).

Table 11: Effectiveness of bio-agents and fungicides/ chemicals against bacterial blight on tomato and yield

Treatment	Yield t/ha	*Xanthomonas* blight Blight (PDI)
T1–Biological module	27.91	15
T2-Botanical module	29.98	12
T3- Chemical module	30.46	10
T4-Chemical & Biological	34.85	8
T5-Chemical & Botanical	34.76	18
T6- IDM module	31.72	10
T7-Untreated Control	23.12	20
C.D.	NS	-
C.V.	16.03	-

Effectiveness of bacterial bio-agents, fungicides and bactericides against bacterial diseases on cabbage and yield: The highest cauliflower (cv. Pusa Snowball) yield (21.76 t/ha) recorded with chemical and botanical module applied at 20 DAT and 4 subsequent spray was done after 20 days of interval from first spray in comparison to control (8.72 t/ha) with lowest black rot percent disease index (5) of bacterial black rot than control (25) (Table 12).

Table 12: Effectiveness of bio-agents, fungicides and plant defense activators against bacterial rot on cabbage and yield

Treatment	Yield (t/ha)	Black rot (PDI)
T1–Bilogical module	17.57	20
T2-Botanical module	16.76	15
T3- Chemical module	20.00	10
T4-Chemical & Biological module	14.31	12
T5-Chemicl & Botanical module	21.76	5
T6- IDM module	19.86	8
T7- Untreated Control (UTC)	8.72	25
C.D.	7.82	-
CV	25.58	-

Evaluation of seed health and detection of seed borne pathogens in seeds of vegetable crops: Seed health status of seed samples of conserved/stored seeds of brinjal, chilli, tomato, winged bean, dolichos bean, French bean, cowpea, pea, cabbage, bottle gourd, ash gourd, sponge gourd of vegetable crops was evaluated. Seed borne pathogens viz *Xanthomonas axenopodis* pv *vesictoria* on brinjal and tomato; *Xanthomonas compestris* pv *compestris* on cabbage, *Pseudomonas* spp. on winged bean; *Phomopsis vexans* on brinjal and *Colletotrichum lindemuthianum* on Indian bean were recorded.

Biological and organic seed treatment: Commercially available chemical, bio-agents and botanicals were applied as seed treating agents in bottle gourd e.v. (Kashi Ganga) @ 500 ppm/kg seed in which kurax (botanical), biocure F (bioagent) and azoxystrobin (23.5% SC) were found effective for enhancement of seed germination percentage up to 96.66, 98.66 and 100.00% respectively, with comparison to control (79.66) (Table 13). Bio-agents evaluated against tomato nursery diseases in which *Pseudomonas fluorescens* (2.5×10^{11} cfu/ml) was found most effective in tomato e.v. Kashi Chayan for enhancement of germination (91.66) in compare to control (65.66) and *Trichoderma asperellum* (IIVR strain) 2×107 cfu/g in VRT-50 (91.00) as compared to control (57.00) (Table 14).

Table 13: *In vitro* screening of bio-pesticides for seed treatment in bottle gourd

Treatment (Conc. 500 ppm)	Germination (%)
Biocure F	98.66
Kurex	96.66
Azoxystrobin	100.00
Nimbicidine	25.00
Biocure B	80.00
Sten-microfood	86.66
Sonata	86.00
Stenohume	73.66
Control	79.66
CD	14.30
CV	10.15

Table 14: *In- vivo* evaluation of bio-agents in tomato

Treatment	Germination (%)		
	VRT-30	VRT-50	Kashi Chayan
Trichoderma asperellum (IIVR strain) 2×107 cfu/g	37.00	91.00	74.0
P. fluorescens (2.5×10^{11} cfu/g)	39.00	83.33	91.66
Carbendazim 50% WP	42.66	90.33	87.66
Kurex	37.33	81.00	85.00
Copper hydraoxide	38.66	64.33	83.66
Biocure F	34.33	92.66	75.00
Control	34.00	57.00	65.66
CD	4.93	2.73	13.48
CV	7.30	1.90	9.33

***In vitro* evaluation of newer fungicides and botanicals:** *In vitro* screening of fungicides (teboconazole 50%+ trifloxystrobin 25%, tebuconazole 25.9% SC, azoxystrobin 23% SC, azoxystrobin 18.2% + difenconazole 11.4% SC, fluopyram 17.7+tebuconazole 17.7 SC), tebuconazole 6.7% + capton 26.9% SC, copper oxychloride 50% WP and botanicals (kurax-herbal, sonata-botanical and spotless-phytotonic) against *Stagnospora* gummy stem blight (GSB) pathogens by poisoned food technique was done. Among tested molecules, tebuconazole 25.9 % SC found most effective against GSB *in vitro* (Table 15).

Table 15: *In vitro* evaluation of newer fungicides & botanicals against GSB

Treatment (Conc. 500 ppm)	CGSB MI (%)
Teboconazole 50%+ Trifloxystrobin 25% (Nativo)	86.27
Tebuconazole 25.9 % SC (Folicur)	98.03
Azoxystrobin 23% SC (Amistar)	78.03
Azoxystrobin 18.2%+ Difenconazole 11.4% SC (Rhodo)	76.46
Copper oxychloride 50% WP (Cutox)	82.31
Fluopyram 17.7+Tebuconazole 17.7 SC (Luna)	86.27
Tebuconazole 6.7% + Captan 26.9%SC (Shamir)	51.10
Kurax (Herbal)	81.56
Spotless (Botanical)	53.32
Sonata (Phytotonic)	50.00
Control	0.00
CD	9.76
CV	8.14

PROJECT 6.7: CHARACTERIZATION OF VIRUSES INFECTING VEGETABLE CROPS AND THEIR MANAGEMENT (till 31.03.2023)

Characterization of begomovirus causing severe yellow mosaic disease in velvet bean: Samples of velvet bean showing severe yellow mosaic disease were collected and subjected to total DNA extraction (Fig. 6a). PCR assay was performed with the begomovirus specific universal primer pair PAL1c1960: 5′-ACNGGNAARACNATGTGGGC-3′ and PAR1v722: 5′-GGNAARATHTGGATGGA-3′ showed an expected amplicon of about 1200 bp in all the symptomatic samples (Fig. 6b). In order to characterize the complete genome of the begomovirus associated with the velvet bean severe yellow mosaic virus, RCA was performed followed by RFLP analysis. Sequencing of cloned RFLP fragment showed the presence of Velvet bean severe mosaic virus DNA A and DNA B genomic components. Full length genome of DNA A had 98.83% identity at the nucleotide level with the previously reported isolate of Velvet bean severe mosaic virus. In phylogenetic analysis, the study isolate had close ancestral relationship with the isolate reported from Lucknow during 2009 (Fig. 6c).

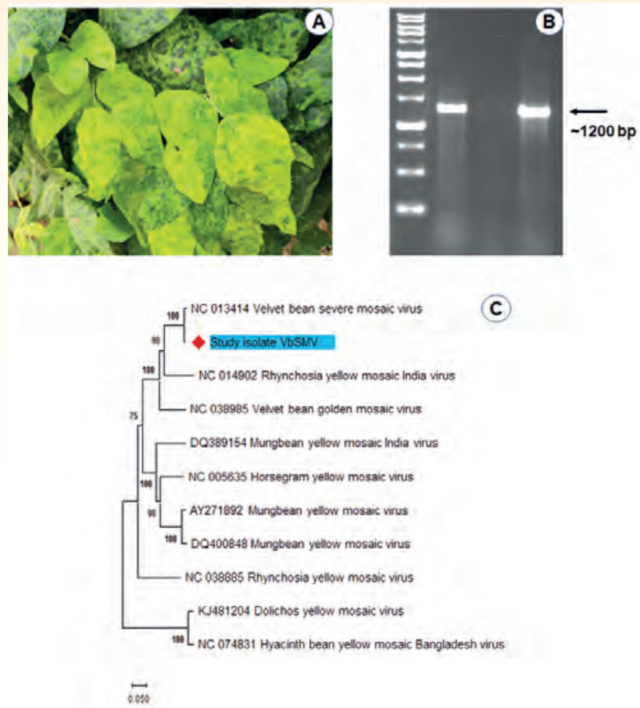


Fig. 6: Symptoms of velvet bean severe mosaic virus (a); PCR amplification of begomovirus genome using universal primer pair (b); and phylogenetic Phylogenetic relatedness based on DNA A genomic fragments of VbSMV isolate infecting velvet bean with other yellow mosaic causing begomovirus species. (c). Tree has been generated using MEGA X with 1000 bootstrap replicates through Neighbour Joining method.

PROJECT 6.9: MANAGEMENT OF PLANT PARASITIC NEMATODES INFECTING VEGETABLE CROPS (till 31.03.2023)

Evaluation of *Trichoderma* isolates against *Meloidogyne incognita* for nematode egg hatching inhibition: Culture filtrate of six *Trichoderma* isolates (IIVR) were evaluated for nematode egg hatching inhibition at different concentrations (50% and 100%) after 120 h exposure under laboratory conditions. In distilled water up to 7.6% of eggs were not hatched after 120 H exposure, whereas up to 25.4% of egg hatch inhibition was observed in 100% PDB media. All *Trichoderma* isolates TTV1, TTV2 and Tasp were found most effective by causing highest egg hatching inhibition at 50 and 100% culture filtrate concentrations after 120 h after exposure. Similarly, *Trichoderma* sp. TCV1 isolate were found next effective among bio-agents in 50 and 100% concentration after 120 h exposure period under *in-vitro* conditions (Table 16).

Table 16: Effect of *Trichoderma* isolates on *Meloidogyne incognita* egg hatching inhibition (%) after 120 H exposure

Trichoderma isolates	Culture filtrate concentrations 50%	Culture filtrate concentrations 100%
TCV1	49.8±0.7[b]	62.0±2.1[b]
TCV2	29.0±0.9[c]	39.6±1.0[c]
TVBG	24.8±1.3[d]	30.2±1.4[d]
TTV1	90.2±1.0[a]	96.0±1.0[a]
TTV2	92.8±1.2[a]	96.8±1.2[a]
Tasp	93.4±1.6[a]	97.6±1.0[a]
PDB	16.0±1.2[e]	25.4±0.8[e]
DW	5.8±0.8[f]	7.6±0.7[f]
df	7, 32	7, 32
F value	418.17	182.56
$P<0.05$	<0.0001	<0.0001

Data represented in (Mean ± SE). Different letters on each column indicate statistically significant difference between fungal isolates at ($P < 0.05$) using Tukey's HSD test. PDB: Potato Dextrose broth media Dw. distilled water.

PROJECT 6.10: PEST AND DISEASE DYNAMICS AND BEHAVIOUR MODIFYING STRATEGIES FOR MAJOR INSECT PESTS OF IMPORTANT VEGETABLE CROPS IN RELATION TO CHANGING WEATHER SCENARIO (till 31.03.2023)

Development of Pest forecasting model for predicting the incidence of *Leucinodes orbonalis* and *Spodoptera litura*: An investigation was carried out to study the seasonal incidence of shoot and fruit borer (*Leucinodes orbonalis* Guene) at ICAR-IIVR, Varanasi. The seasonal incidence was recorded for past five years and the data was compiled. The different weather parameters were considered for developing the regression model. Five years' data (2018 to 2022) was compiled and used for development of the model. Stepwise regression analysis was carried out to identify the important weather parameters influencing incidence of brinjal shoot and fruit borer. This developed model can be used for predicting the incidence of shoot and fruit borer in brinjal. The multiple regression forewarning model developed for *L. orbonalis* as follows:

Developed Model: BSFB: Y = -126.88 + 1.517RH1 (42SMW) - 0.079RH2 (42SMW) + 1.442SSH (42SMW) - 1.687WV1 (42SMW)

Development of Pest forecasting model for predicting the incidence of *Spodoptera litura*: An investigation was carried out to study the seasonal incidence of a polyphagous pest, *Spodoptera litura* at ICAR-IIVR, Varanasi. The seasonal incidence was recorded for past five years and the data was compiled. The different weather parameters were considered for developing the regression model. Five years' data (2018 to 2022) was compiled and used for development of the model. Stepwise regression analysis was carried out to identify the important weather parameters influencing incidence of *S. litura*. This developed model can be used for predicting the incidence of *S. litura* in vegetable crops.

A multiple regression model was developed for forewarning the incidence of *Spodoptera litura*.

Developed Model: *S. litura*

Y = 26.584-3.89 T min. 44 + 1.373 RH1-1.01 RH2

PROJECT 6.12: BIO-MANAGEMENT OF POST-HARVEST DISEASES IN MAJOR VEGETABLE CROPS (till 31.03.2023)

P-solubilization activity of the selected potential biocontrol agents: The biocontrol agents were tested for their ability to promote plant growth through solubilization of phosphorus under laboratory condition. Seven isolates were found positive for their P- solubilization ability. The ability to solubilize phosphorus ranged from 29±3.4µg/ml in *Bacillus amyloliquefaciens* AD29 to 61±3.1 µg/ml in *Bacillus velezensis*AH40 (Table 17).

Table 17: Quantification of ammonia production and P-solubilization activity of the selected potential biocontrol agents

Isolate No	P-solubilization (µg/ml)	Ammonia production (µg/ml)
Bacillus velezensis AA17	55±5.2	-
Bacillus sp AC26	37±1.9	50±2
Stenotrophomonas maltophilia AD28	38±4.5	**56±3.1**
Bacillus amyloliquefaciens AD29	29±3.4	40±2.8
Bacillus subtilis AH39	-	27±3.9
Bacillus velezensis AH40	**61±3.1**	44±3.1
Bacillus subtilis BE11	32±3.4	-
Paenibacillus sp. CC6	34±2.8	32±2.7

Siderophore, ammonia and HCN production: The potential biocontrol agents were tested for ammonia production. Six isolates viz., AC26, AD28, AD29, AH39, AH40 and CC6 were found positive for ammonia production. Quantification of their ammonia producing ability was done through spectrophotometric analysis. The isolate *Stenotrophomonas maltophilia* AD28 was found to be the most efficient ammonia producer 56±3.1 µg/ml. The results were in concurrence with the dual plate assay where isolate AD28 could cause significantly higher inhibition of the postharvest pathogen as compared to other biocontrol agents.

Effect on the plant antioxidant enzyme profile: The microbial inoculants could significantly affect the root and shoot growth parameters along with damping- off disease incidence. The effect of microbial inoculants on antioxidant enzymes like catalase, peroxidase and polyphenol oxidase was also monitored. The antioxidant defense enzyme catalase, peroxidase and polyphenol oxidase acts as a first line of defense against the plant pathogens. It was found that the application of AD 28, AH 40 and Tasp strains significantly enhanced the enzymatic activity of CAT, POX and PPO in the leaves of tomato as compared to chemical control and no management conditions under the presence of pathogen (Fig. 7).

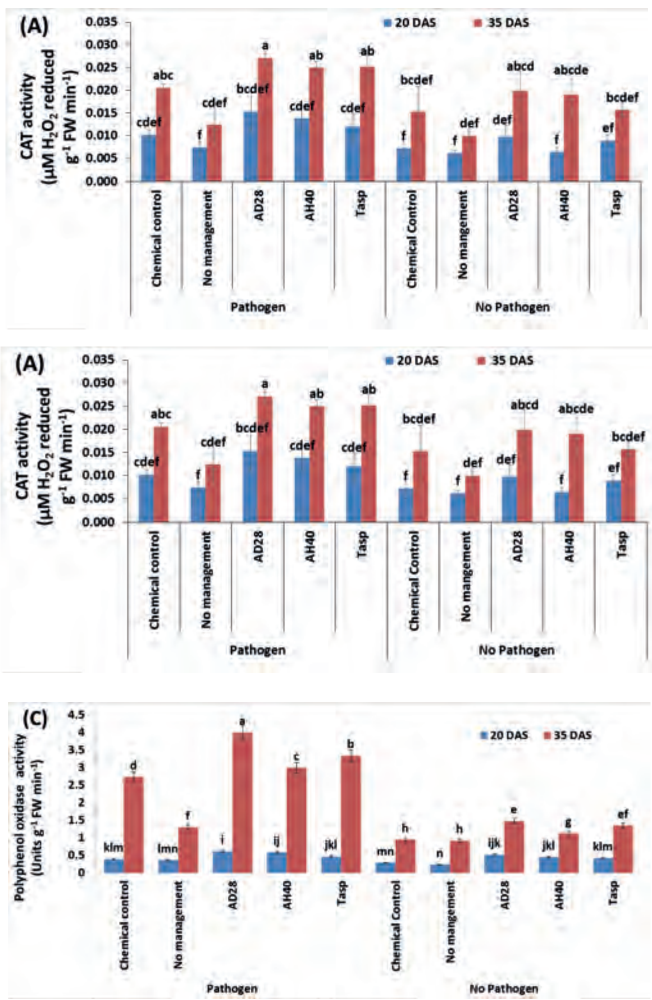


Fig. 7: Modulation of anti-oxidant enzyme in response to plant pathogens and biocontrol agents in tomato crop (A) Catalase (B) Peroxidase (C) Polyphenol oxidase

The elevated activities of antioxidant enzyme are an adaptation by plants to ameliorate the stress-induced oxidative stress. Furthermore, it was also observed that the enzymatic activity of CAT, POX and PPO were significantly higher at 35 DAS as compared to 20 DAS under presence of pathogen.

Testing the efficacy of selected BCA in suppressing postharvest pathogen under field condition: Microbial suspension of postharvest pathogen and biocontrol agents were prepared for artificial inoculation in brinjal under laboratory conditions. An experiment was conducted where the concentration of *Rhizopus* spore suspension was optimized to cause uniform lesion in each artificial inoculated brinjal fruit. The spore suspension was prepared in 0.05% V/V Tween 20. Spores were collected in a week old *Rhizopus* culture grown on PDA medium. Serial dilution of the spore suspension was prepared using 0.05% V/V Tween 20. The spore count in the dilution causing uniform lesion was measured using cell counter. The tubes with $1.81*10^5$ spores/ml of *Rhizopus* could cause uniform lesions in the brinjal fruit and were used for further experiment.

Testing the ability of BCA to suppress postharvest infection by *Rhizopus* under laboratory condition: *Rhizopus* spore suspension with concentration 1.81×10^5 spores/ml was used for the experiment. The concentration of biocontrol agents *S. Maltophilia* AD28, *B. velezensis* AH40 and *B. subtilis* CRB7 used for the experiment were 1.48×10^5, 1.42×10^5 and 1.26×10^5 cells/ml, respectively.

A uniform hole was made with the help of cork borer of depth 1cm in surface sterilized brinjal fruit. 10µlt of live cell suspension of BCA was added in each hole. 10µlt of *Rhizopus* spore suspension (Rh) was added in each hole after half an hour. Lesion diameter was tabulated after three days of incubation (Table 18).

No lesion was observed in the fruits treated with biocontrol agents even after one week of incubation (Table 18). Whereas, fruits inoculated with pathogen Rh only showed significant development of lesion as shown in fig. 8.

Fig. 8: The effect of artificial inoculation of (1) AD 28 + Rh (2) AH40 + Rh (3) CRB7 + Rh (4) Rh on brinjal fruit after one week

Table 18: Lesion diameter in response to artificial inoculation of *Rhizopus* spore suspension and biocontrol agents in brinjal fruit

	Treatment details	Lesion dimension	
		Horizontal (cm)	Vertical (cm)
T1	AD28 + Rh	No lesion	
T2	AH40 + Rh	No lesion	
T3	CRB7 + Rh	No lesion	
T4	*Rhizopus* spore suspension (Rh) (Concentration 10^5)	3.0±0.6	5.0±0.8

Testing the efficacy of selected BCA in suppressing postharvest pathogen under field condition

A field trial was conducted to check the efficiency of the biocontrol agents in suppressing the growth of postharvest pathogens after harvest of brinjal fruit (Fig 9). The two bacterial BCA *Stenotrophomonas maltophilia*AD28 and *Bacillus velezensis*AH40 were used along with *Bacillus subtilis*CRB7 as positive control. Biocontrol agents were used as seed treatment in the nursery, at transplanting and twice each after one month of transplanting. Brinjal variety Kashi Vijay susceptible to postharvest infection caused by *Rhizopus stolonifera* was used for the experiment.

Fig. 9: Field trial in brinjal crop to test the efficacy of biocontrol agents against postharvest pathogens

The field was laid out in RCB (Randomized Complete Block) design with five treatments and four replications. Microbial inoculants could cause significant increase in the yield of brinjal fruit as compared to treatment were no management practices were followed (Table 19). The differences observed in the marketable yield of all the three tested BCA were not statistically significant. Even the proportion of non-marketable fruit was significantly higher in plots where no management practices were followed. The enhanced yield on application of bicontrol agent may be both because of the plant growth promoting traits and biocontrol properties of the used isolates.

Fruit samples were harvested and labeled from each plot carefully. Artificial inoculation of postharvest pathogen *Rhizopus* was done in the harvested fruit under laboratory condition. The observations were recorded after two days of incubation. A significant reduction in lesion dimension was observed upon inoculation with biocontrol agents AD28, AH40 and CRB7 as compared to control (Table 20). The differences observed amongst the lesions developed by biocontrol agents was non-significant

Table 20: Lesion dimension in response to biocontrol agents under field condition and postharvest pathogen *Rhizopus* in brinjal fruit

	Treatment details	Lesion dimension	
		Horizontal (cm)	Vertical (cm)
T1	Biocontrol agent *S. maltophilia* AD28	1.7±0.6	2.0±0.75
T2	Biocontrol agent *B. velezensis* AH40	1.9±0.8	2.4±0.42
T3	Biocontrol agent *B. subtilis*CRB7	1.6±0.4	2.1±0.8
T4	Chemical Treatment	No lesion	
T5	No management practices undertaken	2.5±0.7	3.5±0.9

Table 19: Effect of different management modules on yield of brinjal

Treatment	Marketable Yield (t/ha)	Non- Marketable Yield (t/ha)	Total Yield (t/ha)
Stenotrophomonas maltophilia AD28	40.51^{b}	9.06^{ab}	49.57^{ab}
Bacillus velezensis AH40	41.66^{b}	8.13^{bc}	49.79^{ab}
Bacillus subtilis CRB7	40.97^{b}	7.81^{bc}	48.78^{bc}
Chemical Treatment	49.26^{a}	6.66^{c}	55.93^{a}
No application	32.58^{c}	10.43^{a}	43.01^{c}
CD (0.05)	6.68	1.69	6.40
CV	10.58	13.02	8.41

PROJECT 6.13: RESIDUE DYNAMICS, SAFETY EVALUATION AND DECONTAMINATION OF CHLORANTRANILIPROLE, DELTAMETHRIN, AZOXYSTROBIN AND KRESOXIM-METHYL IN TOMATO, BRINJAL AND CHILLI (till 31.03.2023)

Residue dissipation kinetics, safety evaluation and decontamination of Deltamethrin in tomato:

Persistence and dissipation: A comparison of Deltamethrin dissipation behavior about the recommended dose (RD) and double the recommended dose (DD) was studied. Based on residue dissipation data, in tomato fruits, deltamethrin's initial concentration in RD was found 0.361 mg/Kg and 0.699 mg/Kg. The level of residue on or in the substrate dissipates at an overall rate when the substrate is foliar treated with a pesticide. In order for pesticide residues to dissipate, they need to be physically degraded, volatilized, photolyzed, washed off, leached, hydrolyzed and microbially degraded. The rate of degradation kinetics could be pseudo-first, first, or second order depending on rapid [In phase-1: the linear plot with $R^2 > 0.85$] or slow [Phase-2: two or more nonlinear plots with $R^2 \leq 0.85$] dissipation of the pesticide resulting in small or extended half-lives. However, regulatory agencies apply first order kinetics to the entire dissipation period, regardless of whether there is any scientific basis for doing so. Biphasic dissipation kinetics of pesticides should be given special consideration in federal guidelines. The Deltamethrin dissipation kinetics in tomato was observed to be first-order, with a correlation of determination (R^2) of 0.9485 and 0.9823 of RD and DD, respectively. Since it took less time for Deltamethrin to dissipate at both application dosages to reach the EU-MRL value, the chemical may be used safely in tomato crops to control fruit disease.

Consumer risk assessment: Both dosages of residues showed a similar trend of decline below the standard MRL of 0.07 mg kg^{-1}. The safety of this pesticide residue has to be assessed due to the dearth of information on the usage of Deltamethrin in vegetables. Deltamethrin's recommended daily intake (ADI) is 0.01 mg kg^{-1} of body weight per day. By multiplying the ADI with the bodyweight of an average child (16 kg), the MPI of Deltamethrin was evaluated as 0.16 mg $person^{-1}$ day^{-1}. On all sample days, for both the single dosage and the double dose, average daily consumption of tomato was 0.0179 and 0.025 kg day^{-1} for urban and rural residents respectively; also the dietary exposures to the residues were lower than the MPI of 0.16 mg $person^{-1}$ day^{-1} (Table 21). So, it is determined that when used for pest management in tomatoes, Deltamethrin carries a minimal risk of acute toxicity.

PROJECT 1: INTEGRATED INSECT PEST MANAGEMENT OF MAJOR VEGETABLE CROPS FOR SAFER VEGETABLE PRODUCTION (w.e.f. 01.04.2023)

Bioefficacy of Fipronil 5% SC against pod borer *Maruca vitrata* in vegetable cowpea: The effectiveness of different field doses of Fipronil 5% SC viz., 25, 50 and 100 g ai/ha were evaluated on the incidence of *Maruca vitrata* under open field conditions. Non-significant differences were observed in the pre-treatment count of *M. vitrata* ($F_{(7, 16)} = 0.68$, p= 0.69) at flowering stage and ($F_{(7, 16)} = 2.34$, p= 0.08) at pod stage. However, among the treatments, significant differences in the mean *M. vitrata* larval population at pod stage ($F_{(7, 16)} = 15.76$, $p<0.001$) and flower stage ($F_{(7, 16)} = 8.96$, $p<0.001$) (Table 22 and 23).

The larval population (per 20 flowers) of *M. vitrata* prior spraying was ranged from 12 to 12.37 larvae at flowering stage. The highest dose of Fipronil 5% SC @ 100 g a.i. ha^{-1} resulted in maximum reduction in the *M. vitrata* larval population (0.93 larvae / 20 flowers) over the control after three rounds of spraying. Fipronil 5% SC @ 50 g a.i. ha^{-1} was next best dose with 61.21 PROC, followed by the dose of 25 g a.i. ha^{-1} (59.48 PROC) (Table 23). The other check insecticides i.e., Flubendiamide 39.35% SC, Quinalphos 25% EC, Novaluron 10% EC and Lambda

Table 21: Safety evaluation of day wise residues of Deltamethrin in tomato

Sampling days	Recommended dose			Double the recommended dose		
	Residues (mg kg^{-1})	Dietary exposure (mg $person^{-1}$ day^{-1})		Residues (mg kg^{-1})	Dietary exposure (mg $person^{-1}$ day^{-1})	
		urban	rural		urban	rural
0	0.361	0.00646	0.009093	0.699	0.01251	0.017609
1	0.246	0.00441	0.006206	0.366	0.00655	0.009228
3	0.127	0.00228	0.003211	0.171	0.00306	0.004313
5	0.036	0.00064	0.000898	0.065	0.00117	0.001645
7	0.015	0.00026	0.000373	0.034	0.00061	0.000861
10	0.012	0.00021	0.00029	0.017	0.00030	0.000429
12	BDL			0.009	0.00015	0.000217

cyhalothrin 5% EC were found less effective against *M. vitrata* larval population as compared to all the three field doses of Fipronil 5% SC and resulted only 53.75, 50.69, 49.40 and 56.16 per cent control respectively at flowering stage (Table 23) and 61.83, 56.33, 54.67 and 64.27 per cent control at pod formation stage (Table 22) respectively.

The biology and organic pest management module for radish root and shot hole borer, *Phyllotreta striolata*: Flea beetles (Coleoptera: Chrysomelidae) of the genus *Phyllotreta* are significant economic pests of cruciferous crops around the world. In radish, this nefarious pest causes numerous shot holes on its leaves during its adult stage and soil-dwelling grubs make a large number of abnormal black-brown markings on the tap root and thereby significantly lowering the market value of the crop. The biology of *P. striolata* was studied on radish under laboratory condition. Gravid females laid the eggs in singly or in small batches of 4 to 6 glued to the growing radish root surface. Incubation period ranged between 7.75 to 11.25 days. Three larval instars were observed and larval period ranged between 6.5 to 9.25, 7.75 to 11.75 and 8.75 to 11.25 days in soil, respectively. Total grub/larval period varied from 25 to 31 days. Pupation takes place in earthen cocoon. Pupae were exerate, fleshy, whitish in colour with prominent black eye spots. Pupal period varied from 7.25 to 10.25 days. Adults survived for several weeks depending upon the availability of host plants and environmental condition (Fig. 10). Adult females out-numbered the males.

An organic pest management module was developed, evaluated and compared with farmers' practices. The organic pest management module comprised: Soil application of neem cake @ 500 kg/ha before radish seed sowing; Inter-cropping with bold seeded Indian mustard (*Brassica juncea* (L.)) every alternate 8 rows as trap crop 15 days before radish sowing; vermicompost enriched with *Metarhizium anisopliae* @ 10 g/kg of soil during seed sowing; soil application of entomopathogenic nematode *Heterorhabditis indica* NBAII H38 wettable powder formulation @ 10 kg/ha thoroughly mixed with moist sand with light irrigation; need based foliar spraying of *Metarhizium anisopliae* + Neem oil @ 2.5 g/lit + 2.5 ml/lit at 25 days after sowing (DAS); need based foliar spraying of Azadirachtin 300 ppm @ 5 ml/lit at 35 DAS and need based foliar spraying of *Metarhizium anisopliae* + Neem oil @ 2.5 g/lit + 2.5 ml/lit at 45 DAS (All foliar sprayings were done before 8 am). The number of shot holes on radish leaves and stripes on radish roots were counted. Lowest significant ($P<0.0001$) numbers of shot holes were counted in organic IPM module and the corresponding values were 37.64, 61.35, 88.42 and 117.37 per leaf in 21, 28, 35 and 42 DAS, respectively (Table 24). The radish leaves from the farmers' practices that often relied on a series of chemical insecticides had higher number of shot holes than the IPM module during all the observation followed by untreated control plots. Interestingly, in mustard leaves, used as a trap

Fig. 10: The grub of radish flea beetle on the rhizosphere

Table 22: Efficacy of Fipronil and check insecticides against pod borer, *Maruca vitrata* in vegetable cowpea (pod stage)

Treatment	Application rate (g ai/ha)	PTC	I SPRAY	PPOC	II SPRAY	PPOC	III SPRAY	PPOC	Mean*	PPOC**
Flubendiamide 39.35% SC	48	15.17±0.19a	6.03±0.26b(2.56)	61.79	2.60±0.12b(1.76)	62.34	1.13±0.09b(1.28)	61.36	3.26±1.40a(1.94)	61.83
Quinalphos 25% EC	375	14.53±0.18a	6.87±0.48b(2.71)	54.65	3.67±0.33c(2.04)	55.79	1.87±0.12c(1.54)	58.55	4.13±1.31a(2.15)	56.33
Novaluron 10% EC	75	14.53±0.18a	7.10±0.56b(2.76)	53.11	3.97±0.33c(2.11)	54.50	2.10±0.15c(1.61)	56.41	4.39±1.28a(2.21)	54.67
Lambda cyhalothrin 5% EC	25	15.23±0.09a	5.97±0.38b(2.54)	62.40	2.53±0.20b(1.74)	64.43	1.03±0.09b(1.24)	65.99	3.18±1.40a(1.92)	64.27
Fipronil 5% SC	50	14.77±0.15a	3.90±0.67a(2.10)	74.70	1.23±0.24a(1.32)	76.87	0.47±0.12a(0.98)	73.85	1.87±1.09a(1.54)	75.14
Fipronil 5% SC	100	14.53±0.24a	3.73±0.45a(2.06)	75.37	1.23±0.30a(1.32)	74.89	0.47±0.12a(0.98)	75.30	1.81±1.02a(1.52)	75.19
Fipronil 5% SC	25	14.67±0.24a	4.57±0.43a(2.25)	70.13	1.67±0.17a(1.47)	70.98	0.57±0.12a(1.03)	72.99	2.27±1.18a(1.66)	71.37
Control	-	14.87±0.18a	15.47±0.18c(4.00)	-	16.77±0.23d(4.16)	-	18.00±0.12d(4.30)	-	16.74±0.53b(4.15)	-
Tukey's HSD at 5%	-	NS	0.399	-	0.27	-	0.08	-	2.28	-
df	-	7,16	7,16	-	7,16	-	7,16	-	7,16	-
F value	-	2.34	70.283	-	430.754	-	2627.219	-	15.764	-
P value	-	0.08	<0.001	-	<0.001	-	<0.001	-	<0.001	-

PTC-Pre-treatment Count, PROC-percent reduction over control, NS-Non-Significant, * Mean larval population after three sprays, **PROC after three sprays. Data are means of three replications. Figures in parentheses are $\sqrt{(x+0.5)}$ transformed values. Means in the same column followed by different letters differ significantly ($P < 0.05$) on the basis Duncan's Multiple Range Test (DMRT) test.

Table 23: Efficacy of Fipronil and check insecticides against pod borer, *Maruca vitrata* in vegetable cowpea (flowering stage)

Treatment	Application rate (g ai/ha)	PTC	I SPRAY	PPOC	II SPRAY	PPOC	III SPRAY	PPOC	Mean*	PPOC**
Flubendiamide 39.35% SC	48	12.20a	6.07±0.23ab(2.56)	52.29	3.13±0.15b(1.91)	54.12	1.60±0.12c(1.45)	54.85	1.60±1.31a(1.45)	53.75
Quinalphos 25%EC	375	12.20a	6.70±0.47b(2.68)	47.36	3.87±0.23c(2.09)	51.60	2.10±0.12d(1.61)	53.12	2.10±1.34a(1.61)	50.69
Novaluron 10% EC	75	12.00a	6.80±0.58b(2.70)	45.71	4.03±0.26c(2.13)	50.82	2.27±0.15d(1.66)	51.66	2.27±1.32a(1.66)	49.40
Lambda cyhalothrin 5% EC	25	12.37a	5.97±0.38ab(2.54)	53.74	3.00±0.17b(1.87)	57.40	1.47±0.09bc(1.40)	57.34	1.47±1.32a(1.40)	56.16
Fipronil 5% SC	50	12.00a	5.13±0.59a(2.37)	59.05	2.47±0.23ab(1.72)	60.95	1.10±0.12ab(1.26)	63.65	1.10±1.17a(1.26)	61.21
Fipronil 5% SC	100	12.10a	4.93±0.59a(2.33)	60.97	2.20±0.26a(1.64)	64.01	0.93±0.15a(1.20)	66.92	0.93±1.16a(1.20)	63.97
Fipronil 5% SC	25	12.30a	5.43±0.46ab(2.44)	57.68	2.60±0.21ab(1.76)	60.14	1.23±0.15abc(1.32)	60.62	1.23±1.22a(1.32)	59.48
Control	-	12.00a	12.50±0.17c(3.61)	-	13.43±0.30d(3.73)	-	14.57±0.23e(3.88)	-	14.57±0.60b(3.88)	-
Tukey's HSD at5%	-	**NS**	**0.413**		0.16	-	0.15		2.05	-
df	-	**7,16**	**7,16**	-	**7,16**	-	**7,16**	-	**7,16**	-
F value	-	**0.68**	**27.988**	-	**259.474**	-	**1037.189**	-	**8.96**	-
P value	-	**0.69**	**<0.001**	-	**<0.001**	-	<0.001	-	<0.001	-

PTC-Pre-Treatment Count, PROC-percent reduction over control, NS-Non-Significant, * Mean larval population after three sprays, **PROC after three sprays. Data are means of three replications. Figures in parentheses are $\sqrt{x + 0.5}$ transformed values. Means in the same column followed by different letters differ significantly (P < 0.05) on the basis Duncan's Multiple Range Test (DMRT) test.

crop, suffered maximum among all the treatments. The significant (P<0.0001) numbers of shot holes in mustard leaves were 167.21, 294.15, 423.66 and 672.14 per leaf at 21, 28, 35 and 42 DAS which were 344.23, 379.46, 379.15 and 472.67 per cent increase over organic IPM module plots (Table 24). Similar trend was also observed in stripes on radish roots due to grubs. Untreated control plots harbored significant (P<0.0001) maximum 187.57 black stripes and spots on radish root which was 426.29 per cent higher than the untreated control plots at 42 DAS. This was followed by 116.12 spots at 35 DAS with 388.92 per cent increase over IPM module. Radish roots harvested from local farmers' field had significant (P<0.0001) higher spots (ranged from 16.48 to 74.26 with maximum 146.08 per cent higher) than the organic IPM module. Numbers of stripes on radish roots were significantly (P<0.0001) minimum in organic IPM module ranged between 7.37 to 35.64 (Table 25).

Table 24: Number of shot holes (per leaf) due to adult flea beetles in different treatments

Treatments	21 DAS	28 DAS	35 DAS	42 DAS
IPM Module	37.64	61.35	88.42	117.37
Farmers' practices	58.09 (54.33)	112.49 (83.36)	198.74 (124.77)	266.76 (127.28)
In mustard leaves	167.21 (344.23)	294.15 (379.46)	423.66 (379.15)	672.14 (472.67)
Control	139.37 (270.27)	264.36 (330.90)	392.05 (343.40)	513.84 (337.80)
Comparison	Pr > |t| at 28 df with sample size n1=n2=15 (Two-Sample t-Test) under H0: μ1=μ2 against H1: μ1≠ μ2			
IPM Module vs Farmers' practices	<.0001**	<.0001**	<.0001**	<.0001**
IPM Module vs In mustard leaves	<.0001**	<.0001**	<.0001**	<.0001**
IPM Module vs Control	<.0001**	<.0001**	<.0001**	<.0001**
Farmers' practices vs In mustard leaves	<.0001**	<.0001**	<.0001**	<.0001**
Farmers' practices vs Control	<.0001**	<.0001**	<.0001**	<.0001**
In mustard leaves vs Control	<.0001**	<.0001**	<.0001**	<.0001**

Figures in the parenthesis are the per cent increase over IPM module; **Significant at 1% level of significance

Table 25: Number of stripes in radish roots in IPM module and untreated control plots

Treatments	21 DAS	28 DAS	35 DAS	42 DAS
IPM Module	7.37	13.65	23.75	35.64
Farmers' practices	16.48 (123.61)	33.59 (146.08)	56.08 (136.13)	74.26 (108.36)
Control	32.46 (340.43)	59.60 (336.63)	116.12 (388.92)	187.57 (426.29)
Comparison	Pr > |t| at 28 df with sample size n1=n2=15 (Two-Sample t-Test) under H0: μ1=μ2 against H1: μ1≠ μ2			
IPM Module vs Farmers' practices	<.0001**	<.0001**	<.0001**	<.0001**
IPM Module vs Control	<.0001**	<.0001**	<.0001**	<.0001**
Farmers' practices vs Control	<.0001**	<.0001**	<.0001**	<.0001**

Figures in the parenthesis are the per cent increase over IPM module; **Significant at 1% level of significance

Virulence of entomopathogenic nematodes against radish flea beetle *Phyllotreta striolata*: In the present study, both *Heterorhabditis indica* and *Steinernema carpocapsae* were able to kill third instar and pre-pupal stages of radish flea beetle *Phyllotreta striolata*. Comparing the *H. indica* and *S. carpocapsae* susceptibility of third instar and pre-pupae there was no control mortality. The highest mortality (100%) of third instar larvae caused by *H. indica* at a concentration of 25 IJ per larva, while *S. carpocapsae* were able to cause 87.5% of larval mortality at 50 IJ per larva after 48 H of exposure (Fig. 11). When pre-pupae were exposed to *H. indica* at concentrations of 25 IJ per larva 100% mortality was recorded, while in the case of *S. carpocapsae* mortality of pre-pupae was 58.3% after 48 H exposure (Fig. 11). The mortality of radish flea beetle stages in the laboratory experiment was found to be significant (P <0.05) among the IJ concentration. Among the nematode species, irrespective of IJ concentration, *H. indica* caused significantly (P < 0.05) greater mortality in both radish flea beetle stages compared with *S. carpocapsae*. Among the radish flea beetle different stages, irrespective of EPN species, third instar stage was significantly (P <0.05) more susceptible compared with pre-pupal stage. The calculated LC_{50} and LC_{90} values for *H. indica* and *S. carpocapsae* on radish flea beetle stages are shown in Table 26. The LC_{50} and LC_{90} values indicated that *H. indica* was more virulent against both third instar and pre-pupal stages of radish flea beetle *Phyllotreta striolata.*

PROJECT 2: CHARACTERIZATION AND INTEGRATED MANAGEMENT OF PLANT PATHOGENS (DISEASES) OF VEGETABLE CROPS (w.e.f. 01.04.2023)

Establishment of pure cultures of plant pathogens: Pure cultures of fungal pathogens viz. *Colletotrichum trancatum* (10 no.) from chilli, *Phomopsis vexans* (04 no.) from brinjal and *Alternmaria solani* (30 no.) from tomato were established on PDA. Pure cultures of bacterial wilt (*R. Solanacearum)* pathogens from tomato, brinjal and chilli, were established. Based on the cultural,

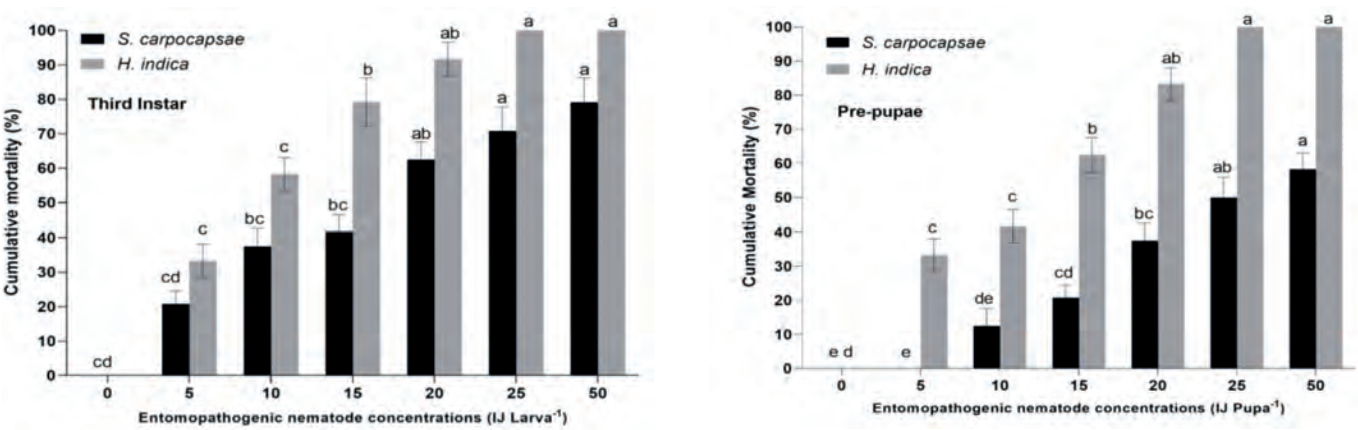


Fig. 11: Cumulative mortality (%) of third instar and pre-pupal stages of radish flea beetle *Phyllotreta striolata* at different concentrations of entomopathogenic nematodes, *Heterorhabditis indica* and *Steinernema carpocapsae* at 48 H after exposure. Different letters on the top of error bars indicate significant difference for different nematode concentrations at (P < 0.05) using Tukey's test. Bars = standard error (*n* = 24).

Table 26: The lethal concentration (LC_{50} and LC_{90} n = 24) of *Steinernema carpocapsae* and *Heterorhabditis indica* against third instar and pre-pupal stages of radish flea beetle, *Phyllotreta striolata,* at 24 and 48 H after exposure in laboratory experiment

Insect Stages	EPN Species	DAT	LC_{50}	95% Fiducial limits	LC_{90}	95% Fiducial limits	Slope ± SE	χ^2	*P*
Third instar	*S. carpocapsae*	24 H	31	26-41	78	54-156	3.2365±0.5705	32.19	<0.0001
		48 H	15	10-20	82	47-281	1.7456±0.3743	21.75	<0.0001
	H. indica	24 H	14	10-19	72	43-219	1.8251±0.3821	22.82	<0.0001
		48 H	7	5-9	18	14-26	3.3117±0.5638	34.51	<0.0001
Pre-pupae	*S. carpocapsae*	24 H	48	36-85	139	80-530	2.7728±0.6125	20.50	<0.0001
		48 H	31	24-47	113	67-352	2.3195±0.4619	25.22	<0.0001
	H. indica	24 H	20	14-31	132	66-811	1.5799±0.3718	18.06	<0.0001
		48 H	9	3-13	24	16-106	2.9778±0.7047	17.86	<0.0001

morphological characteristics, sugar oxidation test and cross pathogenicity test we confirmed that race 1/ biovar III of *R. pseudosolanacearum.*

Standardization of screening method for *Ralstonia solanacearum*: Pure culture of the bacterial pathogens were established from infected samples of solanceous vegetables viz. chilli, tomato and brinjal onto Kelman's triphenyl tetrazolium chloride (TZC) medium. The pathogen isolates grew on the TZC and their virulent and avirulent (mutant) colonies could be differentiated on the TZC medium after 24 hours of incubation at 28 ±1ºC. Pathogenicity of *R. solanacearum* isolates proved on twenty five (25) days old seedlings of cultigens of brinjal and individual seedling inoculated with 5 ml of bacterial inoculum (10^8 cfu/ml) in the leaf axil of third expanded leaf from top and pricking with the help of a sterilized syringe needle. Typical wilt symptoms were observed in inoculated seedlings within 4-6 and 3-5 days, respectively. The seedling inoculated with sterilized distilled water in similar fashion served as control.

Recording of Emergence of *Phomopsis* blight on Water Spinach: Severe disease incidence of *Phomopsis* blight has been recorded on water spinach *viz.* VRWS-31(70%), VRWS-32 (50%), VRWS-33 (75%) and VRWS- red (60%) at ICAR-IIVR, Research Farm. *Phomopsis* leaf blight (PLB) is caused by *Phomopsis* spp. Pathogen was isolated from diseased leaves and seeds of water spinach (var. Kashi Manu), by plating surface sterilized tissues on potato dextrose agar (PDA) medium (Fig. 12 a & b). Inoculated PDA plates produced white mycelium after 7 days of incubation at 24 ºC. Microscopic mount were prepared and oval non-septate conidia were observed. Based on the morphological and microscopic characteristics, the pathogen was identified as *P vexans*. The pathogenicity test was also performed by detached leaf method. The pathogen was re-isolated from inoculated plants for the fulfillment of Koch postulate. This is first report of emergence of *Phomopsis* blight in water spinach.

Fig. 12 (a) Typical symptom of *Phomopsis* blight on water spinach and (b) PDA culture plate of *P. vexans*

PROJECT 3: DIAGNOSTICS OF VIRUSES INFECTING VEGETABLE CROPS AND ITS MANAGEMENT THROUGH NOVEL STRATEGIES (w.e.f. 01.04.2023)

Characterization of distinct watermelon bud necrosis virus (*Orthotospovirus citrullonecrosis*) causing necrosis disease on tomato in India: The near complete genome sequence of L, M and S RNA segments of the WBNV-22ToNV were determined using the primer pairs yielding overlapping fragments. The S RNA segment is 3353 nt long, with 66 and 21 nucleotides in its 5'- and 3'-untranslated regions (UTRs), respectively. The two open reading frames (ORFs) of the S RNA are arranged in an ambisense orientation. The viral-sense ORF (nt 67-1386) encodes an NSs protein of 439 amino acids (49.74 kDa), while the antiviral-sense ORF (nt 2505-3332) encodes an N protein of 275 amino acids (30.8 kDa). The intergenic region between the NSs and N genes (IGR-S) is 1118 nucleotides long with an A/U content of 72.63%. The M RNA of WBNV-22ToNV is 4795 nucleotides long and encodes two ORFs in an ambisense arrangement. The viral-sense strand ORF of 924 nucleotides, comprising 307 amino acids (34.36 kDa), encodes the NSm protein. The antiviral-sense ORF of 3366 nucleotides encodes a glycoprotein precursor of 1121 amino acids (127.22 kDa). The intergenic region of the M RNA (IGR-M) is 409 nucleotides long, with an A/U content of 77.75%. The L RNA of WBNV-22ToNV encodes an RdRP of 2874 amino acids (331.1 kDa) in an antisense arrangement. In the near-complete genome of L, M, and S RNA of WBNV-22ToNV, the terminal completely conserved 8 nucleotides (5′ AGAGCAAU 3′) were observed in the 5′ terminal regions of L and S RNA and the 3′ terminal region of M RNA.

Upon further sequence analysis, it was found that the NSm and Gn/Gc proteins on the M RNA of WBNV-22ToNV had amino acid identities range of 96.74-97.71% and 92.23-95.27%, respectively, with those of other WBNV isolates. The intergenic region of the M RNA (IGR-M) varied in nucleotide length between 401 and 412 nucleotides among WBNV isolates. WBNV-22ToNV possessed 409 nucleotides, including an 18-nucleotide insertion sequence from the unknown origin. The nucleotide identity of IGR-M in WBNV-22ToNV was found to be highly divergent from that of other WBNV isolates, with identities ranging from 81.59% to 83.88%. In comparison, other isolates shared more than 92% identity among themselves in this region. The RdRP protein on the L RNA of WBNV-22ToNV had 91.19% and 96.17% identity at the nucleotide and at the amino acid level, respectively with the previously reported isolates of WBNV from watermelon.

Phylogenetic analysis: The phylogenetic analysis based on the S, M, and L RNA segments consistently indicates that WBNV-22ToNV forms a distinct clade within the cluster of previously reported WBNV isolates from India. Both sequence and phylogenetic analyses affirm that WBNV-22ToNV is a divergent isolate compared to the existing WBNV isolates. This suggests a significant genetic divergence and evolutionary distinction between WBNV-22ToNV and other known WBNV isolates, reinforcing its uniqueness. The near-complete genome sequence and individual genomic regions of WBNV-22ToNV from tomato were compared with the corresponding sequences from other WBNV isolates for which complete sequences were available in the NCBI database. The nucleotide sequence identities were determined to be 86.09-87.64% for the S RNA region, 88.11-90.37% for the M RNA region, and 90.75-91.26% for the L RNA region of WBNV-22ToNV compared to other WBNV isolates. The lengths of the IGR-S region between the NSs and N genes varied among WBNV isolates.

Specifically, the IGR-S segment was 1118 nucleotides long in WBNV-22ToNV, while it ranged between 1120-1150 nucleotides in other reported WBNV isolates. The nucleotide identity between the IGR-S of WBNV-22ToNV and those of other WBNV isolates was found to be 75.97–78.76%. Although the sequences of the S RNA IGRs vary between WBNV-22ToNV and other isolates, the amino acid sequence of WBNV-22ToNV N shares 96.36–98.54% identity with the amino acid sequences of other WBNV isolates. In case of NSs gene, amino acid sequence shares highest of 92.48% identity with the tomato WBNV isolate (MN711686).

Recombination analysis: The analysis conducted using RDP 5 revealed putative recombination events within the genome of WBNV-22ToNV. Recombination was detected within the L RNA, and the potential parental sequences were WSMoV and WBNV. Similarly, recombination events were identified within the M RNA of WBNV-22ToNV, with the potential parental sequences being isolates of WBNV. Furthermore, one putative recombination event was detected in the ORF N of the S RNA (Table 28). The potential parental sequences involved in this recombination event were isolates of both WBNV and WSMoV.

Identification of viruses associated with yellowing disease infected bottle gourd plant: Bottle gourd samples were collected and send for the virome analysis. Totally 57666202 reads were obtained with a data of about 8.64 GB. The quality of raw reads was checked using FastQC (v0.11.8). Adapter sequences from raw reads were trimmed with fastp (0.20.1) and adapter trimmed reads were used for downstream analysis. The adapter trimmed reads were mapped to the *Lagenaria sisceraria* genome (GCA_002890555.2 - ZAAS_Lsic_2.0) using HISAT2 (version 2.2.1). Reads which were not mapped to the reference genome were extracted from the alignment results using samtools (version 1.15.1). The unmapped reads were aligned to the virus database from NCBI. Following plant viruses were detected in the samples (Table 27).

Table 27: Functional annotation of sequences belonging to virus

S. No	Virus	No of sequences
1.	Potato leafroll virus	1
2.	Cucumber green mottle mosaic virus	55
3.	Tomato leaf curl Gujarat virus	1
4.	Tomato leaf curl New Delhi virus	5
5.	Squash vein yellowing virus	3
6.	Lagenaria siceraria endornavirus-California isolate FB	5
7.	Bitter gourd yellow vein virus	2
8.	Lagenaria siceraria endornavirus-Hubei isolate JZ	13
9.	Tomato leaf curl Karnataka virus	2

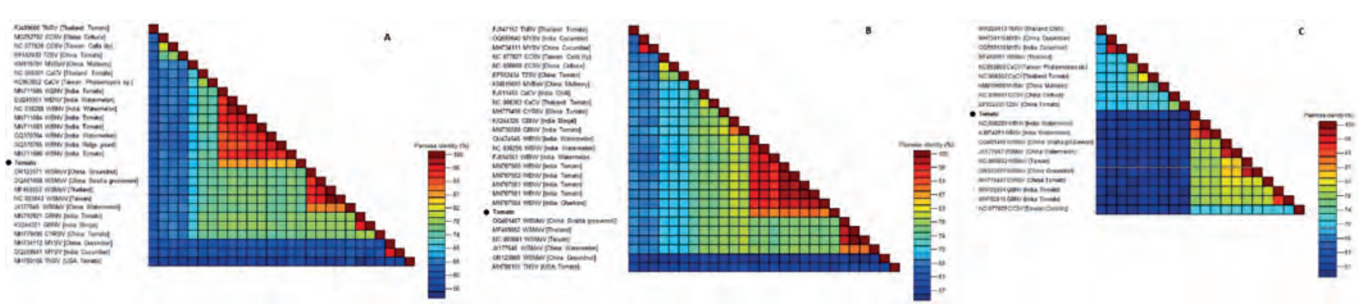


Fig. 13: Heat map showing identity matrix of WBNV isolate genomic fragment S RNA (a), M RNA (b) and L RNA (c) infecting tomato with other previously reported WBNV isolates and other orthotospovirus species belonging to WSMoV serogroup.

Table 28: Recombination analysis of the near complete genomic fragments of WBNV isolate infecting tomato

RNA	Point	Major	Minor	RDP	GENECONV	BootScan	MaxChi	Chimaera	SiScan	3Seq
L RNA	1-3656	WSMoV NC_003832	WBNV NC_038289	1.235×10^{-182}	-	7.219×10^{-189}	8.775×10^{-197}	8.231×10^{-15}	6.566×10^{-52}	1.730×10^{-213}
S RNA	2222-3352	WBNV MN711686	WSMoV MF469053	8.399×10^{-03}	7.181×10^{-10}	2.374×10^{-16}	1.180×10^{-19}	3.161×10^{-11}	1.287×10^{-23}	1.970×10^{-02}
M RNA	4701-4945	MN707984	MN707983	-	6.720×10^{-03}	4.174×10^{-02}	-	-	-	-

PROJECT 4: BIO-INTENSIVE MANAGEMENT OF ROOT-KNOT NEMATODE IN VEGETABLE CROPS (w.e.f. 01.04.2023)

Screening of bottle gourd germplasms for root-knot nematode resistance: Two varities (Kashi Ganga, Kashi Shubra) and four bottle gourd germplasms (DRAG-3, VRBG-9-1-1, VRBG-61-3 and VRBG-67) were screened for root-knot nematode (*Meloidogyne incognita*) resistance through challenged nematode inoculation under screen-house conditions. Each germplasms was screened at an inoculum level of 2 second-stage juveniles (J_2) per g of soil. Observations were recorded after 60 days of nematode inoculation. The results revealed that, four bottle gourd germplasms and two varieties were susceptible to root-knot nematode, *Meloidogyne incognita*.

Screening of pumpkin germplasms for root-knot nematode resistance: Ten pumpkin germplasms were screened for root knot nematode (*Meloidogyne incognita*) resistance under pot conditions. Each plant was challenged with 2000 second stage infective juveniles or 2 J_2 per g of soil. Observations were recorded after 60 days of nematode inoculation. The results revealed that two germplasms i.e. Swarna Amrit and VRPK-18-1 were moderately resistant against root-knot nematode, *Meloidogyne incognita* with having gall index (3.0).

Screening of brinjal germplasms for root-knot nematode resistance: Nine brinjal germplasms including susceptible checks Kashi Taru and Kashi Sandesh were screened for root-knot nematode (*Meloidogyne incognita*) resistance under screen house conditions through challenged nematode inoculation @ 2 J_2 per g of soil. Among nine brinjal germplasms, three germplasms i.e. GB-6, GB-11 and GB-14 are shown resistance reaction against root-knot nematode, *Meloidogyne incognita* with having gall index (2.0). However, this is preliminary screening, resistance reaction is needed to be revalidated (Fig. 14).

Screening of tomato germplasms for root-knot nematode resistance: Eighteen tomato advance lines including susceptible checks were screened for root-knot nematode (*Meloidogyne incognita*) resistance under screen house conditions through challenged nematode inoculation @ 2 J_2 per g of soil. Among them, tomato lines i.e. S1-150-P22-39-9, S1-2018-171-190, S1-2018-150-P22-1 and LA2823 are shown immune reaction against root-knot nematode, *Meloidogyne incognita* with having gall index (0) and S1-150-34-19, S1-150-20-1, S1-150-34-20 and H-88-78-1 are shown highly resistant reaction against root-knot nematode, *Meloidogyne incognita* (Fig. 15).

Fig. 15: Reaction of tomato lines against root-knot nematocle M. incognita-A. Money maker (Highly susceptible); B. S1-150-P22-39-9 (Immune) and C. C-12-1-4-120-18 (Highly Susceptible)

Fig. 14: Reaction of brinjal germplams against root-knot nematode *M. inco.* **gnita - A. GB-10 (Highly suceptible);** *B. Kashi* **Taru (Highly susceptible); C. GB-11 (Resistant) and D. GB-14 (Resistant)**

Nematicidal activity of nano-formulation of methyl eugenol on *Meloidogyne incognita*: Nano-formulation of methyl eugenol was evaluated against second-stage juvenile *Meloidogyne incognita* at different concentrations (0, 250, 500, 1000, 1500, 2000 ppm) for 24 h under laboratory conditions. Among, tested concentrations, highest mortality (91.2 and 100%) of second stage juvenile were recorded at 1500 and 2000 ppm concentration after 24 h of exposure respectively. Analysis of variance revealed that there was significant (df: 6, 49, F: 3186.18, *P*<0.0001) difference in second-stage juvenile mortality, when exposed to different concentrations of nano-formulation of methyl eugenol under laboratory conditions (Fig. 14). The LC_{50} and LC_{90} values revealed that, methyl eugenol nano-formulation at lower concentrations possess a strong nematicidal activity (Table 29).

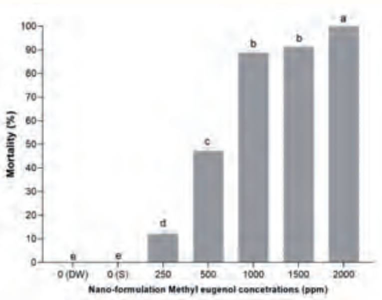


Fig. 16: Nematicidal activity of nano-formulation methyl eugenol on *Meloidogyne incognita*

Evaluation of fungal isolates against *Meloidogyne incognita* for nematode antagonistic activity: Culture filtrate of three IIVR native *Trichoderma* isolates along with six fungal isolates from rhizosphere of bitter gourd grown under protected cultivation were evaluated for egg hatching inhibition and juvenile mortality at 50% culture filtrate concentration for 120 h and 24 h exposure respectively under laboratory conditions. In distilled water 14% of eggs were not hatched after 120 H exposure whereas second-stage juvenile mortality was not observed in distilled water after 24 h exposure in juvenile mortality assay. However, 16.8% of egg hatching inhibition and 3.1% of second-stage juvenile mortality was recorded in potato dextrose broth at 50% filtrate concentration after 120 h and 24 h of exposure, respectively. All *Trichoderma* isolates TTV1, TTV2 and Tasp were found effective by causing highest egg hatching inhibition and juvenile mortality at 50% culture filtrate concentrations after 120 h and 24 h of exposure respectively. However, fungal isolates from rhizosphere of bitter gourd grown under protected cultivation not exhibited a greater nematicidal activity except BGF4 which shown 66% of egg hatching inhibition and 34% of second stage juvenile mortality under laboratory conditions (Table 30).

Evaluation of nematicidal activity of *Trichoderma* isolates on *Meloidogyne incognita* under nursery conditions: Experiment conducted in raised nursery beds were prepared in a screen house conditions, where it was naturally infested (>2 $J_2 g^{-1}$ of soil) with *Meloidogyne*

Table 29: The lethal concentration (LC50 and LC90) of nano-formulation of methyl eugenol against *Meloidogyne incognita* after 24 H exposure under laboratory conditions

LC_{50}	95% Fiducial limits	LC_{90}	95% Fiducial limits	Slope ± SE	χ^2	*P*
517.85	390.62-650.57	1159	894.7-1781	3.6615±0.4018	83.05	<.0001

Table 30: Effect of fungal isolates on *Meloidogyne incognita* egg hatching inhibition and juvenile's Mortality (%)

Fungal isolates	Egg hatching inhibition (%)	Second-stage juvenile mortality (%)
	120 h	24 h
BGF1	$37.8±1.3^{c}$	$13.5±0.6^{e}$
BGF2	$26.7±1.1^{ef}$	$6.4±0.3^{f}$
BGF3	$24.3±0.6^{f}$	$4.6±0.2^{g}$
BGF4	$66.1±0.8^{b}$	$34.3±0.7^{b}$
BGF5	$31.2±0.9^{d}$	$15.7±0.7^{d}$
BGF6	$28.7±0.6^{de}$	$21.1±0.6^{c}$
TTV1	$90.3±0.5^{a}$	$100.0±0.0^{a}$
TTV2	$91.4±0.4^{a}$	$100.0±0.0^{a}$
Tasp	$90.8±0.5^{a}$	$100.0±0.0^{a}$
PDB	$16.8±0.5^{g}$	$3.1±0.3^{g}$
DW	$14.7±1.0^{g}$	$0.0±0.0^{h}$
df	10, 55	10, 55
F value	807.29	5529.05
P<0.05	<0.0001	<0.0001

Data represented in (Mean ± SE). Different letters on each column indicate statistically significant difference between fungal isolates at (*P* < 0.05) using Tukey's HSD test. PDB: Potato Dextrose broth media. DW: Distilled Water *incognita*. The application of different *Trichoderma* (IIVR) isolates and Fluopyram in the nursery bed resulted in a significant reduction in number of galls formation and egg mass production in roots of tomato seedlings compared to the untreated control. Nematicidal activity of three *Trichoderma* isolates was comparable with chemical control Fluopyram 34.48% SC. However, *Trichoderma* isolates significantly (P<0.05) enhanced tomato seedlings germination and plant height compared to untreated and chemical control (Table 31).

Evaluation of nematicidal activity of *Trichoderma* isolates on *Meloidogyne incognita* under pot conditions: Application of *Trichoderma* isolates significantly (P<0.05) reduced the nematode reproduction in tomato plants. Among the *Trichoderma* isolates, the highest reduction in the number of galls root system^{-1} (58.2%), egg mass root system^{-1} (70.5%) and nematode (J2) population at the time of harvest (56.0%) was recorded in the treatment (T_2) having drenching of Tasp @ 5 g per plant compared to untreated control tomato plants. Besides, the nematicidal efficacy of the treatment (T_2) was comparable with chemical control (T_7). The other *Trichoderma* isolates i.e. TTV1 (T_6) and TTV2 (T_4) at highest dose (5 g per plant) was found next best effective treatment against *M. incognita* (Table 32).

Dissipation kinetics of Nematicide fluopyram 34.58% SC in tomato under field condition: The field experiment was conducted at nematode infested field condition. The tomato fruit samples were collected in zig-zag manner from each replication and control plots separately at a regular time interval on 0 (2 h after spraying), 1, 3, 5, 7 and10 days after the final spray. The samples were taken in polyethene bags (transparent, 8x11inches) and stored at -20°C until analysis to avoid any degradation of the pesticide or any others losses of the pesticide. The pedicels were removed from the fruits and directly crushed without any washing or pretreatment. The residue was extracted using acetonitrile solvent and analyzed through LC-MS/MS.

The results of experiment revealed that, in tomato fruits, after the last spray (2 h after application), the initial deposition of fluopyram residues was found 0.29, 0.48 and 0.89 mg kg^{-1} for half doses (HD), recommended dose (RD) and double dose (DD), respectively. The degradation was faster up to 5 days after application (DAA), where almost 50% residues were dissipated in all the doses and 10 days after application (DAA) residues became below the detectable limit (BDL). The dissipation behavior was initially faster and then slowed down over the time period. This indicated an exponential pattern of degradation and implied that it follows simple first-order kinetics that is adequate to explain the dissipation behavior of the residues. The dissipation of the pesticide is generally expressed in terms of life ($t_{1/2}$) which is the time required for the 50% dissipation of pesticide residue from its initial concentration. The half-lives of fluopyram in tomato fruits were 1.56, 1.83 and 1.93 days for HD, RD and DD, respectively. The regression equations were $y = 0.2962e^{-0.445x}$, $y= 0.5053e^{-0.378x}$ and $y = 1.1109e^{-0.359x}$ for HD, RD and DD, respectively.

Table 31: Evaluation of nematicidal activity of *Trichoderma* isolates on *Meloidogyne incognita* under nursery conditions.

Treatments	Germination (%)	Number of galls per root system	Number of egg mass per root system	Plant height (cm)
T1	79.3±1.1^{c} (0.0)	12.5±0.4^{a} (0.0)	4.1±0.2^{a} (0.0)	16.6±0.2^{b} (0.0)
T2	81.8±1.4^{bc} (3.1)	2.9±0.1^{b} (-77.2)	0.8±0.1^{c} (-80.5)	16.0±0.3^{b} (-3.6)
T3	86.3±1.2^{ab} (8.8)	3.5±0.1^{b} (-72.4)	1.3±0.1^{b} (-69.5)	20.3±0.2^{a} (22.3)
T4	88.0±1.4^{a} (11.0)	3.3±0.1^{b} (-74.0)	1.0±0.1^{bc} (-75.0)	21.1±0.7^{a} (26.8)
T5	87.8±1.4^{a} (10.7)	3.1±0.1^{b} (-75.4)	0.9±0.1^{bc} (-78.0)	21.4±0.8^{a} (28.9)
df	4, 15	4, 15	4, 15	4, 15
F value	6.67	362.0	86.90	21.39
P value	<0.0001	<0.0001	<0.0001	<0.0001

Data represented in (Mean ± SE). Different letters on each column indicate statistically significant difference between treatments at (P < 0.05) using Tukey's HSD test. Treatment details: T_1: Untreated control, T_2: Fluopyram 34.48% SC @ 1.25 ml/litre, T_3: Nursery drench of TTV1 @ 10 g/sq. m, T_4: Nursery drench of TTV2 @ 10 g/sq. m, T_5: Nursery drench of Tasp @ 10 g/sq. m.

Table 32: Evaluation of nematicidal activity of *Trichoderma* isolates on *Meloidogyne incognita* under pot conditions.

Treatments	GI (0-5)	Number of galls per root system	EM root per root system	FNP (100 CC)	RF	Yield (g/plant)
T1	2.6^{b}	78.3±1.7^{b} (-31.5)	41.0±1.7^{c} (-37.2)	174.3±2.4^{c} (-40.7)	0.9	375.0±12.5^{bc} (20.0)
T2	1.1^{d}	47.8±1.1^{d} (-58.2)	19.3±1.2^{e} (-70.5)	129.3±2.3^{e} (-56.0)	0.6	425.0±12.5^{a} (36.0)
T3	2.7^{b}	83.3±2.3^{b} (-27.2)	39.5±1.4^{c} (-39.5)	180.3±2.3^{bc} (-38.6)	0.9	347.5±17.8^{cd} (11.2)
T4	1.4^{c}	52.3±3.0^{d} (-54.3)	23.8±1.7^{e} (-63.6)	136.5±2.2^{e} (-53.5)	0.7	387.5±10.8^{abc} (24.0)
T5	2.9^{b}	84.0±2.0^{b} (-26.5)	46.5±1.7^{b} (-28.8)	183.8±2.7^{b} (-37.5)	0.9	362.5±10.8^{bc} (16.0)
T6	1.7^{c}	65.8±1.9^{c} (-42.5)	31.8±1.3^{d} (-51.4)	155.5±2.3^{d} (-47.1)	0.8	400.0±17.7^{ab} (28.0)
T7	1.1^{d}	23.0±1.8^{e} (-79.9)	11.3±1.0^{f} (-82.8)	65.3±2.0^{f} (-77.8)	0.3	350.0±17.7^{cd} (12.0)
T8	3.8^{a}	114.3±2.5^{a} (0.0)	65.3±1.8^{a} (0.0)	293.8±2.7^{a} (0.0)	1.5	312.5±10.8^{d} (0.0)
df	7, 24	7, 24	7, 24	7, 24		7.24
F value	83.00	131.24	92.52	523.36		4.57
P value	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001

Data represented in (Mean ± SE). Different letters on each column indicate statistically significant difference between treatments at (P < 0.05) using Tukey's HSD test. Treatment details: T_1: Tasp 2.5g@ plant or pot, T_2: Tasp 5.0g@ plant or pot, T_3: TTV2 2.5g@ plant or pot, T_4: TTV2 5.0g@ plant or pot, T_5: TTV1 2.5g@ plant or pot, T_6: TTV1 5.0g@ plant or pot, T_7: Fluopyram 34.48% SC @ 1.25 ml/litre, T_8: Untreated control.

PROJECT 5: RESIDUE ANALYSIS AND RISK ASSESSMENT OF PESTICIDES IN VEGETABLE CROPS (w.e.f. 01.04.2023)

Evaluation of common household methods for removal of deltamethrin from vegetables

Method validation: In the present investigation recovery experiments were carried out at different levels to establish the reliability and validity of analytical method and to know the efficiency of extraction and clean-up procedures. The control samples of tomato were spiked at 0.01, 0.02, 0.05, 0.1 and 0.5 mg kg^{-1} respectively, and processed by following the methodology as described above. The average recovery values from the fortified samples were found to be more than 85%. The limit of quantification (LOQ) was found to be 0.10 mg kg^{-1} and limit of detection (LOD) being 0.03 mg kg^{-1}.

Sample preparation: Adding of water during crushing of sample provided precision in the results and cleanup with 50, 75 and 100 mg PSA,15 mg GCB, 225 mg $MgSO_4$ produced less matrix effect (<20%) whereas cleanup with only 50, 75 and 100 mg PSA and 225 mg $MgSO_4$ gives > 30% ME along with various noise signal. Hence, 50, 75 and 100 mg PSA,15 mg GCB, 225 mg $MgSO_4$ combination were utilized for sample cleanup step.

Decontamination of deltamethrin residues from treated samples: The levels of deltamethrin residues in various produce such as tomato, okra, bitter gourd, cowpea, and chili have been significantly reduced through different household processing methods. The extent of reduction and the resulting residue levels are presented in a table 33.

Decontamination from tomato: Different home processing techniques have effectively lowered deltamethrin residues in tomato fruits (Table 14). Immersing the tomatoes in boiling water reduced the residues by 79.15%. Sonication combined with distilled water resulted in a 75.98% reduction. Employing a 1% NaCl solution for washing led to a residue reduction of 70.87%. Rinsing with vinegar solution removed 65.75% of residues. The use of warm water achieved a reduction of 61.34%, slightly more effective than using running tap water which yielded a reduction of 58.85%.

Decontamination from okra: The blanching method proved notably effective in reducing deltamethrin residues in okra compared to the other five processing techniques. Boiling water washing achieved the highest reduction at 69.25%, followed by sonication with distilled water (65.72%), 5% acetic acid solution (62.41%), and warm water (60.77%). Washing with 1% NaCl solution and running tap water removed 59.39% and 44.97% of the residues, respectively (Table 33).

Chili Decontamination: Table 4 outlines the reduction percentages and residue levels in chili. Blanching (boiling water washing) decreased residues by 77.5%. Sonication with distilled water and washing with 1% NaCl solution achieved reductions of 69.05% and 69.26%, respectively. Washing with 1% NaCl solution yielded a 56.41% reduction, while using a 5% acetic acid solution led to 64.08% reduction. Warm water and distilled water washes showed slightly better results, reducing deltamethrin by 61%.

Decontamination from bitter gourd: Washing with warm water showed slightly superior results, reducing deltamethrin by 74.25%. Washing with distilled water and sonication reduced residues by up to 72.72%. Vinegar solution washing led to a residue reduction of 68.74%. Warm water rinsing removed 50% of deltamethrin, while running tap water washed off 49.64%. Cleaning with 1% NaCl solution reduced pesticide residues by 54.73% (Table 33).

Decontamination from cowpea: The decontamination percentages for cowpea pods are presented in table-6. Blanching (boiling water washing) reduced deltamethrin by 79.78%. Distilled water washing and sonication resulted in a residue reduction of 73.61%. Vinegar solution washing reduced residues by 65.71%, while brine solution washing removed 64.17%. Washing with tap water achieved a 52.15% reduction, while immersion in warm water (50°C) washed off 46.31% of residues.

Consumers can take steps to minimize their exposure to pesticide residues by choosing organic produce, which generally has lower pesticide levels due to restricted pesticide use in organic farming. Additionally, peeling fruits and vegetables can further reduce pesticide intake, although this may also lead to loss of some nutrients and fiber. Overall, a balanced approach that includes thorough washing, boiling, and consideration of organic options can help consumers make safer choices for their diet.

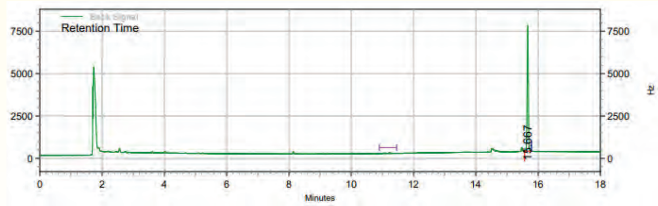


Fig. 17: Representative chromatogram for deltamethrin

PROJECT 6: INTEGRATION OF COMPATIBLE COMPONENTS TO DEVELOP CROP-SPECIFIC MODULE FOR THE INSECT-PEST AND DISEASE MANAGEMENT (IPDM) IN VEGETABLES (w.e.f. 01.04.2023)

Expt 1. Effect of insecticide exposure on honey bees, *Apis mellifera*

An experiment was conducted to study the honey bee, *A. mellifera* mortality upon exposure to flupyradifurone and imidacloprid under in-vitro condition and the mortality was recorded at every hour for the 6-hour experiment and daily for the 10-day experiment. Total mortality was calculated at the end of the experiment for each replicate cage in all treatment and control groups. Kaplan-Meier Log Rank Survival analysis was performed and the survival curves were calculated for a period up to 6 hours for the shorter contact exposure experiment and 10 days for the longer contact exposure experiment.

a. Six-hour contact exposure experiment.

The survival curves were significantly different among the treatments in the 6-hours contact exposure experiment ($\chi 2 = 60.20$, df = 2 and $p < 0.0001$) with the highest bee survival recorded in the control group,

Table 33: Effect of different household preparations in the removal of deltamethrin residue from tomato fruits

Treatment	% Reduction of residue (±SD)				
	Tomato	Okra	Chilli	Bitter gourd	Cowpea
Washing with running tap water	58.85 ± 3.08	44.97±1.37	61.53±6.19	49.64±0.96	52.15±12.96
Washing with 1% NaCl solution	70.87 ± 0.72	59.39±1.36	69.26±0.74	54.73±1.96	64.17±11.64
Warm water (50 °C)	61.34 ± 2.03	60.77±1.56	61.11±1.53	50.77±1.56	46.31±1.19
Vinegar solution	65.75 ± 0.42	62.41±1.65	64.08±2.03	68.74±2.12	65.71±0.93
Sonication with dist. Water	75.98 ± 1.61	65.72±0.32	69.05±0.49	72.72±1.29	73.61±0.80
Washing with boiling water (blanching)	79.15 ± 1.09	69.25±1.18	77.58±0.60	74.25±0.64	79.78±0.97

followed by the flupyradifurone and imidacloprid groups. No mortality of bees was recorded in the untreated control group. The survival of bees exposed to flupyradifurone was 90% whereas the survival of bees exposed to imidacloprid was 40%. (Fig. 18A).

b. Ten-day contact exposure experiment.

The Log-rank test of Kaplan Meier survival analysis revealed the significant differences in the survival of honeybees survival among the experimental treatments ($\chi 2 = 391.4$, df = 2 and $p < 0.0001$). While more bees survived in the control group compared to the flupyradifurone group, this difference became pronounced by the end of the experiment when control cages had 90% survival compared to 70% in the flupyradifurone group. All the bees exposed to imidacloprid were died at the end of 10 days exposure (Fig. 18B).

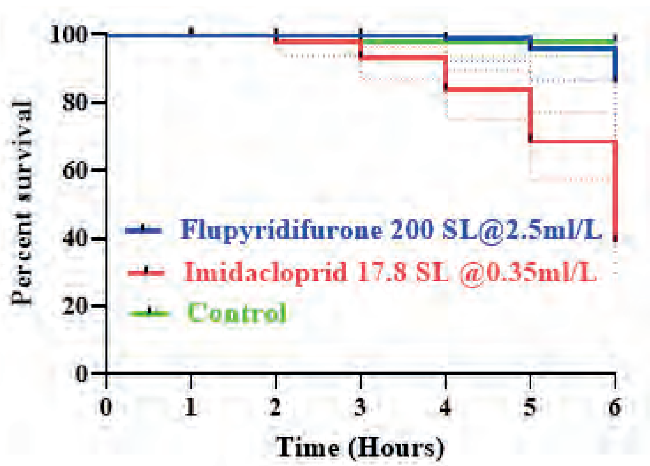


Fig. 18 A: Honey bee survival during the 6-hour contact exposure experiments when exposed to Imidacloprid and Flupyradifurone

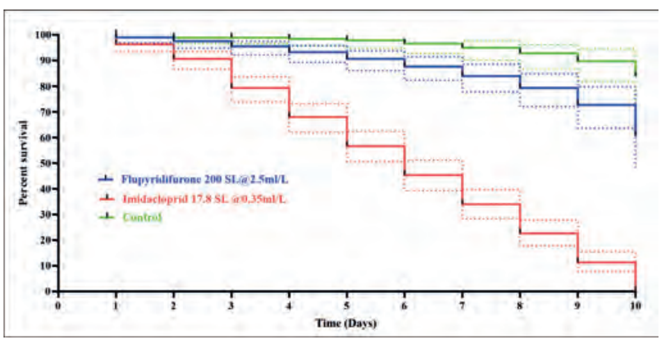


Fig. 18 B: Honey bee survival during the 10-day contact exposure experiments when exposed to Imidacloprid and Flupyradifurone

Expt 2. Formulation and field evaluation of integrated pest and disease management (IPDM) module in cabbage

An IPDM module was formulated using compatible components to manage the major insect-pest and disease in cabbage. The experiment on field evaluation of compatible IPDM module is underway at ICAR-IIVR, Varanasi and ICAR-IIVR, Regional Research Station (RRS), Kushinagar (Fig. 19). The experiment includes the following modules: Integrated module, Biointensive module, Chemical module and Untreated control.

Fig. 19: Experimental set up showing field evaluation of integrated pest and disease management (IPDM) module in cabbage at A. ICAR-IIVR, Varanasi, B. ICAR-IIVR, RRS, Kushinagar.

Externally Funded Projects

EXTERNALLY FUNDED PROJECTS

PROJECT 1: NATIONAL INNOVATIONS IN CLIMATE RESILIENT AGRICULTURE (NICRA) [ICAR]

Development of tomato hybrids for high temperature stress tolerance: During summer 2023, F_1s developed in 2018-19 and 2019-20 were evaluated under high-temperature (35-40°C day) conditions. Out of 36 hybrids, VRNTH-20131 (394.4 q/ha), VRNTH20122 (371.6 q/ha), Kashi Adbhut (368.7 q/ha), VRNTH-20149 (345 q/ha), VRNTH-20133 (331.5 q/ha) and Kashi Tapas (314.2 q/ha) performed better in terms of yield and fruit quality as compared to private hybrids. During 2021–22, 77 hybrids were identified, and they were also evaluated under high-temperature conditions in summer 2023 along with private hybrids. Out of which, hybrid VRNTH-22033 (506.44 q/ha), VRNTH-22057 (475.3 q/ha), VRNTH-22069 (444.36 q/ha), VRNTH-22002 (435.9 q/ha), and VRNTH-22041 (434 q/ha) were found superior for yields compared to private hybrids.

Use of phytohormones for high temperature tolerance in tomato hybrids: A total of 14 hybrids of tomato (11 developed from NICRA and 3 private sector hybrids) were evaluated for yield and fruit quality under high temperature during summer season (February to June). Four phytohormones, *viz.*, proline (10 µM), salicylic acid (SA 250 µM), sodium nitro-prusside (SNP 25 µM) and GA_3 (50 ppm) were sprayed at 30, 45 and 60 DAT. Among these phytohormones, irrespective of hybrids, SNP increased the fruit yield by 40.32% followed by proline (23.25%) and SA sprays (16.61%). When considering hybrids and their response to phytohormones, the best performing combinations were Kashi Adbhut with SNP, and VRNTH 20132 with SNP (each yielded 1.84 kg/plant) followed by Kashi Adbhut with proline (1.55 kg/plant).

Evaluation of tomato hybrids tolerant to moisture deficit condition: A total of 36 F_1s developed during 2018-19 and 2019-20 were transplanted in the field on 2nd October 2023 along with private sector hybrids as check for evaluation under moisture deficit condition. These hybrids were exposed to about 50 days drought stress condition during flowering form 25th October to 20th December. Study revealed that Kashi Adbhut (749.3 q/ha), VRNTH-20141 (722.30 q/ha), VRNTH-20131 (721.9 q/ha), VRNTH-20133 (708.8 q/ha), VRNTH-19069 (673 q/ha), VRNTH-20132 (654.6 q/ha), VRNTH-20122 (645.1 q/ha), VRNTH-20105 (612.4 q/ha) and VRNTH-20148 (604.5 q/ha) were promising in terms of yield over private hybrids.

Improving moisutre stress tolerance in tomato through grafting technique: In this study also, transplanting was done on 2nd October 2023 and grafted plants were exposed to moisture stress condition form 25th October to 20th December for nearly 50 days during flowering. Among the graft combinations, *S. pimpinellifolium* + Kashi Aman and Punjab Chhuhara + Kashi Aman performed better and produced fruit yield of 2.75 kg and 2.67 kg per plant, respectively, with increase of 20.3% and 18.1% over non-grafted (control).

Generation advancement of Punjab Chhuhara x H-88-78-1 populations for phenotyping study under high temperature tolerance: GBS based $F_{2:3}$ populations of Punjab Chhuhara x H-88-78-1 were raised in the field during October 2023 for their generation advancement to produce $F_{3:4}$ progenies. Individual plants of 200 $F_{2:3}$ progenies were selfed to generate $F_{3:4}$ progenies.

PROJECT 2: CRP ON HYBRID TECHNOLOGY (TOMATO) [ICAR]

A total of 47 hybrids developed at the institute were evaluated for yield and its related traits, processing parameters and ToLCV resistance. Of total, three hybrids were selected for yield and other traits (minimum standard: > 70 t/ha) with yield range between 749.99 q/ha (CRPVRTH-23-14) to 839.99 t/ha (CRPVRTH-23-34). A few promising hybrids were identified having high TSS such as VRTH-18-26 (4.96°B), VRTH-16-4 (4.66°B), VRTPH-23-26 (4.63°B), VRTPH-23-4 (4.60°B), VRTPH-23-13 (4.56°B) and VRTH-21-21 (4.46°B). During the year, parental lines namely VRT-34 (5°B), VRT-67 (4.4°B) and ToLCV-32 (5.3°B) were identified with high TSS, which fulfill the processing parameters. Besides, resistance source were also identified based on marker-assisted selection for *Ty-2* and *Ty-3* (ToLCV), *Mi-1* (RKN) and *ph-3* gene (late blight) resistance genes. Total 15 germplasm lines were screened against RKN, of which AVTO-1424, AVTO-1906 and AVTO-0102 were found highly resistant to RKN.

Tomato hybrid VRTH-16-4

PROJECT 3: CRP ON AGRO BIODIVERSITY [ICAR]

i) **Component I: (Characterization and multiplication of brinjal):** A total of 404 germplasm received from NBPGR, New Delhi including five check varieties were evaluated in augmented randomized block design with six blocks for 22 agro-morphological characters. The characters included both quantitative and qualitative traits with focus on yield related traits useful for breeding programs. The germplasm set included significant variation for all characters evaluated except for number of primary branches per plant. Accession IC0601469 was the earliest in flowering with 61 days after sowing. Seven different fruit skin colours at commercial harvest were observed with green colour showing maximum frequency (34%). About 12% of the genotypes possessed thorns on calyx. Accessions IC0285138, IC0644521, IC0644922, IC0644912, IC0644885, IC0526173, IC0523081, IC0604992, and IC0555927 were promising with higher average fruit yield per plant (1.8-2.0 kg/plant) (Fig. 1).

Fig. 1: Variation in fruit colour and shapes in brinjal germplasm accessions evaluated in CRP Agrobiodiversity during 2023

ii) **Component I: (Characterization and multiplication of cucumber):** A total of 160 genotypes and 6 checks were evaluated against the downy mildew of cucumber under natural epiphytotic conditions during late Kharif 2023. The genotypes, CRP-283, CRP-328, CRP-344, CRP-370 and CRP-418 were found to be resistant.

iii) **Component III (Okra):** The seeds of ICAR- IIVR developed interspecific crosses *viz*., VRO-6 × VRmanihot-1, Pusa Sawani × VRmanihot-1, VRO-6 × RCM/PK/63 (*Abelmoschu* spp. *nova*), Pusa sawani × RCM/PK/63 (*Abelmoschu* spp. *nova*), VRO-6 × RCM/PK/65 (*Abelmoschu angulosus*), and VRO-6 × *A. moschatus* (IC-333272) along with interspecific crosses (Pusa Sawani × IC624235, *A. pungens var. mizoramensis*; Pusa Sawani × IC624221, *A. pungens var. mizoramensis*; Pusa Sawani × IC433555, *A. moschatus*; Pusa Sawani × IC433550, *A. moschatus;* Pusa Sawani × EC360794, *A. moschatus*; Pusa Sawani × EC360830, *A. moschatus*; Pusa Sawani × EC360586, *A. moschatus*; Pusa Sawani × LJPS/21-1, *A. enbeepeegeearensis*; Pusa Sawani × IC417446, *A. enbeepeegeearensis*; Pusa Sawani × IC636446, *A. crinitus*; and Pusa Sawani × IC333272, *A. ficulneus*;) supplied by ICAR-NBPGR, RS Thrissur were sown in portrays for polyploidization. Out of these cross combinations, the seeds of Pusa Sawani × EC360794, *A. moschatus*; Pusa Sawani × EC360830, *A. moschatus*; Pusa Sawani × EC360586, *A. moschatus*; Pusa Sawani × LJPS/21-1, *A. enbeepeegeearensis*; Pusa Sawani × IC417446, *A. enbeepeegeearensis*; Pusa Sawani × IC636446, *A. crinitus*; and Pusa Sawani × IC333272, *A. ficulneus* not germinated. The seedlings of germinated cross combinations were treated with 0.1% colchicine at two true leaf stage. After flowering pollen viability test was carried out for all the colchicine treated plants in various interspecific crosses and selfing was also carried out. Based on the pollen viability and development of seeded fruits upon self- pollination, 1-3 numbers of polyploidized plants identified in each combination and were also used for back crossing with cultivated okra. Nine newly supplied CWRs of okra such as *A. pungens var. mizoramensis* (IC624235), *A. pungens var. mizoramensis* (IC624236), *A. pungens var.*

mizoramensis (IC624222), *A. enbeepeegeearensis* (IC417446), *A. enbeepeegeearensis* (IC582757), *A. enbeepeegeearensis* (LJPS/21-1), *A. angulosus* var *grandifloras* (IC599701), *A. angulosus* var *grandifloras* (IC599702) and *A. angulosus* var *grandifloras* (IC599701) grown and evaluated for YVMV and OELCV resistance. Except *A. enbeepeegeearensis* (IC582757) and *A. enbeepeegeearensis* (LJPS/21-1) all the 7 accessions showed high degree of resistance to YVMV and OELCV. These nine lines are also used to developed new combination of interspecific crosses. Seed multiplication of *A. manihot* and *A. angulosus* also carried out and required quantity of the seeds deposited to National Genebank for IC allotment. Resistant wild relatives were also screened artificially through grafting and begomovirus specific rojas primers. Besides, artificial screening of 12 promising *A. esculentus* lines was also performed which showed resistance under field condition against YVMV and ELCV. A preliminary cytological studied also under taken to count the somatic chromosome number of *A. manihot* (VRmanihot-1). A total of 10 back cross family also developed through back crossing of resistant interspecific crosses with the cultivated okra.

PROJECT 4: AGRI-BUSINESS INCUBATOR-IIVR, VARANASI [ICAR]

To facilitate technology commercialization, development of agri-entrepreneurships and to provide human resource development support for empowering entrepreneurs through training for industry-oriented vocations, an ABI unit has been established by the Council under NAIF at ICAR-IIVR, Varanasi.

The ABI unit in association with the institute, organized an Entrepreneurship Development Programme (EDP) in Vegetable Seed Production on 17th October 2023. The chief guest of the programme was Chief Development Officer of Varanasi. About 40 participants from FPOs, SHGs etc. participated in the programme (Fig. 1).

The ABI unit organized another Entrepreneurship Development Programme (EDP) on Entrepreneurship in Agriculture for 20 students of Gopal Narayan Singh University, Sasaram, Bihar on 21st December 2023 to motivate them towards entrepreneurship (Fig. 2).

Fig.2: Entrepreneurship Development Programme (EDP) in Agriculture on 21st December 2023 by ABI unit at ICAR-IIVR, Varanasi

One more Entrepreneurship Development Programme (EDP) was organized on 27th December 2023 on Entrepreneurship in Horticulture for 12 students of College of Horticulture, CAU, South Sikkim to encourage them towards developing their own horticulture based enterprise (Fig. 3).

Fig.1: Entrepreneurship Development Programme (EDP) in Vegetable Seed Production on 17th October 2023 by ABI unit at ICAR-IIVR, Varanasi

Fig. 3: Entrepreneurship Development Programme (EDP) in Horticulture on 27th December 2023 by ABI unit at ICAR-IIVR, Varanasi

During the year 2023, one technology commercialization license agreement was executed for commercialization of IIVR developed Ridge gourd variety kashi Shivani as a result of the efforts undertaken in this direction by ABI unit. Overall, a revenue of Rs. 6.37 lakhs was generated through licensing, royalties and incubates registration during this year.

An NGO Manviya Drishtikon Sewa Samiti; individuals Mr. Uday Pratap & Mr. Paritosh Singh, Varanasi; Mr. Tripurari Singh Patel, Mirzapur; a startup firm M/s Mahadev Seeds, Raipur and an FPO Rudrakshi FPC Ltd., Varanasi were enrolled as an incubatee of the ABI unit, ICAR-IIVR, Varanasi during 2023.

PROJECT 5: ZONAL TECHNOLOGY MANAGEMENT UNIT-IIVR, VARANASI [ICAR]

To help ITMUs of the zone in commercialization of technologies, showcasing of technologies, management of IP portfolio, helping in IPR related issues and to serve as a link between IPTM unit of the Council and ITMUs of the zone, a Zonal Technology Management Unit has been established by the Council under NAIF at ICAR-IIVR, Varanasi. The unit has eleven different ICAR Institutes under its umbrella *viz*. ICAR-Central Institute of Arid Horticulture, Bikaner; ICAR-Central Institute of Sub-Tropical Horticulture, Lucknow; ICAR-Central Institute of Temperate Horticulture, Srinagar; ICAR- Central Potato Research Institute, Shimla; ICAR-Directorate of Medicinal and Aromatic Plants Research, Anand; ICAR-Directorate of Mushroom Research, Solan; ICAR-National Research Centre for Litchi, Muzaffarpur; ICAR-National Research Centre on Orchids, Pakyong, Sikkim; ICAR-National Research Centre on Seed Spices, Ajmer, ICAR- Central Island Agricultural Research Institute, Port Blair and ICAR-Indian Institute of Vegetable Research, Varanasi.

The reports from all the ITMUs in domain on management of IP portfolio, commercialization of technologies, outreach activities, capacity building in IP Management and training/workshop/seminar etc. organized was compiled and sent to IPTM unit of the Council as and when required.

A Programme entitled "IPR -Women and IP: Accelerating Innovation and Creativity" was organized on 26th April, 2023 at ICAR-IIVR, Varanasi on the occasion of World Intellectual Property Day (Fig. 4). Dr. Geeta Rai, Associate Professor in Department of Molecular and Human Genetics, Institute of Science, BHU, Varanasi was the guest speaker to deliver the talk to the participants. About 50 scientists and scholars participated in the programme.

Fig. 4: Programme on IPR -Women and IP: Accelerating Innovation and Creativity organized on 26th April, 2023 at ICAR-IIVR, Varanasi

Another programme on Intellectual Property was organized in Hybrid mode on 8th August, 2023 at ICAR-IIVR, Varanasi. Dr. Sunil Archak, Principal Scientist and ICAR National Fellow from ICAR-NBPGR, New Delhi delivered an informative awareness talk on "Intellectual Property Issues and Their Management in Agriculture.'

About 70 scientists and scholars, including participants from other ITMUs under this ZTMU, participated in the programme (Fig. 5).

Fig. 5: Awareness Programme on Intellectual Property Issues and Their Management in Agriculture organized on 8th August, 2023 at ICAR-IIVR, Varanasi

A market sensitization programme as 'Technology Promotion Day' for varieties/hybrids and promising lines of okra and cucurbitaceous crops was organized on 19 September, 2023 (Fig. 6) for promoting the commercialization of ICAR-IIVR technologies. The programme was attended by 30 representatives from private sector seed companies dealing in vegetable seeds. The representatives of seed-companies visited the research farm of the Institute, saw and discussed about the promising materials in these vegetables. They expressed interest in many promising materials.

Fig. 6: Technology Promotion Day organized on 19th September, 2023 at ICAR-IIVR, Varanasi

In addition to above activities, an Appl. No. 6187480 for registration of trademark for IIVR technologies was also filed on 16th November 2023 which is under consideration.

PROJECT 6: DISCOVERY OF NOVEL GENES AND QTLS CONFERRING RESISTANCE TO TOLCNDV DISEASE FROM INDIGENOUS SOURCES, GENOME-WIDE TRANSCRIPTIONAL DYNAMICS AND ALLELE MINING OF THE CANDIDATE GENES IN CUCURBITACEOUS VEGETABLES [NASF, ICAR]

During phenotypic screening of ICAR-IARI germplasm, 2 genotypes were found resistant, 18 genotypes moderately resistant, 28 genotypes showed moderately susceptibllity and remaining 6 genotypes were identified as susceptible to ToLCNDV. In the case of IIVR genotypes, 17 genotypes were resistant, 7 genotypes moderately resistant, 41 lines found moderately susceptible and remaining 16 genotypes were susceptible to ToLCNDV. These genotypes were also characterized for 11 phenotypic traits. For IARI muskmelon germplasm, highest AUDPC value found in DOM-122 & 201 genotypes (1250 & 1162.5, respectively) and on the other hand lowest AUDPC value found in DSM-19& DSM-14 (242.5 & 287.5, respectively). In case of IIVR germplasm, lowest value of AUDPC found in the KK-1& VRLM-160 (187.5 & 200)). Moreover, VRMM-134-1&VRMM-06 showed the highest AUDPC value (1150 &1100).

In case of spring-summer season field trial of cucumber, total 95 genotypes were used for ToLCNDV screening and phenotypic traits characterization. Data of prescribed phenotypic traits was taken and phenotypic screening for ToLCNDV completed 5 times at 10 days interval. In the phenotypic screening of ToLCNDV, 17 lines identified as resistant, 43 moderately resistant, 26 moderately susceptible and remaining 8 genotypes were found to be susceptible under natural field condition. Highest AUDPC value found in DPAC-59 genotypes (1475) that indicate the most susceptibility to ToLCNDV. On the other hand, Pahari Barsati showed the lowest value of AUDPC (75) that was identified as resistant genotype among the other genotypes that was screened for ToLCNDV at phenotypic level.

PROJECT 7: IDENTIFICATION OF SUITABLE VARIETIES/HYBRIDS OF CUCURBITACEOUS CROPS AND DEVELOPMENT OF PRODUCTION PROTOCOL FOR BETTER LIVELIHOOD OF RIVER BED (DIARA LAND) FARMING COMMUNITY [UPCAR]

A total nine varieties of 9 cucurbitaceous vegetables *viz.* bottle gourd (Kashi Ganga), pumpkin (Kashi Harit), sponge gourd (Kashi Shreya), ridge gourd (Kashi Shivani), bitter gourd (Kashi Mayuri), muskmelon (Kashi Madhu), water melon (Sugar baby), longmelon (Chandraprabha) and summer squash were evaluated. The crops were sown in the river bed by direct sown method as well as by transplanting method. The recommended management practices were followed to control the insects. The infection of root knot nematode was observed in all the crops, and it was most serious in pumpkin crop. Red pumpkin beetle at two cotyledon leaf stage and sucking pest in the middle of February was observed on the all cucurbits and were managed with bio pesticides. Based on the sampling of infected plants, *Meloidogyne incognita* nematode species were identified and treatment- I *i.e.* biological control which comprises of application of 50 g neem cake per pit at the sowing time and drenching of *Trichoderma harzianum* (2 g) + *Paecilomyceslilacinus* (2 ml) + *Pseudomonas fluorescens* (2 ml) in per liter water found most effective in managing nematode infection.

Fig. 7: Sponge gourd var Kashi Shreya

Fig. 8: Summer squash var Zuchhini Yellow

Fig. 9: Long melon var Super Chandraprabha

Fig. 10: Bottle gourd var Kashi Ganga

Fig. 11: Grafted tomato var Kashi Aman

Fig. 12: Grafted brinjal var Surya



गंगा के दियारा में सब्जी उत्पादन पर किसानों को किया ज

गंगा के कछार के इलाके वर्तमान में कद्दूवर्गीय सब्जियों समेत कई अन्य सब्जी फसलों को पैदा करने वाले प्रमुख क्षेत्र हैं और सम सामयिक फसलों की पैदावार के लिए सामुदायिक कृषि उत्पादन में विशेष योगदान देते हैं। अनुकूल वातावरण में भी इन फसलों को बालुसिक मिट्टी में प्रायः पोषक तत्वों की कमी होती है। साथ ही प्रतिकूल परिस्थितियों में जैसे पाला की स्थिति में पौधों के रोगग्रत होने और कीटों के अत्यधिक प्रकोप का खतरा बढ़ जाता है। साथ ही चूंकि इन क्षेत्रों में पौधों की जड़ों को मिट्टी के अंदर ज्यादा दूर तक जाना पड़ता है, अतः उनमें निमेटोड का संक्रमण एक बड़ी समस्या है। ऐसे में ज्यादातर किसान अनियंत्रित रूप से रासायनिक उर्वरकों और कीटनाशकों का प्रयोग कर रहे हैं जिससे गंगा के नद-तल में पेस्टिसाइड प्रदूषण बढ़ रहा है। इन विषम स्थितियों को देखते हुए आईआईवीआर के वैज्ञानिकों ने गंगा के तलछट में पारंपरिक रूप से की जा रही कद्दूवर्गीय फसलों की खेती के साथ ही क्षेत्र के किसानों को टमाटर और बैगन की फसलों के उत्पादन हेतु भी प्रशिक्षण, बीज, पौधे एवं अन्य इनपुट उपलब्ध कराए हैं। इसी क्रम में वैज्ञानिकों ने दियारा के कृषि क्षेत्रों का दौरा किया। संस्थान

Fig. 13: Awareness programme by Institute experts among growers at Diara project site

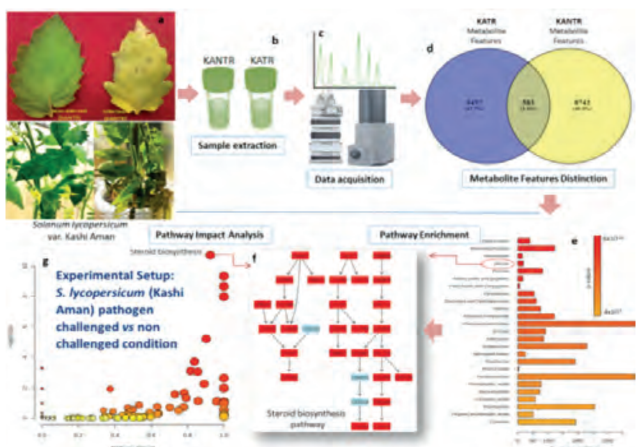
PROJECT 8: DEVELOPMENT AND EVALUATION OF ANNUAL MORINGA FOR FOOD FODDER AND NUTRITION CONTENT IN UP [UPCAR]

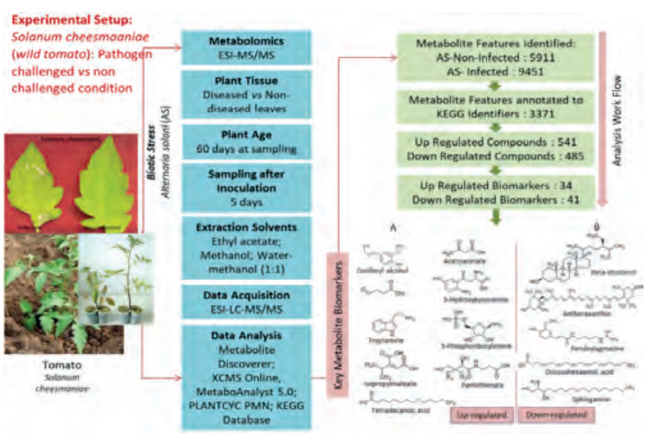
A total of 20 genotypes were evaluated for flowering and fruiting under the project. The target is to identify high yielding genotype of annual moringa with at least two major flushes. The genotype Sel -24 was found for the last two years and producing fruits in the range of 500-800 fruits per year. So, this genotype can be recommended for further multiplication and testing. The micronutrient for iron (Fe), zinc (Zn), manganese (Mn) and copper (Cu) were analyzed in genotypes ODC-3, 150 GY, LSV/21-58, PD-9, 200 GY, LSV/21-92, Sel-24 and PKM-1.

PROJECT 9: PROTEOMIC AND METABOLOMIC STUDIES ON ABIOTIC STRESS-CHALLENGED TOMATO TO DECIPHER FUNCTIONAL METABOLIC CLUES FOR PLANT RESPONSES, CROP YIELD AND NUTRITIONAL VALUES [CABin ICAR]

Protocol for metabolome and proteome extraction from different tissues of tomato *viz.* leaf, fruit and root was developed and standardized under tripartite set of experimental conditions (plant-pathogen-abiotic interaction). LC-ESI-MS/MS platform based untargeted metabolomics data was generated on tomato leaves and fruits from different sample sets including *Alternaria solani* pathogen-challenged *vs* non-challenged tomato plant for comparative analysis of susceptible (Kashi Aman) pathogen challenged *vs* non challenged plants. Similarly, comparative analysis of moderately resistant *Solanum cheesmaniae* (wild species) in *Alternaria* challenged *vs* non-challenged conditions was also performed. For untargeted metabolomics data analysis & visualization, web-based servers and tools including Metabo Analyst 5.0, KEGG, PLANT CYC PMN, Mass Bank etc. were utilized.

Metabolomic response of tomato (*S. lycopersicum*) susceptible to the early blight pathogen resulted in 9405 metabolite features (*m/z*) in pathogen challenged and 9667 in non-challenged plant leaves including 8487 infection-exclusive and 8742 non-infection exclusive features. Annotation of metabolite features revealed 4104 putatively annotated metabolites. Pathway mapping suggested metabolic pathways, biosynthesis of secondary metabolites, ubiquinone and terpenoid-quinones, brassinosteroids, steroids/terpenoids, phenylpropanoids, carotenoids, oxy/sphingolipids biosynthesis, and biotin and porphyrin metabolism. Fold change analysis (threshold ≥2.0) revealed 481 significantly over- and 548 down accumulated metabolite features. OPLS-DA analysis revealed 44 over-accumulated metabolites including melatonin, glucose 6-phosphate, sphingosine, zeatin-β-D-glucoside as most prominent markers. Dihydrozeatin, pantothenate, pyropheophorbide*a*, dethiobiotin and melatonin were identified as key metabolite biomarkers in pathogen interaction response of susceptible tomato species. In contrary, metabolomic response of wild tomato species (*S. cheesmaniae*) to pathogen *A. solani* was surprisingly different and showed altered metabolite profile in plant leaves. Annotation of metabolite features revealed 3371 compounds belonging to biosynthetic pathways including secondary metabolites, cofactors, steroids, brassinosteroids, terpernoids, and fatty acids. Significantly upregulated (541) and downregulated (485) features distributed in metabolite classes crucial for defense, infection prevention, signaling, plant growth, and plant homeostasis to survive under stress conditions were identified. The OPLS-DA showed 34 upregulated biomarker metabolites including 5-phosphoribosylamine, kaur-16-en-18-oic acid, pantothenate, and *O*-acetyl-L-homoserine. Downregulated metabolite biomarkers (41) were mapped with pathways specifically known for plant defense and suggested prominent role in pathogen resistance. Overall, the comparative analysis displayed that the response of wild plants to *A. solani* was quite different than the susceptible plants and the metabolite differentiation was supposed to offer tolerance to wild species against the pathogen. Metabolite biomarkers identified in the analysis, especially those showed up-regulation could be used for exogenous application on pathogen challenged plants to analyze their mitigation role against stress.





PROJECT 10: DUS TESTING OF POINTED GOURD [PPV&FRA]

As per the objective, reference varieties like Kashi Alankar, Kashi Suphal, Kashi Amulya, Swarna Rekha, Swarna Alaukik, VRPG-221, VRPG-220, VRPG-103, VRPG-126, VRPG-173, VRPG-219, VRPG-141, VRPG-176-1, VRPG-105, BCPG-1, BCPG-2, BCPG-4 and BCPG-5 clonally propagated and maintained separately. Data related to various crop descriptors based on the DUS guideline of pointed gourd recorded. Characters recorded for all the reference varieties were as per DUS guide lines and no deviation reported.

PROJECT 11: DUS TESTING OF OKRA [PPV& FRA]

During the year, 38 okra entries were evaluated under DUS testing, which included 12 first year hybrids, 18 second year hybrids (7 Candidate Hybrid + 7 SMG Hybrid + 4 Candidate Hybrid) and 8 typical varieties. The data were recorded as per PPV&FRA guide lines. The experimental trial was monitored by an expert committee constituted by the authority on 31/10/2023. Maintenance breeding was done to maintain the reference varieties. A total 42 reference varieties of okra were maintained as reference collection and are being used as reference during DUS testing of candidate varieties.

PROJECT 12: DUS TESTING OF BRINJAL [PPV&FRA]

DUS characters for 17 entries of brinjal including 5 candidate hybrids with 5 SMG hybrids (2873/2028/H, 2871/2504/H, 2873/2056/H, 2876/2958/H, 2871/2503/H) and 7 Farmers' varieties (22 Kh BF 1, 22 Kh BF 2, 22 Kh BF 3, 22 Kh BF 4, 22 Kh BF 5, 22 Kh BF 6, 22 Kh BF 7) in 2nd year were recorded in three replications, evaluated and data submitted in the prescribed format to the funding agency. Among all the entries off types were observed in 22KhBF3, 22KhBF5, 22KhBF6 and 22KhBF7, while 22 Kh BF 2 did not germinate. During 2023-2024, DUS characters for total 16 entries of brinjal including 6 Candidate hybrids with 6 SMG F1 Hybrids (2871/2498/H, 2871/2496/H, 2876/2967/H, 2876/2957/H, 2873/2031/H, 2873/2033/H) in 2nd year DUS testing and 4 Candidate Hybrids (2889/2196/H, 2889/2145/H, 23BRARND01H, 23BRBRNG01H,) in 1st year DUS testing were recorded in three replications. In 2nd year trial, code 2871/2498/H CH (Candidate hybrid) did not germinate.

PROJECT 13: DUS TESTING OF CUCUMBER AND PUMPKIN [PPV&FRA]

During the year, 8 cucumber entries were evaluated under DUS testing, which includes 4 hybrids of 1st year, and 4 farmer's variety. Monitoring of cucumber was done on 27.04.2023. Maintenance breeding was done to maintain the reference varieties. Twenty-four varieties of cucumber and 25 varieties of pumpkin were maintained as reference collection and are being used as reference during DUS testing of candidate varieties.

PROJECT 14: DUS TESTING OF TOMATO [PPV& FRA]

During the year 27 tomato entries i.e, 13 entries (8 Candidate + 5 SMG) of 2nd year, and 14 entries of 1st year (6 Hybrid + 4 FV, Typical + 4 Typical) were received for DUS testing at ICAR-IIVR, Varanasi. Among the 27 entries received, there was no germination in 22 TH 7 Hybrid and very poor germination observed in 22 TFV4. Monitoring of remaining 25 entries was done on 23.02.2023 under the chairmanship of Dr. T K Behera, Director, ICAR-IIVR, Varanasi. (Fig. 15) DUS characterization for all the entries were recorded as per DUS test guidelines. Among all the entries off types were observed in 22TFV2 and 22TFV3. Monitoring report was submitted on 02.03.2023. For the year (2023-24), 32 tomato entries i.e, 23 (13 Candidate + 8 SMG + 2 Typical) of 2nd year and 9 of 1st year (9 Candidate Hybrid) were received for DUS testing at ICAR-IIVR, Varanasi. Among the 32 entries received, there was no germination in 22 TH 7 Candidate Hybrid. Related germination report was submitted on 25.10.2023.

Fig. 15: Monitoring of DUS testing on tomato field

PROJECT 15: DUS TESTING OF BOTTLE GOURD AND BITTER GOURD [PPV&FRA]

Bitter gourd: In bitter gourd, 4 entries i.e. 22BIGH-1, 22BIGH-5, 22BIGH-7 and 22BIGH-8 were received but only one candidate hybrid 22BIGH-1 germinated. In this experiment entries were evaluated as per DUS test guidelines for bitter gourd. Monitoring was done on 22.5.2023. Total 25 varieties of bitter gourd were maintained as reference varieties.

Bottle gourd: In bottle gourd 5 entries i.e. 22BOGH-1, 22BOGH-2 and 22BOGH-31 with one candidate hybrid (2877/2991/H) and one SMG hybrid (2877/2991/H) were evaluated as per DUS test guidelines for bottle gourd. Monitoring was done on 22.5.2023. Total 25 varieties of bottle gourd were maintained as reference varieties through selfing. All these varieties are being used as reference under DUS testing of candidate varieties.

PROJECT 16: DUS TESTING OF VEGETABLE PEA AND FRENCH BEAN [PPV&FRA]

Vegetable Pea: Forty-three vegetable pea varieties were collected from different centres *i.e.* IARI (RS) Katrain, IIVR., Varanasi, IIHR, Bangalore, DARL, Pathoragarh, NDUA &T, Faizabad, GBPUA &T, Pantanagar, HAU, Hisar, HARP, Ranchi, PAU, Ludhiana , MPKV, Rahuri, Dr. YSPHU & F, Solan, VPKAS, Almora, CSAUA &T Kanpur and maintained as reference varieties for DUS testing. These varieties were grown and characterized for 20 DUS characters

French Bean: Twenty seven French bean varieties were maintained as reference varieties for DUS testing. These varieties were collected from various centers *i.e.* IARI, New Delhi, IARI, Regional Station, Katrain, IIVR Varanasi, Dr. YSPH & F, Solan, MPKV, Rahuri, BHU, Varanasi, CSAUA &T, Kanpur, CHES., Ranchi, VPKAS, Almora, IIHR, Bangalore, IIPR, Kanpur. In French bean 16 Bush type, 11 Pole type varieties were grown and characterized for 22 DUS characters and the data recorded for 2022-23.

PROJECT 17: DUS TESTING OF ASH GOURD, SNAKE GOURD AND IVY GOURD [PPV&FRA]

A total of 5 and 9 reference varieties of snake gourd and ash gourd, respectively were collected and maintained for DUS testing. In addition, planting material of ivy gourd were collected and maintained for reference in DUS testing.

PROJECT 18: STRENGTHENING QUALITY SEED PRODUCTION OF VEGETABLE CROPS (MIDH)

A total of 4290.00 kg TL seed of vegetables (tomato, chilli, pea, okra, radish, cowpea, French bean, summer squash and pumpkin) and 47.80 kg hybrid seed of chilli, brinjal and cucumber were produced at ICAR-IIVR, Varanasi. In addition, 980 kg TL seed of different vegetables and 34 kg hybrid seed of cucumber and brinjal were produced at RRS, Sargatia.

PROJECT 19: GENOME-WIDE SNP DISCOVERY FOR DEVELOPMENT OF HIGH-DENSITY GENETIC MAP AND QTL MAPPING OF MULTI-FLOWERING AND YIELD ASSOCIATED TRAITS IN VEGETABLE PEA (*PISUM SATIVUM* L.) [DST-SERB]

Phenotyping of multi-flowered RIL population of pea at ICAR-IIVR, Varanasi and IIVR-RRS Kushinagar: Two RIL populations of peas proposed in the project *viz.*, VRP–386 ×VRP–500; MF–01P and VRPSel–17 ×VRPM–901–5; MF–02W comprising 122 and 198 individuals, respectively were grown in 3×3 meter square plot (each line in one plot) during the *Rabi* season 2023. The same set was also grown at IIVR Regional Research Station, Kushinagar (IIVR-RRS). Phenotyping was done on 16 phenological traits including the flowering traits at both the locations. Both the RIL populations were found stable for their multi-flowered expression for single, double and triple flowering behaviors.

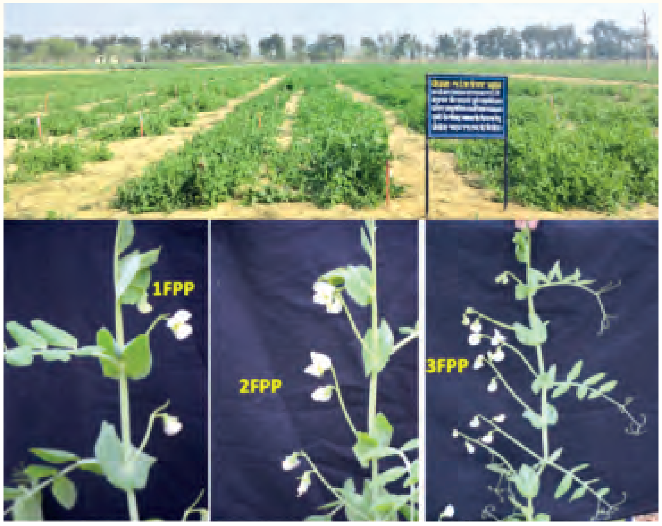


Fig. 16: A field view of RIL population MF–01P and MF–02W grown at ICAR-IIVR, Varanasi and Fixation of Flower Per Peduncle in the RIL population of MF–02W

DNA isolation and sampling for QTL-Seq analysis: Genomic DNA was extracted from both the mapping populations from 20-day-old seedling leaves using the CTAB method and stored in a -80°C freezer. Samples were gathered for QTL Seq analysis from the RIL population of VRPSel–17 × VRPM–901–5, with Bulk 1 containing 20 samples of multi-flowered genotype and Bulk 2 comprising single-flowered individuals. The parent VRPSEL-17 was also sent for sequencing. Additionally, approximately 200 SSR polymorphic markers across seven pea linkage groups were identified from the literature and sent for synthesis.

PROJECT 20: ICAR-LBS AWARD PROJECT (NEXT-GENERATION TOMATO IMPROVEMENT FOR PROCESSING TRAITS THROUGH GENOME EDITING (CRISPR/CAS9) APPROACH) [ICAR]

The project aimed to develop genome-edited tomato genotypes suitable for processing purpose. Under this project, regeneration protocols were standardized in tomato using cotyledonary leaf and hypocotyl for *Agrobacterium*-mediated genetic transformation. Further, candidate genes were selected for increasing TSS in tomato namely *SlINVINH1* (*Solyc12g099200.1*) and the vacuolar processing enzyme *SlVPE5* (*Solyc12g095910.1*). Then, gRNAs were designed (Fig. 17) and gene construct was synthesized and cloned into pORE binary vector for transformation in tomato variety Kashi Aman. *Agrobacterium*-mediated genetic transformations were done into tomato cv. Kashi Aman for regeneration of calli.

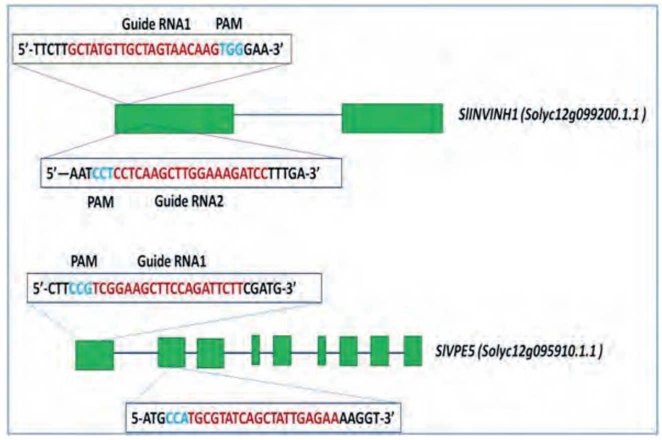


Fig. 17: Guide RNA designing in tomato for processing traits

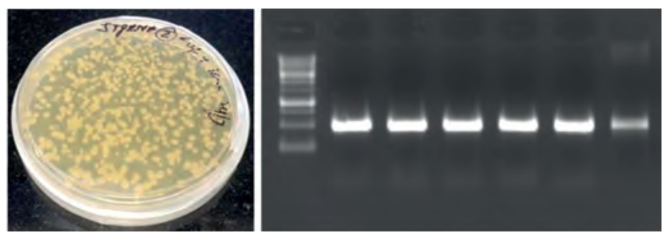


Fig. 18: Colony PCR and confirmation of construct for TSS-related genes

PROJECT 21: FIELDHEAT: ADAPTING TOMATO GERMPLASM TO THE DRY AND HUMID HEAT OF THE INDIAN MONSOONAL CLIMATE [DBT]

A total of 78 tomato genotypes along with 5 check varieties were planned for evaluation will be evaluated at the ICAR-Indian Institute of Vegetable Research, Varanasi to understand the physiological challenges to tomato growth and reproduction in dry heat conditions. The genotypes under examination include, 49 genotypes shared from the ICAR-Indian Institute of Horticultural Research, Bangalore; 17 lines shared from Punjab Agricultural University (PAU), Ludhiana and 17 genotypes from the ICAR-IIVR, Varanasi. Seeds of the germplasm were received from respective centers.

PROJECT 22: FARMER FIRST PROGRAM ON "INTERVENTION OF IMPROVED AGRICULTURAL TECHNOLOGIES FOR LIVELIHOOD AND NUTRITIONAL SECURITY ADHERING LOCAL RESOURCES AND WORKING KNOWLEDGE OF THE FARMERS" [ICAR]

Farmers FIRST project was initiated in 06 villages of Araziline block in Varanasi and during 2023, 04 new villages namely, Tofapur, Kajichak, Bangalipur and Nakkupur were added with an objective to enhance crop productivity and farm income along with empowering farmers/farm women in different aspects of agriculture enterprises through skill development.

The interventions carried out in this project were target specific and as per available resources and working knowledge of the people. The interventions were categorized in two module *i.e.* Horticulture based and Crop based, under which Cowpea var. Kashi Nidhi was demonstrated in 4.30 ha, among 90 beneficiaries and 125.05 q/ha yield was recorded with 34.10% increase in production as compared to the local variety. Okra var. Kashi Kranti was demonstrated in 0.67 ha, among 30 beneficiaries and 122.45 q/ha yield was recorded with 25.83% increase in production as compared to the local variety. Bottle gourd var. Kashi Ganga was demonstrated in 0.67 ha, among 15 beneficiaries and 340 q/ha yield was recorded with 18.88 % increase in production as compared to the local variety. Pumpkin var. Kashi Harit was demonstrated in 6.50 ha, among 65 beneficiaries and 308.30 q/ha yield was recorded with 19.70 % increase in production as compared to the local variety. Sponge gourd var. Kashi Rakshita was demonstrated in 0.40 ha, among 20 beneficiaries and 242.64 q/ha yield was recorded with 24.08 % increase in production as compared to the local variety. Chilli var. Kashi Ratna was demonstrated in 1.84 ha, among 10 beneficiaries and 212.70 q/ha yield was recorded with 11.19 % increase in production as compared to the local variety. Tomato var. Kashi Aman was demonstrated in 1.43 ha, among 26 beneficiaries and 398.40 q/ha yield was recorded with 18.93 % increase in production as compared to the local variety. Brinjal var. Kashi Sandesh was demonstrated in 0.33 ha, among 10 beneficiaries and 535.20 q/ha yield was recorded with 10.24 % increase in production as compared to the local variety. Pea var. Kashi Uday was demonstrated in 5.52 ha, among 51 beneficiaries and 76.40 q/ha yield was recorded with 18.91 % increase in production as compared to the local variety. Wheat var. DBW-187 was demonstrated in 33.33 ha, among 97 beneficiaries and 55.54 q/ha yield was recorded with 31.89 % increase in production as compared to the local variety (Table 20 & Fig. 29).

Fig. 29a: Demonstration of wheat var. DBW-187 in Rajapur village

PROJECT 23: NETWORK PROGRAMME ON PRECISION AGRICULTURE [ICAR]

Development of sensor-based irrigation and fertigation modules in tomato & capsicum under polyhouse and open field condition: In Capsicum, the maximum fruit yield in open field (924.23 g/ plant or 217.11 q/ha) and under polyhouse (1.45 kg/plant or 293.23 kg/ 1000 m^2) was obtained with drip irrigation at 20% soil moisture

Table 20: Selected Successful Interventions Demonstrated at Farmers' Field

Name of demonstrated interventions	Number of Beneficiaries	Area (ha)	Average Yield (q/ha)		Yield Increase (%)
			Demo Yield	Control Yield	
Cowpea (K. Nidhi)	90	4.30	125.05	93.25	34.10
Okra (K. Kranti)	30	0.67	122.45	97.31	25.83
Bottle Gourd (K. Ganga)	15	0.67	340.00	286.00	18.88
Pumpkin (K. Harit)	65	6.50	308.30	257.55	19.70
Sponge Gourd (K. Rakshita)	20	0.40	242.64	195.55	24.08
Chilli (K. Ratna)	10	1.84	212.70	191.30	11.19
Tomato (K. Aman)	26	1.43	398.40	335.00	18.93
Brinjal (K. Sandesh)	10	0.33	535.20	485.50	10.24
Pea (K. Uday)	51	5.52	76.40	64.25	18.91
Wheat (DBW-187)	97	33.33	55.54	42.11	31.89
Kitchen Garden Packet (275 Packet)	275	-	-	-	-

Fig. 29b: Demonstration of Cowpea var. Kashi Nidhi in Rajapur village

Fig. 29c: Demonstration of Pumpkin var. Kashi Harit in Bangalipur village

Fig. 29d: Demonstration of Pea var. Kashi Uday in Nakkupur village

(16.2% depletion of ASM) coupled with N fertigation at 200 kg/ha (12 & 16 times). Similarly, in indeterminate tomato (polyhouse condition), the maximum fruit yields (8.068 kg/plant or 214.27 kg/ 1000 m^2) were registered with drip irrigation at 20% soil moisture with N fertigation at 180 kg/ha (16 times), whereas in open field (det. tomato), the maximum fruit yield was recorded at 18% soil moisture (I_3) with N fertigation at 180 kg/ha (N_3); however, I_2N_3 also registered yield at par to I_3N_3 (Fig. 30).

Fig. 30: Indeterminate tomato grown under naturally ventilated polyhouse condition

PROJECT 24: SENSOR BASED INTEGRATED VERTICAL FARMING FOR HORTICULTURAL CROPS AND AQYAPONIC STSTEN [NASF, ICAR]

Aquaponic System: Design structure was finalized for the development of integrated hydroponic/soilless and recirculating aquaponic based vertical farming system with the following features. Dimension 2m x 1.7m x 1.4m (Lx W x H); No. of NFT Growing Channels in each Rack 12 Nos.; No. of holes. with net pot (for plants) in each Rack:- more than 102 Nos.; This includes gutter or drainage, A type fixed frame & supporting accessories for the gutter are usually made of galvanized steel. This also includes plumbing work with fish water tank 500 l, fishes, bio filter trays, oxygen air pump & motor for entire system. Growing gullies Size: 100 x 50 mm food grade, PVC material including end cap and complete in all respect.

PROJECT 25: PAID UP TRIAL ON KHARIF (OKRA) FOR EVALUATION OF THE NANO UREA [COROMONDEL PVT. LTD., SECUNDERABAD]

An externally funded paid up trial on "Evaluation of Coromandel International Nano Urea on Okra crop during Kharif season" was under taken to study the impact of foliar application of nano-urea on growth and yield parameters of okra crop and also to explore the possibility of reduction of urea application with the application of nano-urea.

The experiment was laid out in a Randomized Complete Block Design (RCBD) consisting of Nine treatments combinations of nitrogen levels and foliar spray of nano-urea, having 3 replications. The okra crop was sown on 14.07.2023 with seed rate of 8-10 kg/ha of okra variety Kashi Chaman at row to row spacing of 70 cm and plant to plant spacing of 20 cm in ridge and furrow system of sowing (Fig. 31).

First year data revealed that plant height, number of leaves, chlorophyll content, NDVI value and yield parameters *viz.,* number of fruits/plant, fruit weight/plant, length and girth of fruit, average fruit weight, nitrogen uptake was affected by nitrogen rates and foliar application of nano-urea. In general, plant height number of leaves, chlorophyll content, NDVI value increased with the progress in day of sowing and recorded highest at harvest. Close scanning of data revealed that up to 30 DAS, plant height, number of leaves, chlorophyll content, NDVI value remains at par among the treatments but at 60 DAS and 90 DAS, 100 % of recommended N dose + two spray of nano urea at 25 DAS (1250 ml/ha/application) and 50 DAS (1250 ml/ha/application) recorded the maximum plant height number of leaves, chlorophyll content and NDVI value.

At growth stage of 60 DAS, the treatments T2, T3, T1, T5 and T6, *i.e.* application of 100% of recommended N dose + one spray of nano urea at 25 DAS (1250 ml/ha/application) , application of 100% of recommended N dose + two spray of nano urea at 25 DAS (1250ml/ha) and 50 DAS (1250 ml/ha), application of 100% of recommended N dose without spray of nano urea but only water, application of 75% of recommended N dose + one spray of Nano urea at 25 DAS (1250 ml/ha/application), application of 75% of recommended N dose + two spray of nano urea at 25 DAS (1250ml/ha) and 50 DAS (1250 ml/ha), were statistically at par, but significantly superior over rest of the treatments. The treatment T9 *i.e.* 50 % recommended N dose + two spray of nano urea at 25 DAS (1250ml/ha) and 50 DAS (1250 ml/ha) resulted in significantly higher value over only 50% of recommended N dose (T7). Similarly, application of 75% recommended N dose + one spray of nano urea at 25 DAS (1250 ml/ha/application) (T5) was at par to application of 75% recommended N dose + two spray of nano urea at 25 DAS (1250ml/ha) and 50 DAS (1250 ml/ha)(T6) but was significantly superior to only application of 75% recommended N dose (T4). On the basis of experimental finding it can be concluded that to maximize the yield and Net return in Okra under the agro climatic zone of Varanasi, 150 Kg nitrogen in combination of two spray of nano-urea @ 1250 ml/ha/application at 25 and 50 DAS can be adopted by the farmers to achieve higher yield and net return in okra. Application of 75% RDN with two sprays of nano urea @ 1250 ml/ha/application at 25 and 50 DAS gave yield at par to 100% RDN, therefore it gives 25 % savings in nitrogen application in okra crop.

Fig. 31: View of the experimental field

PROJECT 26: ESTABLISHMENT OF BIOCONTROL DEVELOPMENT CENTER FOR PRODUCTION AND PROMOTION OF BIOAGENTS TO MANAGE SOIL-BORNE DISEASES IN VEGETABLE CROPS [RKVY]

Excellent full functional biocontrol research laboratory and bioagent multiplication unit has been developed. One training programme on production and utilization of biocontrol agents for the management of soil borne diseases of vegetable crops organized on 13.09.2023 and total 29 farmers were participated.

PROJECT 27: RESISTANCE MONITORING STUDIES IN TOMATO EARLY BLIGHT (*ALTERNARIA SOLANAI*) FOR AZOXYSTROBIN FUNGICIDE [Syngenta India Ltd.]

Collection of isolates of *Alternaria solanii* and *in vitro* sensitivity towards azoxystrobin 23% SC: Tomato *Alternaria solanii* isolates *viz*. TAS 1, TAS 2, TAS 3, TAS 4, TAS 5, TAS 6, TAS 7, TAS 8, TAS 9, TAS 10, TAS 11, TAS 12, TAS 13, TAS 14, TAS 15 from Nasik, Maharashtra; TAS 16, TAS 17, TAS 18, TAS 19, TAS 20, TAS 21, TAS 22, TAS 23 from Pune, Maharashtra; UK 1, UK 2, UK 3, UK 4, UK 5, UK 6, LOC 1, LOC 2, LOC 3, LOC 4, LOC 5, LOC 6, LOC 7, LOC 8 from Uttarakhand; E-1, E-2, E-3, E-4, E-5, E-6, E-7, E-8, E-9, E-10, E-11, E-12, E-13, E-14, E-15, E-16 and E-17 from various blocks of Karnataka and EC 620544 , EC 620471 , Kashi Adbhut , Kashi Aman, VRNTH 20131, VRNTH 20141, Ashutosh, VRTH 19132, VRNTH 20122, P. sadabahar from Varanasi were evaluated for resistance monitoring and sensitivity under *in vitro* towards azoxystrobin 23% SC using poison food technique. Sterilized water agar media amended with different concentration of the azoxystrobin 23% SC and amended media was poured onto sterile Petri plates. From 7 days old culture of *A. solani* isolates cut using a cork borer and mycelial plug placed onto water agar plates. The radius of the fungal colony was measured with the help of rulers in treated and untreated control (UTC) plates for further studies.

PROJECT 28: BASE LINE STUDY OF TOMATO POWDERY MILDEW PATHOGEN AGAINST A FUNGICIDE MOLECULE (ADEPIDYN) [Syngenta India Ltd.]

***In vitro* sensitivity of tomato powdery mildew pathogen towards Adepidyn:** The 10 tomato leaves samples were collected from Mulabagli, Kadapa, Vijipura, Chintamani, Bangarpete Kolar, Malur block of Karnataka and bio assayed for further experimentation. Samples comprised about 10-15 tomato leaves from each site in a sealable plastic bag. Conidia of powdery mildew pathogens were collected by using paint brush and sprinkled over fresh tomato leaves which were placed in a 14 cm Petri dish, containing water agar 0.8% amended with 50 ppm benzimidazole. After 10-15 days incubation at 20°C 14h light regime abandoned spores obtained for bioassay. Biotest performed in plates consisting 0.2% agar (Oxoid, technical).

PROJECT 29: AICRP ON BIOLOGICAL CONTROL OF CROP PESTS [ICAR-NBAIR, BENGALURU]

Evaluation of biointensive management practices for the cabbage pests Aphids (*Myzus persicae*) and Diamond back moth (*Plutella xylostella*): Bio-intensive insect pest management module (BIPM) for major insect pests of cabbage comprising sowing of Indian bold seeded mustard as a trap crop (25:2); installation of sex pheromone traps for DBM @ 12/acre from 30 DAT, periodical release of *Trichogramma chilonis* @ 100000/ha; sprayings of *Bacillus thuringiensis* NBAIR BtG-4 ($2x10^8$ cfu/g) 1% WP and each spraying was done at 10 days intervals during the initiation of DBM and one spraying of Azadirachtin 1500 PPM @ 2 ml/lit and subsequent spraying of *Lecanicillium lecanii* NBAIR Vl-8 ($1x10^8$ cfu/g) @ 5 g/lit of water at 10 days intervals revealed that lowest diamond back moth larval population (6.67/plant) accompanied with highest per cent reduction over control (56.67) followed by common package of practices (with 10.82 DBM population/plant and 29.70 PROC) where 5% NSKE was sprayed. Similarly, the lowest aphid population (*Myzus persicae* and *Brevicoryne brassicae*) was recorded also from the BIPM package (2.65/leaf and 62.36 PROC) followed by package of practices (4.97/leaf and 26.40 PROC) and untreated control plots (7.04/leaf).

Evaluation of BIPM practices against sucking pests and fruit flies *Zeugodacus cucurbitae* in bitter gourd: Cucurbit fruit fly (*Zeugodacus cucurbitae*; Cucumber moth (*Diaphania indica*; whitefly (*Bemisia tabaci*), leaf hoppers (*Amrasca biguttula biguttula*), are predominant in bitter gourd. To control these, three pest management modules were evaluated. The biointensive pests management module (BIPM) comprising installation of cue lure bottle traps @ 15-20/ha for mass trapping for cucurbit fruit flies; need based sprayings of *Lecanicillium lecanii* NBAIR Vl-8 (2.5 g /L) + Neem oil (2.5 ml/L) for sucking pests and *Bacillus thuringiensis* NBAIR Bt G4 @ 2 ml/L for cucumber moth was found most effective with lowest fruit damage by fruit fly (8.49%), whitefly (0.73/leaf), jassid (0.46/ leaf), cucumber moth (2.91/plant) followed by Module 2 (PoP= bait spray containing 20 ml Malathion 50 EC+10 g protein hydrolysate + 500 g of molasses/jaggery in 20 litres of water per acre) with 16.60% fruit damage by fruit fly. In enigma, the untreated control (M3) plots had maximum fruit fly damage (25.90% fruit damage) and also harboured highest whitefly (2.69/leaf), jassid (1.79/leaf) and cucumber moth (8.27/plant) populations. However, the populations of beneficial fauna *viz*., lady bird beetle (4.21/plant) and spider (3.88/plant) on bitter gourd were highest in untreated control plots (M3).

PROJECT 30: STRENGTHENING AND SETTING UP OF NUCLEUS STOCK DEVELOPMENT CENTRE IN EXISTING APICULTURE UNIT AND DEVELOPMENT OF AGRI-START-UPS [ICAR]

As per approved activities, Bee hives and other items/equipment were procured and distributed to identified beneficiaries. Further, training programme was organized on beekeeping to 35 farmers before distributing the essential inputs. Moreover, research on pollination requirements in protected vegetable production using stingless bee, *Tetragonula iridipennis* was initiated.

All India Coordinated Research Project (Vegetable Crops)

ACHIEVEMENTS OF ALL INDIA COORDINATED RESEARCH PROJECT ON VEGETABLE CROPS

During the year 2022-23, 2283 trials were conducted at 36 regular and 24 voluntary centres of AICRP on Vegetable Crops (Table1).

Table 1: Details of the trials conducted during 2022-23 through AICRP (VC)

Division	Trials	No. of Trials	No. of Trials conducted at different centre
Crop Improvement	Varietal Trials	57	970
	Hybrid Trials	34	599
	Resistant Varietal Trials	15	206
Crop Production	Vegetable Production Trials	13	85
	Protected Cultivation	14	74
	Seed Production Trials	17	51
	Physiology & Biochemistry Trials	9	17
Crop Protection	Integrated pest management	29	124
	Integrated disease management	10	157
Total		198	2283

The following recommendations under Crop Improvement, Crop Production and Crop Protection were made during 41st Annual Group Meeting of AICRP (VC) held at SKUAST, Srinagar from 03-05th June, 2023.

Crop Improvement

Variety evaluation trials: five entries of 4 vegetable crops were identified for release and notification for different agro-climatic zones of the country.

Hybrid evaluation trials: two entries of 2 vegetable crops were identified for release and notification for different agro-climatic zones of the country.

Production Technologies Recommended

Vegetable Production:

- **At Jorhat,** application of FYM @ 20 t/ha augmented with 5 kg microbial consortia (Azospirillum & PSB) produced highest green leaf yield in amaranths (186.63q/ha) and found highly profitable with a Benefit: Cost ratio of 4.80. Hence, the same was recommended for organic production of amaranths under Assam condition. **At Dharwad,** the pooled result revealed that applications of Vermicompost @ 2 t/ha + PSB + Azospirrilum (5kg/ha each) recorded maximum amaranths leaf yield of 162.36 q /ha with B:C ratio of 3.06, hence the above organic farming module was recommended for Karnataka zone.
- The three-year study on organic farming in Coriander-Radish cropping sequence at

Table 2: Varieties identified for release and notification

S. No.	Crop	Code	Name of the entry	Source	Zone
1.	Cabbage (Red)	2019/CABRVAR-5	KTCBR-5	IARI (RS), Katrain	I
2.	Carrot (Temperate)	2019/CARTVAR-5	UHF-SOL-CARVAR-2	YSPUH&F, Solan	IV
3.	Watermelon	2019/WMVAR-4	AHW/BR-37	CIAH, Bikaner	VII
4.	Bottle gourd	2019/BOGVAR-2	VRBG-14	IIVR, Varanasi	IV
5.	Bottle gourd	2019/BOGVAR-6	PLR-1	TNAU, Coimbatore	V

Table 3: Hybrids identified for release and notification

S. No.	Crop	Code	Name of the entry	Source	Zone
1.	Sponge gourd Hybrid	2019/SPGHYB-6	VNR Anita	VNR Seeds, Raipur	VIII
2.	Ridge gourd Hybrid	2019/RIGHYB-6	VNR-103	VNR Seeds, Raipur	V

Durgapura revealed that the safe production practices consisting of Recommended FYM + Fertilizer + IIHR microbial consortium (12.5 kg/ha) + plant protection with organic methods resulted highest coriander leaves yield of 94.03 q/h and radish root yield of 237.61 q/h with net income of Rs.2,55,100 /ha and B.C. ratio of 4.0. Hence, it was recommended for Coriander-Radish cropping sequence in Rajasthan zone.

- At Nagaland, the highest coriander leaves yield of 92.5 q/ha and radish root yield of 325.4 q/h with B:C ratio of 3.75 was recorded in application of recommended FYM +Fertilizer+ plant protection with chemicals method + IIHR microbial consortium (12.5 kg/ha). Hence, this was recommended for coriander-radish sequence cultivation under Nagaland condition (zone III).
- At Kalyanpur, weed management during kharif season in cowpea revealed that pre-emergence application of pendimethalin @ 6ml/L + one hand weeding and pre-emergence application of pendimethalin @ 6ml/L + post emergence application of quizalofop ethyl @ 40-50 g/ha were found most suitable for realizing optimum green pod yield (118.25 and 111.96 q/ha) with maximum B:C (3.11 and 3.10). Hence, these were recommended for U.P. (Zone- IV).
- Three-year study on weed management in okra revealed that pre-emergence application of pendimethalin @ 6 ml/L + one hand weeding at 25 DAS gave maximum fruit yield of 127.82 q/ha at Hyderabad and 116.73 q/ha at Dharwad with highest B:C ratio of 3.30 and 1.64, respectively. It was recommended under Hyderabad and Dharwad conditions for better weed control and remunerative return in okra.
- At Jorhat, three-year pooled data on French bean revealed that application of 25% NPK (7.5:10:5 kg N P K/ha) through inorganic source combined with 75% N through FYM (7.2 t/ha) produced highest total fruit yield of 135.17 q/ha with highest B:C ratio of 2.53. Therefore, it was recommended for Jorhat region. While at Jabalpur, on the basis of three-year pooled data, it was observed that the maximum pod yield (156.57 q/ha) was observed in treatment consisting of 50% NPK through inorganic and 50% N through VC with B:C ratio of 2.21. Therefore, it was recommended for Keymore Plateau & Satpura Hills Agro-climatic zone of Madhya Pradesh in French bean (Kharif season).
- At Dharwad, the results of pooled data of three years on micronutrient experimentation showed that applications of Mixture of Boric acid +ZnSO4+CuSO4+FeSO4+MnSO4+Ammonium molybdate, recorded highest yield of 135.60 q/ha with highest B:C ratio of 2.38. Hence, this may be recommended under Dharwad condition in Bitter gourd.

Protected cultivation:

- Pooled data of 3 years in fertigation studies of parthenocarpic cucumber at Pantnagar gave maximum yield 1198.0 q/ha and B:C ratio 2.94 was recorded under treatment T_3 (200:150:250 NPK Kg/ha) in Pant Parthenocarpic Cucumber 3. Hence, the same treatment was recommended for polyhouse cultivation of Parthenocarpic Cuncumber in Pantnagar condition.
- The experiment conducted on micro nutrient management in polyhouse under green capsicum, the maximum yield of 330.93 q/ha and B:C ratio 2.77 at IIVR, Varanasi and maximum yield of 520 q/ha and B:C ratio of 3.59 at Ludhiana, respectively was recorded under T_3 (foliar application of micronutrient vegetable special). Hence, this treatment was recommended for the cultivation of green capsicum under poly/net house of Zone IV.
- The pooled data of experiment on fertigation studies on hybrid brinjal for three years gave maximum yield of 754 q/ha and B:C ratio 2.99 at Ludhiana and maximum yield of 407.74 q/ha and B:C ratio 3.00 at Coimbatore, respectively under treatment T_2 (150:100:150 NPK kg/ha). Hence, this treatment was recommended for the cultivation of hybrid brinjal at Ludhiana and Coimbatore conditions.
- At IIVR, Varanasi, the trial on evaluation of cherry tomato genotypes under protected cultivation, pooled data of three years from 2019 to 2022 showed that the maximum yield of 915.2 q/ha, net profit Rs.7,49,620 and B:C ratio of 4.53 was recorded in the genotype CPCT-214. Therefore, cherry tomato genotype CPCT-214 is recommended for Zone IV.

Seed production:

- In the trial "Effect of abscisic acid on seed yield and seed quality of cowpea", based on the pooled data of four years (2017-18, 2018-19, 2019-20 & 2020-21), it was revealed that application of 1.0 ppm abscisic acid recoded the highest seed yield (11.02 q/ha) with lower viviparous germination count (11.5%) and registered the highest B:C ratio (3.68) at Vellanikkara. Hence, application of 1.0 ppm abscisic acid at 10 days before 1st picking was recommended for reducing viviparous germination in the seed production of cowpea under the Vellanikkara condition.

- Under the trial "Effect of integrated weed management on quality and seed yield in cucumber", the application of mulching with black polythene (T7) in cucumber recorded highest seed yield (1.49 q/ha), 100 seed weight (3.48 g), number of seeds per fruit (328.4) and fruit length (23.1cm) with maximum seed quality parameters and highest C:B ratio (2.94). Therefore, the application of mulching with black polythene was recommended for integrated weed management in cucumber seed production at Varanasi condition.
- In the trial "Effect of seed protectants on seedling health in vegetables", on the basis of pooled data over two years (2020-21 and 2021-22) it was revealed that chilli seed treatment with Tebuconazole @ 1.5ml/kg seed+ Imidachloprid @10ml/kg seed (T4) had the highest germination percentage (79.83), seedling vigour index I and II (1017.36 and 13.36) and field emergence percentage (76.50) with highest B:C ratio (1.73). Hence, the seed treatment with Tebuconazole @ 1.5ml/kg seed in combination with imidacloprid recommended as an alternate molecule to existing fungicides in chilli under Lam condition.

Protection Technologies Recommended

Integrated Disease Management:

IDM package for cucurbit diseases:

At Vellanikkara, based on the pooled data of the 4 years (2015, 2017, 2018 and 2022), treatment T_2 comprising growing of maize as a border crop plus silver mulching + Seed treatment with combination of carbendazim 12% + mancozeb 63% WP @ 3g/kg seed, soil drenching with captan 70% + hexaconazole 5%WP @ 0.1 %, alternate 5-6 foliar sprays with Seed Pro @ 1.0% and neem oil @ 0.2% at 10 days interval recorded average PDI of 5.127 in comparison with control plot of 23.415 for the mosaic disease of bitter gourd (cv. Preethi). Same treatment has highest average yield of 133.9q/ha with highest B:C ratio of 2.67. Hence, this treatment was recommended for the Vellanikkara region.

At Sabour, based on the pooled data, the treatment combination of T5 comprising of growing of two rows of jowar or maize as border crop, use of agri silver mulch, seed treatment with carbendazim 12% + mancozeb 63% @ 3g/kg and drenching with captan 70% + hexaconazole 5% WP @ 0.1% at 15 days after germination followed by spraying of tebuconazole 50% + Trifloxystrobin 25% @1g/L + spray with (imidacloprid 17.8 SL @7.5ml/ 15L + Neem oil 0.2%) followed by fosetyl-Al @0.1%,tebuconazole 50% + trifloxystrobin 25% @1g/l + spray with (imidacloprid 17.8sl @7.5ml/ 15l + neem oil 0.2%) and fosetyl-Al @0.1% at 10 days interval on bitter gourd (cv. Kantedar) has reduced incidence of various diseases viz., mosaic disease (6.19%), downy mildew (6.56%) and anthracnose (1.98%) and recorded highest yield (142.97 q/ ha) with 1:2.23 C:B ratio. Considering the significance, this treatment module was recommended for management of bitter gourd diseases in Sabour.

- **Bio-intensive management of diseases of capsicum under poly house:** At Hyderabad, for the biointensive management of diseases of capsicum under polyhouse conditions studies, based on the 3 years pooled data, treatment (T_6) comprising of soil solarization after flooding the structure and covering it by 200 gauge transparent polysheet for three weeks, Seed treatment with seed pro @ 10g/kg seeds, soil drenching with seed pro (@5%), application of 5 kg FYM fortified with 500g neem cake and 50 g *Trichoderma* sp. + 50 g *Paecilomyces lilacinus* at the time of bed preparation, foliar spray with Bordeaux mixture 0.8% 6-7 times at 15 days interval beginning from 30 days after transplanting, showed highest yield (23.79 t/ha) with highest B:C ratio (2.83). This treatment recorded least average Powdery mildew (22.04) and *Cercospora* (4.58) disease severity whereas control plot recorded 30.80 and 13.34, respectively in capsicum. Hence, this treatment was recommended for the bio-intensive management of capsicum diseases under polyhouse conditions at Hyderabad region.
- **IDM for bacterial wilt management of tomato:** At Coimbatore, based on the three years (2018-19 to 2020-21) cumulative data, treatment T7 comprising of soil application of bleaching powder @15kg/ha before transplanting, soil amendment with lime depending upon pH of the soil to make soil neutral, seedling root dipping with Streptocycline @ 200ppm and soil drenching of copper oxychloride @0.3% thrice at 10 days interval started from 20 days after transplanting has recorded least bacterial wilt disease incidence on tomato (hy. Co-3) of 3.06% whereas control plot recorded 16.65%. Same treatment T7 has recorded highest average fruit yield of 416.14q/ha with B:C ratio of 3.99 against the control plot of 334.1 q/ha.
- **The trial on identification of causal agent involved in stem splitting and gummy stem blight in cucurbit crops,** among the 15 allotted centres, causal agent for stem splitting and gummy stem blight in cucurbit crops was identified as *Stagonosporopsis cucurbitacearum* (Sexual: *Didymella bryoniae*) among the 7 centres (Coimbatore,

Hessaraghatta, Hyderabad, Junagadh, Kalyanpur, Varanasi, Vellanikkara). However, *Fusarium* sp. was also found to be associated with the GSB at 3 centres (Lam, Ludhiana and Rahuri), whereas no occurrence of the GSB was reported in the remaining 5 centres.

- **Integrated management of bitter gourd virus diseases:**

  At Bhubaneshwar (Nakhra Local), Kalyani (Meghna -2 Local), Rahuri (Phule Green Gold) and IIVR(cv. VRBTG10), treatment T5 comprising of raising barrier crop with two rows of bajra/ maize, mulching with black-silver plastic mulch, installation of yellow sticky traps followed by rotational spray of Arka Microbial Consortia @ 5 ml/l, sea weed extract @ 0.2% and pyriproxifen @ 0.1% at 10 days interval has recorded least mosaic disease severity of 9.7 (control –58.1), 21.86 (control –56.85), 12.2 (control - 34.56) and 7.75 (control - 17.03), respectively. Same treatment has recorded highest fruit yield at Bhubaneshwar (149.2 q/ha against control of 65.2 q/ha), Kalyani (198.24 q/ha against control of 101.87q/ha), Rahuri (181.58 q/ha against control of 139.52 q/ha) and IIVR (137.79 q/ ha against control of 68.78 q/ha) with the highest B:C ratio of 3.3, 6.96, 2.27 and 2.21, respectively.

  On bitter gourd, at Coimbatore (cv. CO-1), Junagadh (hy. Parag), Lam (Kathai Local) and Sabour (Kateeli Local), treatment T6 comprising of raising barrier crop with two rows of bajra/ maize, mulching with black-silver plastic mulch, installation of yellow sticky traps followed by rotational spray of acephate @ 0.15% + neem oil @ 0.2% followed by pyriproxifen @ 0.1% at 10 days interval has recorded least mosaic disease severity of 7.64 (control – 31.92), 17.65 (control – 41.37), 38.91 (control – 77.82) and 8.25 (control –22.31), respectively. Same treatment has recorded highest fruit yield at Coimbatore (173.17 q/ha against control of 128.33 q/ha), Junagadh (180.35 q/ha against control of 79.7 q/ha), Lam (129.77 q/ha against control of 78.15 q/ha) and Sabour (81.65 q/ ha against control of 49.25 q/ha) with the highest B:C ratio of 3.91, 11.92, 5.72 and 1.90, respectively.

  At Vellanikara, on bitter gourd (cv. Preethi), treatment T1 comprising of raising barrier crop with two rows of bajra/maize, mulching with black-silver plastic mulch, installation of yellow sticky traps followed by repeated spray of Arka Microbial Consortia @ 5 ml/l at 10 days interval has recorded least mosaic disease severity of 12.25 against the control plot of 28.58. Same treatment has recorded highest fruit yield of 112.47 q/ha against control of 66.88 q/ha with the highest B:C ratio of 2.25.

- **Trial on integrated management of virus disease in okra,** at Kalyani (Arka Anamika), IIVR (Kashi Pragati), Durgapura and Coimbatore (Arka Anamika), treatment T7 comprising of mulching with Agrimulch silver polythene sheet+ seed treatment with thiomethoxam 30% FS@ 4g/kg of seed followed by sequential spray of pyriproxyfen (5% EC) + fenpropathrin (15 %EC) @ 1ml/l, spiromesifen (22.9% SC) @ 1ml/l, buprofezin 25% SC @ 2ml/l and neem oil @ 3ml/l at 10 days interval has recorded least disease incidence of yellow vein mosaic disease of 12.69% (control – 87.50%), 24.44% (control – 71.85%), 17.29% (control – 39.93%) and 11.35% (control – 69.56%), respectively. Additionally, at Coimbatore, incidence of enation leaf curl disease was also least (7.32%) in the T7 against the control plot of 53.18%. Same treatment has recorded highest average yield of 98.72 q/ha against control of 25.69 q/ha; at Kalyani, 155.41 q/ ha against control of 77.91 q/ha; at IIVR, 62.49 q/ ha against control of 24.94 q/ha; at Durgapura and 183.16 q/ha against control of 85.64 q/ha and at Coimbatore with the highest BC ratio of 2.17, 1.97, 20.40 and 3.98, respectively.

- **Trial on management of foliar blight disease of Leguminous Vegetable crops,** at Vellanikkara on cowpea (cv. Anaswara), on the basis of three years pooled data, treatment T_3 comprising four foliar sprays with Streptocycline @100 ppm + Tebuconazole 50% + Trifloxystrobin 25%WG @ 0.2% at 10 days interval started with initiation of the diseases has recorded highest mean yield (94.43 q/ha) in comparison with the control of 35.38 q/ ha with highest BC ratio of 1:291. Same treatment T3 has registered least per cent disease severity of *Cercospora* leaf spot of 23.63 against the untreated control plot of 69.82. Therefore, this treatment was recommended for the Vellanikkara region for the management of *Cercospora* leaf spot disease on cowpea.

Insect Pest Management:

- **Evaluation of different insecticide strategies for management of shoot and fruit borer in brinjal**

  For management of IRM in *Leucinodes orbonalis* on Brinjal, the rotational treatment T_6 (Rynaxpyre 20 SC @ 0.4 ml/L followed by Emmamectin benzoate 5 SG @ 0.5 g/L, Spinosad 45SC @ 0.5 ml/L, Chlorpyriphos 20 EC @ 2 ml/L, Cypermethrin

25 EC @ 0.5 ml/L at 10 days intervals each) was found effective with lowest percent shoot damage with highest yield (19.8 t/ha) and highest ICBR 1:5.35 followed by the sequential treatment T_1 (Rynaxpyre 20 SC @ 0.4 ml/L under Hyderabad condition. The current result is also in accordance with the earlier of result of ICAR-IIVR, Varanasi.

- **Evaluation for identification of effective insecticides against *Tuta absoluta* in tomato**

For the management of tomato pin worm (*Tuta absoluta*), among all the treatments Lamda Cyhalothrin 2.5 EC @ 0.6 ml/lit was the best in terms of having highest ICB ratio (1:5.32) followed by Novaluron 10 EC @ 1.5 ml/lit (1:4.92). However, among the newer molecules Cyantraniliprole 10.26 OD @ 1.8 ml/lit registered maximum fruit yield (19.34 t/ha) with ICBR of 1:4.48 under Hyderabad condition. The present study was also in conformity with IIHR, Bangalore centre where Cyantraniliprole 10.26% OD @ 1.8 ml/litre at 10 days intervals from appearance of *Tuta absoluta* was found most effective.

- **Development and evaluation of IPM modules for tomato pinworm *Tuta absoluta***

In tomato, among the modules tested for *Tuta absoluta,* the chemical module comprising the spraying of lamda cyhalothrin 5 EC @ 0.6 ml/L at 30 DAT, followed by Indoxacarb 14.5 SC @ 1 ml/L, Rynaxypyr 20 SC @ 0.3 ml/L, Novaluron 10 EC @ 1.5 ml/L each at 10 days interval found to be the best management practice for *Tuta absoluta* on tomato under Hyderabad conditions with ICB Ratio of 1:14.33. The same chemical module was also found effective under IIHR, Bengaluru condition.

- **Evaluation of different pest management modules against vector and sucking pests management of Bitter gourd**

In bitter gourd (cv. Palee), the Chemical Pest Management Module comprising of seed treatment with Imidacloprid 48 FS @ 5-10 g/kg seed, followed by spraying of Thiamethoxam 25 WG @ 1 g/3L at 20 DAS, spraying of Cyantraniliprole 10.26 OD @ 1.8 ml/L at 30 DAS, spraying of Imidacloprid 70 WG @ 1 g/12 L at 40 DAS onwards till 70 DAS in rotation at 10 days interval each recorded lowest leafhopper count (0.4 hoppers/plant) and fruit fly damage (17.7%) with maximum PROC of 84% and 58%, respectively. Further, highest fruit yield (22.1 t/ha) and cost- benefit ratio (1:2.33) was recorded from chemical module under IIHR, Bangalore conditions. However, integrated pest management module was found the most promising at IIVR, Varanasi and MPKV, Rahuri.

- **Evaluation of some novel insecticide molecule against whitefly of cucumber**

Based on pooled analysis of three years, Nagaland center reported that Flonicamid 50 WG @ 0.4 g/litre gave the most effective result in controlling whitefly (3.37 mean population of whitefly with 74.12 PROC) accompanied with the highest fruit yield (168.99 q/ha) and the highest cost benefit ratio of 1:5.63 in cucumber and hence recommended.

- **Evaluation of some entomopathogenic fungi and their compatibility with neem oil against sucking pests of cucumber**

Under validation of Division of Crop Protection, ICAR-IIVR developed technology on "Compatibility of neem oil and different entomopathogens for the management of major vegetable sucking pests", SKLTSHU-Hyderabad centre based on the three year pooled data recommended that combination of *Lecanicilium lecanii* @ 2.5 g/litre + neem oil 0.5% was found significantly superior for the control of whitefly and thrips in cucumber than rest of the treatments with 8.68 q/ha yield and ICBR of 1:11.44 which was on par with Imidacloprid 17.8 SL @ 0.33 ml/L.

- **Integrated nematode management in tomato under protected conditions**

At PAU, Ludhiana, among the three tested modules the Integrated nematode management module (T2) comprising soil application of Fluopyram 400 SC at 500 ml /acre before planting + soil drenching of neem cake enriched biopesticides suspension crop (suspension prepared by mixing of 20 kg of enriched neem cake in 200 litre of water) @ 10 % once in 30 days in standing was found most effective in reducing soil nematode population (67.38 %), root galling index (65.26%) and increasing marketable yield up to 31.05% over untreated control with C:B ratio 1.30. However, it was at par with the chemical module (T3) with 60.76% reduction in soil nematode population, 59.60 % reduction in root galling index under PAU, Ludhiana condition.

At IIHR, Bengaluru, for managing root knot nematodes in tomato grown under protected conditions, integrated nematode management module comprising soil application of Fluopyram

400 SC at 500 ml per acre combined with soil drenching of neem cake enriched biopesticides suspension once in 30 days in standing crop recorded the maximum decrease in nematode population (74.45 to 80.74%) and increase in yield (treatment can be considered for managing root knot nematode in tomato under protected conditions in Bengaluru region.

- **Management of root-knot nematodes (*M. incognita*) on tomato under open field conditions**

For the management of *Meloidogyne incognita* in tomato, the seed treatment with 20 g of *Bacillus amyloliquefaciens* (IIHR BA2) + substrate treatment for the nursery (*B. amyloliquefaciens* (IIHR BA2) 10 g/ kg of the substrate) + application of 5 ton of FYM enriched with 5 kg *B. amyloliquefaciens* (IIHR BA2)/ha was found most effective under field conditions by reducing final nematode population in soil (66.6%) and root population (74.6%) with least root-knot index (1.0) and recorded maximum increase in yield (21.9%) with maximum C:B ratio 1:1.22 under field conditions in the Varanasi region. The same result was also recorded from IIHR, Bengaluru and PAU, Ludhiana Center during 2022.

Breeder Seed Production of Vegetable Crops

During the year 2022-23, an indent of 1687.380 kg breeder seed for 173 varieties of 28 vegetable crops was received from the Deputy Commissioner (Seed) DAC, GOI, New Delhi for Kharif, 2023 and the same were allotted to 24 coordinating centres for undertaking the production. However 1557.600 kg breeder seed accepted by the 22 coordinating centres for 139 varieties of 27 vegetable crops. A total of 1941.690 kg of Breeder Seed was produced against the indents and its reports sent to the Deputy Commissioner (Seed) DAC, GOI, New Delhi for onward supply to the indenters.

Apart from this an indent of 7161.870 kg breeder seed for 113 varieties of 31 vegetable crops was received from the Deputy Commissioner (Seed) DAC, GOI, New Delhi for Rabi, 2023 and the same were allotted to 19 coordinating centres for undertaking the production. However 6751.290 kg breeder seed accepted by the 16 coordinating centres for 88 varieties of 24 vegetable crops. A total of 6972.120 kg of Breeder Seed was produced against the indents and its reports sent to the Deputy Commissioner (Seed) DAC, GOI, New Delhi for onward supply to the indenters.

Krishi Vigyan Kendras

KRISHI VIGYAN KENDRA, KUSHINAGAR

Training Programmes: Krishi Vigyan Kendra, Kushinagar organized **88** need based on and off–campus training programs under human resource development comprising diverse aspects of production technologies of cereals, oilseeds, pulses, vegetables, livestock, soil health management, value addition, household food security, and women empowerment benefiting a total of **2610** participants comprising **343** female and **2267** male farmers, rural youth and extension functionaries.

Clientele	No. of Courses	Male	Female	Total participants
Farmers & Farm women	58	1082	268	1350
Rural Youths	1	65	27	92
Extension Functionaries	24	972	30	1002
Sponsored Training	4	98	18	116
Vocational Training	1	50	0	50
Total	**88**	**2267**	**343**	**2610**

Frontline demonstration: Front line demonstration were conducted in 110.9 ha area at 573 farmers field on Paddy, Mustard, Lentil, Onion, Green Gram, Brinjal, Green fodder and Balance Diet through Nutritional garden etc.

Frontline Demonstrations Summary

Enterprise	No. of Farmers	Area (ha)	Units/Animals
Oilseeds	55	20.0	-
Pulses	156	30.0	-
Cereals	161	46.2	-
Vegetables	105	11.7	-
Other crops	22	3.0	-
Total	**499**	**110.9**	**-**
Livestock & Fisheries	24	-	24 units
Other enterprises (Kitchen garden)	50	-	50 units
Total	74	-	-
Grand Total	573	110.9	74 unit

Frontline Demonstration at KVK, Kushinagar

S. No.	Crop	Technology demonstrated	Horizontal spread of technology				
			No. of farmers	Area in ha	Demo Yield	Check Yield	Yield Increase %
1.	Mustard 2022-23	Improved Variety (PM-31)	90	21	16.5	12.9	27.9
2.	Mustard 2023-24	Improved Variety (PM-31)	55	20	17.14	12.25	39.9
3.	Pigeon pea Kharif 2022-23	Line sowing (Rajendra Arhar 1)	31	10.0	20.1	13.3	51.1
4.	Lentil Rabi 2022-23	Line sowing (IPL-316)	139	20.0	12.6	7.9	47.0
5.	Green Gram Zaid 2023	Line sowing (Shikha)	38	10.0	10.8	8.8	22.7
6.	Pigeon pea Kharif 2023-24	Line sowing (Rajendra Arhar 1)	53	10.0	20.8	14.3	45.4
7.	Lentil Rabi 2023-24	Line sowing (IPL-316)	65	10.0	12.9	9.4	37.2
8.	Wheat 2022-23	Zero tillage (DBW-187)	10	1.6	42.2	34.3	23.0
9.	Wheat 2022-23	Zero tillage (DBW 252)	8	1.6	43.6	35.7	22.1
10.	Wheat 2022-23	IPM (ST)	35	10	42.6	34.7	22.5
11.	Paddy 2023	Drum Seeder(S-52)	22	10	46.6	36.2	28.7
12.	Paddy 2023	Drum Seeder(BPT-5204)	25	08	47.3	37.8	25.1
13.	Paddy 2023	Leaf folder Mgt. (Trichocard)	12	6	45.2	36.1	25.2
14.	Paddy 2023	ST(ST + Trichodarma)	25	5	44.6	36.8	21.1

15.	Wheat 2023-24	Zero tillage(DBW-187)	26	6.0	45.4	37.8	20.1
16.	Wheat 2023-24	Zero tillage(DBW 252)	15	4.5	44.5	36.3	22.5
17	Wheat 2023-24	IPM(ST)	18	3.5	43.6	35.7	22.1
18	Bitter Gourd (Zaid 2023)	HYV/hybrid, (Kashi Pratishtha)	12	1.0	237.6	192.7	23.3
19	Sponge Gourd (Zaid 2023)	HYV/hybrid,(Kashi. Divya)	13	1.0	194.9	168.3	15.8
20	Onion Kharif 2023	Varietal perfornance (ADR)	10	1.25	218.4	162.7	34.2
21	Okra Kharif 2023	HYV (Kashi chaman)	10	2.0	132.3	114.2	15.8
22	Ridge gourd Kharif 2023	HYV/hybrid, (Kashi khusi)	8	1.25	110.7	94.2	17.5
23	Tomato Rabi 2023-24	HYV(Kashi Aman)	11	1.0	430	325	32.3
24	Chili Rabi 2023-24	HYV(Kashi anmol)	15	1.0	152	115	32.1
25	Brinjal Rabi 2023-24	HYV(HYV- Kashi sandesh)	06	1.0	647	490	32.0
26	Brinjal Rabi 2023-24	HYV(HYV- Kashi uttam)	10	1.0	463.5	371	25.0
27	Banana + cauliflower 2023-24	Sequential inter cropping of vegetables in banana (2:1) (G-9)	10	1.0	cauliflower -122.5	Banana Result awaited	
28	Sugarcane +cowpea 2022-23	Intercropping (CoSe- 8272+ K. Kanchan)	12	1.0	683+44.3	605	20.2
29	Sugarcane + Cowpea2023-24	Intercropping (Co- 118+ K. Nidhi)	10	2	45.4	Sugarcane Result awaited	
30	Low milk production in Dairy animals	Use of green fodder (Jwar)	24	24	5.86	5.48	6.91
31	Nutri farming system (Zaid 2023)	Agri Nutri smart Village model	50	0.5 ha / 50 units (100 sqm per unit)	325	215	51.1
32	Nutri farming system Kharif (2023)	Agri Nutri smart Village model	50	0.5 ha / 50 units (100 sqm per unit)	375	235	59.5
33.	Nutri farming system Rabi (2023)	Agri Nutri smart Village model	50	0.5 ha / 50 units (100 sqm per unit)	325	215	51.1

Technology Assessment and Refinement in Detail

Thematic areas	Crop	Name of the technology assessed	No. of trials	No. of farmers
Integrated Pest Management	Sugarcane	Use of Agrochemicals for borer management under AESA based IPM involving the recommended use of chlorantraniliprole @ 375ml/ha, use of Neem cake post irrigation, Trichogramma egg parasitoid and timely use light trap.	1	6
	Brinjal	Use of Agrochemicals for BSFB management under AESA based IPM involving the recommended use of imidacloprid 17.8% @ 1ml/kg and root dip @ 1ml/l, intermittent use of indoxacarb @ 0.4 to 0.6 ml/l, Neem oil (300ppm) @ 5ml/l, Trichogramma egg parasitoid, pheromone trap @ 25/ha and timely use light trap.	1	5

Integrated Crop Management	Paddy - Sugarcane + Vegetables (potato & cowpea	Assessment of Rice- Sugarcane cropping system with inter cropping of vegetables to improve socio economic status of farmers.	1	10
	Paddy- wheat-Pulses	Assessment of cropping intensity Paddy- wheat-Pulses cropping system to improve socio-economic status of farmers.	1	10
	Banana + cauliflower	Inter cropping of cauliflower with banana for increasing income per unit area	1	10
	Cowpea (Zaid), Okra (Kharif) and Tomato (Rabi)	Assessment of vegetable based cropping system under local conditions	1	10
RCT	Wheat	Residue management in wheat by happy seeder machine	1	06
Total			07	57

Summary of technologies assessed under livestock by KVKs

Thematic areas	Name of the livestock enterprise	Name of the technology assessed	No. of trials	No. of farmers
Feed and Fodder management	Poultry	Maize and soya based poultry feed	1	5
Total			1	5

OFT -1: Low yield of wheat due to burning of crop residue

Residue management in wheat by happy seeder machine. Krishi Vigyan Kendra, Kushinagar conducted OFT in the year 2023 and 2023-24 on effect of sowing by happy seeder in wheat crop. A total of 10 farmer's fields were selected for residue management in wheat. The observations recorded are as follows:

Technology Option	No. of trials	Yield (t/ha)	Net Returns (Rs./ha)	BC Ratio
T_0 - Traditional practice	10	35.1	34200	1.95
T_1 – Sowing of wheat by happy seeder with mulching of paddy straw (Var- DBW-187 & DBW-252) 2022-2023		43.5	55706	2.78
T_0 - Traditional practice	10	37.8	42525	2.1:1
T_1 – Sowing of wheat by happy seeder with mulching of paddy straw (Var- DBW-187) 2023-24		44.2	61825	2.9:1

OFT – 2: Low economic return from Paddy-Wheat cropping system

Assessment of Paddy - Sugarcane cropping system with inter cropping of vegetables to improve socio economic status of farmers. Krishi Vigyan Kendra, Kushinagar conducted OFT in year 2021-22 and will be carry forwarded through 2022-23 to estimate the effect of Paddy – Sugarcane + Vegetables (potato & cowpea) cropping system. Ten farmers were identified to estimate the enhancement of income per unit area. Farmers grow Paddy - wheat usually. The observations recorded from the trials are as follows:

Technology Option	No. of trials	Major parameter	Advantages	Yield (t/ha)	Net Returns (Rs/ha)
T_0 - Paddy-Wheat	10		-	Paddy-35.8 Wheat-34.5 Paddy-36.4	129405
T_1 Paddy - Sugarcane + Vegetables (potato & cowpea)		Utilized inter space, more engagement of farm family, more labour man paydays	Increasing cropping intensity, higher returns	Paddy - 45.8 Sugarcane + Potato + Cowpea (825.6 + 119.4 + 45.2)	394211.1

T_0 - Paddy-Wheat	10		-	Paddy-36.7 Wheat -37.8 Paddy -	Result awaited
T_1 Paddy - Sugarcane + Vegetables (potato & cowpea)		Utilization of inter-crop spaces, more engagement of farm family, more involvement of labour (paydays)	Increasing cropping intensity, higher returns	Paddy - 47.6 Sugarcane + Potato -90.2 Cowpea	

OFT – 3: Low income from mono cropping of banana cultivation

Inter cropping of cauliflower with banana for increasing income per unit area.Krishi Vigyan Kendra, Kushinagar conducted OFT in year 2022-23 on effect of inter cropping of cauliflower (Kashi Gobhi 25) with banana (G-9) at 10 farmer's field to enhance the total income per unit area of the farmers. Farmers usually grow banana as a mono-crop. The observations recorded are as follows:

Technology Option	No. of trials	Major parameter	Advantages	Yield (q/ha)	Net Returns (Rs. / ha)
T_1 - banana cultivation as mono-cropping (G-9)	10	-	-	Banana – 734.5	440700
T_2 –Intercropping of cauliflower (Kashi Gobhi 25) with banana (G-9) 2022-23		Crop performance better with more intercultural operations	Utilized the inter spaces with cauliflower as inter-crop and found more income	Cauliflower – 135.4 + Banana – 765.6	699570

OFT – 4: Low income due to traditional cultivation under rice – wheat cropping system

Assessment of vegetable based cropping system under local conditions. Krishi Vigyan Kendra, Kushinagar conducted OFT in year 2023-2024 on Vegetable based cropping system under local conditions. A total 10 farmer's field were selected covering an area of 0.5 hectare. The observations recorded are as follows:

Technology Option	No. of trials	Major parameter (duration in days)	Advantages	Yield (t/ha)	Net Returns (Rs. / ha)
T_1 - Rice – wheat cropping system	10			Paddy - 34.6 Wheat - 35.4	71466
T2- Cowpea (Zaid), Okra (Kharif) and Tomato (Rabi)				Cowpea -112.6 Okra - 116.8 Tomato -412	581550

OFT – 5: Low sugarcane yield due to borer infestation

Use of Agrochemicals for borer management under AESA based IPM involving the recommended use of chlorantraniliprole @ 375ml/ha, use of Neem cake post irrigation, Trichogramma egg parasitoid and timely use light trap.

Krishi Vigyan Kendra, Kushinagar conducted OFT in year 2022-2023 for assessment of Sugarcane borer management under AESA based IPM module involving the recommended use of chlorantraniliprole @ 375ml/ha, use of Neem cake post irrigation, recurring need based application of Trichogramma egg parasitoid and timely use of light trap. A total 06 farmer's field have been covered over an area of 1 hectare. The results are as below:

Technology Option	No. of trials	Incidence of borer (%) (per 100 shoots)	Yield (q/ha)	% Increase in yield over farmer's practice
T0- Farmer practices	6	37.8	605	13.8
Chlorantraniliprole @ 375 ml/ha + Neem cake post irrigation + Trichogramma @ 50000/ha + light trap.		8.7	689	

OFT – 6: Low yield of brinjal due to shoot and fruit borer infestation

Use of Agrochemicals for BSFB management under AESA based IPM involving the recommended use of imidacloprid 17.8% @ 1ml/kg and root dip @ 1ml/l, intermittent use of indoxacarb @ 0.4 to 0.6 ml/l, Neem oil (300ppm) @ 5ml/l, Trichogramma egg parasitoid, pheromone trap @ 25/ha and timely use light trap.

Krishi Vigyan Kendra, Kushinagar conducted OFT in year 2023-2024 for assessment of Brinjal shoot and fruit borer under AESA based IPM module involving the recommended use of chlorantraniliprole @ 375ml/ha, use of Neem cake, Trichogramma egg parasitoid and timely use of light trap. A total 05 farmer's field have been covered over an area of 1 hectare. The results areas below:

Technology Option	No. of trials	Incidence BSFB (%) (per 100 fruits)	Yield (kg/ha)	% Increase in yield over farmer's practice
T0 - Farmer practices	05	31.4	354.2	26.27
T1-Seed treatment and root dip imidacloprid 17.8% @ 1 ml/kg + indoxacarb @ 0.4 to 0.6ml/l + Neem oil (300ppm) @ 5ml/l + Trichogramma @ 50000/ha + pheromone trap @ 25/ha + light trap.		8.1	447.8	

OFT – 7: Impact of poultry feed on growth of broiler

Krishi Vigyan Kendra, Kushinagar conducted OFT in year 2022-2023 on Impact of poultry feed (growth of broiler) under local conditions. A total 5 farmer's were selected with each for 20 chicks. The observations recorded are as follows:

Technology Option	No. of trials	Per cent increase in body weight
T_{0-} Farmers Practice (Readymade feed)	5	20 %
T1- Maize and Soya based poultry feed		

Details of Technology	No. of Chicks	Average body weight (Kg.)	Average Feed Consumption (Kg.)	Average cost (Rs./ unit.)	Average Gross return (Rs. /unit.)	Average Net return (Rs./unit.)	B:C Ratio
T_{0-} Farmers Practice (RTU)	100	1.05	1.92	84.48	120.75	36.27	1.42:1
T1- Maize and Soya based poultry feed	100	1.26	1.62	82.89	145.25	62.36	1.75:1

Extension Activities: To expedite the process of transfer of technology programme the KVK, organized 6 kisan gosthis wherein 452 farmers participated. Thirty four field days were organized covering 792 farmers for demonstration of technologies. KVK participated in 6 exhibitions for awareness creation of farmers benefitting a total of 9720 farmers. A total 89 scientific visits to farmer's field visits by KVK officials and 152 diagnostic visits were made by the KVK scientists and S.M.S. for the benefit of 2297 farmers. 67 Viksit bharat programmes were attended as resource person benefitting more than 27269 farmers of kushinagar and adjoining districts.

Extension Programmes:

Activities	No. of programmes	No. of farmers	No. of Extension Personnel	Total
Advisory Services	138	1740	374	2114
Diagnostic visits	152	2240	57	2297
Field Day	34	792	42	834
Group discussions	25	325	25	350
Kisan Ghosthi	6	452	38	490
Film Show	12	612	60	672
Self -help groups	15	280	15	295
Kisan Mela	1	3200	82	3282
Exhibition	6	9000	720	9720
Scientists' visit to farmers field	89	947	60	1007

Plant/animal health camps	1	87	9	96
Farm Science Club	1	50	4	54
Ex-trainees Sammelan	1	309	12	321
Farmers' seminar/workshop	2	118	7	125
Method Demonstrations	21	387	16	403
Celebration of important days	8	1912	78	1990
Special day celebration	3	450	19	469
Exposure visits	4	116	6	122
Others (pl. specify) Viksit Bharat	67	27269	2144	29413
Total	**586**	**50286**	**3768**	**54054**

Mobile Advisory Services

Message Type	Type of Messages						
	Crop	Livestock	Weather	Marketing	Awareness	Other enterprise	Total
Text only	418	101	14640	105	384	6	**15654**
Voice only	12	10	56	2	-	23	**103**
Voice & Text both	-	-	-	-	-	-	-
Total Messages	**430**	**111**	**14696**	**107**	**384**	**29**	**15757**
Message on Kisan Sarthi Portal							**202523**

Soil & water Analysis

Samples	No. of Samples	No. of Farmers	No. of Villages	Amount realized (Rs.)
Soil	9	25	08	-
Water	-	-	-	-
Total	**9**	**25**	**08**	-

Seed & Planting Material Production

	Quintal/Number	Value Rs.
Seed (q)	2100.38	1015535.00
Planting material (No.)	18.41 + 26251 (Nos.)	167760.8
Livestock Production (No.)	1.1 q	33000.00
Fishery production (No.)	2.90 q	50000.00
Total	2122.79 q + 26551	1266295.8

Glimpses of Activities in KVK, Kushinagar

CFLD in mustard

NARI programme training

World Soil Day

Kisan Diwas Celebration

Honorable Agriculture Minister visit at KVK Kushinagar

Dr. R. Selvarajan Diretcor, ICAR-NRCB Workshop lecture delieverd

Training programme

Exposure visit of farmers at Kalanamak trial

Farmer felicitation

Poultry farming

Kisan gosthi

Vegetable seed distribution

Independence day

Fish unit

Field day at Green gram

बौर से लदे आम के पेड़, बागवानों के चेहरे खिले

गृह वाटिका में सब्जी की खेती करें किसान

दैनिक उज्जवल

मेले में किसानों ने जानी कृषि की आधुनिक विधा

अमर उजाला

अपना शहर कुशीनगर

सरकार किसानों की हितैषी : सूर्य प्रताप

हिन्दुस्तान

अपना कुशीनगर

कृषिमंत्री ने अत्याधुनिक मशरूमलैब की दी सौगात

धान-गेहूं के उत्पादन में देश आत्मनिर्भर है: कृषि मंत्री

Newspaper Coverage

KRISHI VIGYAN KENDRA, DEORIA

Krishi Vigyan Kendra, Deoria conducted training programs, On Farm Testing`s (OFTs), frontline demonstrations (FLDs) and other extension activities based on thrust areas recognized after PRA. Selected programmes were organized according to the thematic area on promotion of HYV in cereal, oilseed, pulses, vegetable & fruit crops, promotion of farming system approach for sustainable agriculture and resource conservation technology, entrepreneurship development in mushroom cultivation, bee keeping, poultry, organic input production, value addition, protective cultivation maintenance of farm machinery andimplements etc..

Training programmes: To upgrade the knowledge, skills and increase the income of farming communities, a total of 48 including on and off campus training, Rural Youth, Extension Functionaries and Sponsored Training programmes were organized in different thematic areas and total number of 1105 farmers & farm women, rural youth and Extension Functionaries benefitted.

Table: 1 Detail of Training Programmes

Clientele	No. of Courses	Male	Female	Total participants
Farmers & farm women	37	298	453	751
Rural youths	7	160	56	216
Extension functionaries	1	19	6	25
Sponsored Training	3	95	18	113
Total	48	572	533	1105

On Farm Testing (OFT): A total of 04 on farm testing (OFTs) were conducted in different adopted villages of KVK, Deoria for assessment of selected technologies on agriculture and allied field.

Category	No. of Technology Assessed & Refined	No. of Trials	No. of Farmers
Technology Assessed			
Crops	4	23	23
Total	4	23	23

OFT 1: Assessment of nano urea on production and productivity of transplanted rice- To assess the performance of nano urea with the combination of 50% RDN with urea and DAP and two foliar spray of nano urea at 30 DAT and 60 DAT under transplanted rice. Application of 50% RDN and two foliar spray of nano urea @ 4ml/liter of water at 30 and 60 DAT produced the comparatively higher yield compared to traditional nitrogen management in rice. It recorded 7.34% higher grain yield of farmers practice.

OFT 2: Assessment the performance of HYV Mustard (Giriraj) with thinning at 25 DAS + application of Sulphur 20 kg/ha –The high yielding variety Giriraj coupled with thinning at 25 DAS and application of sulphur @ 20 kg/ha was found effective to produced the higher seed yield compared to farmers practice. It recorded 20.4 q/ha seed yield which was 25.92% higher over farmers practice (16.2 q/ha). It also recorded higher net return of Rs. 82580.00/ha with BCR of 3.88.

OFT 3: Assessment the performance Banana as double row plating system- High density double row planting system of bananaat row planting at 1.5x1.5x 2.0 m spacing (3750 plants/ha) recorded 26.21% increase in yield (930 q/ha) with net return of Rs. 8.94 lakh/ha as compared to the farmers practice (736.81) with net returns of Rs. 6.99 lakh/ha.

OFT 4: Assessment the performance of cucumber as inter crop in spring planted sugarcane- Intercropping of cucumber in spring planted sugarcane between two row of sugarcane was found effective and recorded 981.92 q/ha sugarcane equivalent yield with the net return of Rs. 2.41 lakh/ha as compared to sole sugarcane crop (750q/ha) with net return of 1.78 lakh/ha

Front Line Demonstration- Frontline demonstration under oilseed, pulses, cereals, vegetables and other enterprises were conducted in total of 113.25 ha and 462 farmers were benefited.

Enterprise	Area (ha)	No. of Farmers
Oilseeds	20	78
Pulses	70	259
Cereals	20	55
Vegetables	3.25	70
Grand Total	113.25	462

Details of Front Line Demonstration

Crop	Thematic Area	technology demonstrated	Variety	No. of Farmers	Area (ha)	Yield (q/ha)		% Increase in yield	Economics of demonstration (Rs./ha)	Economics of check (Rs./ha)
						Demo	Check		BCR (R/C)	BCR (R/C)
Oilseed										
Mustard	Varietal	High Yielding Variety	RH 749	78	20	19.6	14.5	35.17	2.95	2.18
Pulses										
Pigeonpea	Varietal	High Yielding Variety	RA 1	65	20	19.3	14.6	32.19	3.59	2.71
Greengram	Varietal	High Yielding Variety	IPL 2-3	30	10	8.7	6.2	40.32	2.00	1.52
Chickpea	Varietal	High Yielding Variety	RVG 202	78	20	19.6	13.4	46.27	2.38	1.62
Lentil	Varietal	High Yielding Variety	IPL 316	86	20	14.2	10.9	30.27	2.39	1.83
Cereal										
Paddy	Varietal	Direct Seeded of Rice	PS 1850	30	10	47.8	43.2	10.65	3.21	2.30
Wheat	RCT	Zero Till	HD 2967	25	10	52.6	46.7	12.63	2.63	1.94
Vegetable										
Vegetable Pea	Varietal	High Yielding Variety	Kashi Mukti	46	2	80.84	63.6	27.11	3.09	2.52
Onion	Varietal	High Yield Variety	ADR	24	1.25	286.4	237.4	20.64	4.2	3.48

Extension Activities: A total of 167 extension activities were organized during the period Jan.–Dec., 2023 by the KVK details is given below.

Activities	No. of programmes	No of beneficiaries
Advisory Services	53	165
Diagnostic visits	35	105
Field Day	4	90
Group discussions	5	280
Kisan Ghosthi	6	316
Film Show	9	350
Self -help groups	1	20
Kisan Mela	1	2510
Exhibition	7	6200
Scientists' visit to farmers field	35	85
Celebration of important days	7	240
Special day celebration	2	167
Others	2	85
Total	167	10613

Production of Seeds of cereals, vegetables and commercial crops Production & Planting Material Production at KVK Farm.

Enterprise	Name of crop	Name of Variety	Quantity (q)	Amount (Rs)	Distributed to No. of farmers
Cereals	Wheat	DBW 187 & DBW 252	41.68	157048	17
	Paddy	Kala Namak & PS 1850	12.05	72770	64
	Total		53.73	229818	81
Vegetables	Okra		0.01525	610	28
	Other		0.079	3160	34
	Total		0.09425	3770	62
Commercial crops	Potato	Kufri Anand & Kufri Garima	20.65	73690	2
	Total		20.65	73690	2
	Grand Total		74.47425	307278	145

Seedling production of vegetable crops

Enterprise	Name of crop	Quantity (No.)	Amount (Rs)	Distributed to farmers
Vegetables	Brinjal	13199	11956	150
	Chilli	11245	7443	117
	Tomato	5426	5207.8	88
	Cabbage	265	185	8
	Cauliflower	8465	7208	76
	Broccoli	485	776	9
	Onion	-	2925	17
	Cucumber	165	840	42
	Bottle gourd	578	4624	113
	Bitter gourd	517	4136	86
	Sponge gourd	606	4978	104
	Pumpkin	169	1368	47
	Others	674	4281	58
	Total	**41794**	**55927.8**	**915**

Sapling production of Fruits and ornamental plants

Enterprise	Name of crop	Quantity (No.)	Amount (Rs)	Distributed to farmers
Fruits	Litchi	5	300	4
	Papaya	330	8250	30
	Jack fruit	12	600	6
	Lemon	10	500	6
	Total	357	9650	46
Ornamentals	Crotons	20	400	4

Production of Bio products

Enterprise	Name of crop	Quantity (No.)	Amount (Rs)	Distributed to farmers
Fruits	Bio-product			
	Vermi compost	20	20000	
	Other	0.5	25000	
	Total	20.5	45000	

Special Programme

Bio-Fortified Crops used for nutritional security

Category	Bio Fortified Crop	Variety	Area (ha)	No of Beneficiaries
Cereal	Wheat	DWB 187	10	25
Millet	Finger millet	BL 352	1	6
	Pearlmillet	Kaveri Super Boss	1	5

Training programme under ARYA Project

S.No.	Name of entrepreneurial units	No. of entrepreneurial units established	No. of Training programs organized	No. of rural youth trained		No. of youth established units	
				Male	Female	Male	Female
1	Mushroom production	3	2	33	23	15	10

Seed production under Pulses Seed Hub

Season/Crop	Name of Pulse crop	Variety	Production	Category of seed
			Actual Production (q)	(F/S, C/S)
Kharif	Green Gram	Shikha	21.06	F/S II
	Pigeon pea	RA 1	24.59	F/S II
Rabi	Chick pea	Pusa 3043	15.26	T/L
	Lentil	IPL 316	7.28	T/L

Trail under KVK-CSISA Network project

Trail No.	Trail	No. of Farmers
	Kharif 2023	
1	Reducing seed rate of rice through rice nursery enterprise.	3
2	Demonstrating the performance of DSR under dust mulch (pre-sowing irrigation or equivalent pre-monsoon rain)	2
3	Rice-wheat system optimization through crop establishment with DSR	3
	Rabi 2023	
1	Performance of timely sown and late sown wheat varieties under different sowing schedules across ecologies.	30
2	Rice-wheat system optimization through crop establishment with DSR followed by ZT wheat	16
3	Assessing the effect of irrigation intensification on productivity of early and late planted wheat under conventional and zero tillage	9

Activities under Swachhata Abhiyan

S.No.	Items	No. of Programmes	No. of participants
1.	Toilet maintenance	25	110
2.	Road, drain cleaning	56	525
3.	Garbage disposal	45	165
4.	Door to door awareness	6	70
5.	Awareness campaign	8	96
6.	Composting	6	6
7.	Swachhata Mah (1st Oct-31st Oct, 2023)	31	265
7.	Other	12	180

KRISHI VIGYAN KENDRA, BHADOHI

Training Programmes: Krishi Vigyan Kendr, Bhadohi organized 101 training courses for 1277 male and 876 female on different aspects of agriculture & allied field which help in changing the knowledge and skills of participant.

Clientele	No. of Courses	Male	Female	Total participants
Farmers & farm women	91	1192	740	1932
Rural youths	5	58	49	107
Extension functionaries	5	27	87	114
Total	101	1277	876	2153

Frontline demonstrations

Enterprise	No. of Farmers	Area (ha)	Units/Animals
Oilseeds	141	60.5	-
Pulses	171	60.625	-
Cereals	204	52.1	-
Vegetables	91	2.67	-
Total	607	175.895	
Nutri Garden & Mushroom Enterprises	119	-	119
Total	119	-	119
Grand Total	**726**	**175.895**	**119**

Details of FLDs implemented during 2023

Sl. No.	Crop	Thematic area	Technology Demonstrated	Season and year	Area (ha)	No. of farmers/ demonstration
					Actual	Total
1	Mustard (RH-749)	Varietal Evaluation	Improved Variety, Timely Sowing	Rabi, 22-23	21.6	39
2	Mustard (RH-725)	Varietal Evaluation	Improved Variety, Timely Sowing	Rabi, 23-24	50	91
3	Mustard NICRA (RH-749)	Varietal Evaluation	Improved Variety, Timely Sowing	Rabi, 22-23	5.33	21
4	Mustard NICRA (RH-725)	Varietal Evaluation	Improved Variety, Timely Sowing	Rabi, 23-24	8.0	32
5	NEP Mustard (Pusa Vijay)	Varietal Evaluation	Improved Variety, Timely Sowing	Rabi, 22-23	1.0	8
6	Pigeon Pea (Rajendra Arhar-1)	Varietal Evaluation	Improved Variety, Timely Sowing	Rabi, 22-23	10	25
7	Pigeon Pea (Rajendra Arhar-1)	Varietal Evaluation	Improved Variety, Timely Sowing	Rabi, 23-24	20	46
8	Pigeon Pea	IPM	NPV+bird perches+Agrochemical	Rabi, 22-23	2.0	5
9	Chickpea (RVG-202)	Varietal Evaluation	Improved Variety, Timely Sowing	Rabi, 22-23	10.125	32
10	Chickpea (IPC-2006-77))	Varietal Evaluation	Improved Variety, Timely Sowing	Rabi, 23-24	10.0	26
11	Field Pea (HFP-529)	Varietal Evaluation	Improved Variety, Timely Sowing	Rabi, 22-23	13.2	46
12	Field Pea (IPFD 12 -2)	Varietal Evaluation	Improved Variety, Timely Sowing	Rabi, 23-24	10.0	33
13	Lentil (IPL-316)	Varietal Evaluation	Improved Variety, Timely Sowing	Rabi, 22-23	10	28

14	Lentil (IPL-526)	Varietal Evaluation	Improved Variety, Timely Sowing	Rabi, 23-24	10	25
15	Paddy (P-1850)	Varietal Evaluation	Improved Variety, Timely Sowing	Kharif-2023	4.5	23
16	Paddy (MTU-7029) SCSP	Varietal Evaluation	Improved Variety, Timely Sowing	Kharif-2023	20	71
17	NICRA Paddy Early Co-51	Varietal Evaluation	Improved Variety, Timely Sowing	Kharif-2023	7.143	30
18	NEP Wheat (HD-2967)	Varietal Evaluation	Improved Variety, Timely Sowing	Rabi, 22-23	2.0	14
19	SCSP Wheat (DBW-187)	Varietal Evaluation	Improved Variety, Timely Sowing	Rabi, 22-23	13.24	110
20	NICRA Wheat (HD-3298)	Varietal Evaluation	Improved Variety, Timely Sowing	Rabi, 23-24	10.0	32
21	NF Wheat (DBW-187)	Varietal Evaluation	Bijamrit, Jivamrit etc	Rabi, 23-24	4.0	20
22	Bajra (MPMH-17)	Varietal Evaluation	Improved Variety, Timely Sowing	Kharif, 2023	6.0	19
23	Greengram Natural Farm (Virat)	Varietal Evaluation	Bijamrit, Jivamrit etc	Kharif, 2023	6.5	19
24	Greengram NICRA (Virat)	Varietal Evaluation	Improved Variety, Timely Sowing	Kharif, 2023	4.125	16
25	Finger Millet VL Mandua-204	Nutritional, WUE	Millets in Cropping system	Kharif, 2023	0.5	9
26	Tomato(KashiAman)	Varietal Evaluation	Improved variety,Timely Sowing	Rabi, 22-23	1.0	23
27	Bottle gourd NICRA (Kashi Ganga)	Varietal Evaluation	Improved Variety, Timely Sowing	2022-23	0.0187	2
28	Pumpkin NICRA (Kashi Harit)	Varietal Evaluation	Improved Variety, Timely Sowing	2022-23	0.0625	5
29	Bitter Gourd NICRA (BG-10)	Varietal Evaluation	Improved Variety, Timely Sowing	2022-23	0.125	9
30	Vegetable Pea (Kashi Uday)	Varietal Evaluation	Improved variety,Timely Sowing	Rabi, 23-24	0.20	5
31	NICRA Sponge gourd (Kashi Shreya)	Varietal Evaluation	Improved variety,Timely Sowing	2022-23	0.0625	5
32	Onion (AFDR)	Varietal Evaluation	Improved variety,Timely Sowing	Kharif 2023	0.75	22
33	Okra (Kashi Kranti)	Varietal Evaluation	Improved variety,Timely Sowing	2023	1.0	15
34	OKRA NICRA (Kashi Kranti)	Varietal Evaluation	Improved variety,Timely Sowing	2023	0.125	7
35	OKRA Kharif (Kashi Kranti)	Varietal Evaluation	Improved variety,Timely Sowing	Kharif 2023	0.5	7
36	Turmeric (Meghna)	Varietal Evaluation	Improved variety,Timely Sowing	2023	0.1	35
37	Oyster Mushroom	Spawn	Utilize farm waste, wheat straw	2023	30 Unit	30
38	Oyster Mushroom	Spawn	Utilize farm waste, wheat straw	2023	34 Unit	34
39	Nutrition garden	Nutrition security	Improved variety	Zaid 2023	25 Unit	25
40	Nutrion garden	Nutrition security	Improved variety	Khrif 2023	30 Unit	30

Sl.No.	Activity	No. of activities organized	Date	Number of participants	Remarks
		Field day			
1	Field day of Nutri-garden	01	10/01/23	26	Amavakala
2	Field day of Vegetable pea	01	31/01/23	21	Surahan
3	Field day of Moong (Virat)	01	02/06/23	45	Uchetha
4	Field day of Mustard RH-749	01	13/02/23	36	Bisapur
5	Field day of Mustard RH-725	01	15/02/23	35	Bharatpur
6	Field day of fieldpea HFP-529	01	03/03/23	29	Digui Patpatiya
7	Field day of Chickpea RVG-202	01	08/03/23	41	Sadopur
8	Field day of Lentil IPL-316	01	15/03/23	30	Kome
9	Field day of Arhar RA-1	01	25/03/23	30	Samdhakhas

Technology Assessment (OFT)

SN	Thematic areas	Crop	Name of the technology assessed	No. of trials	No. of farmers
1.	Integrated Nutrient Management	Onion	Effect of Sulphar after application of 20Kg/ ha	19	19
2.	Varietal Evaluation	Brinjal	Evaluation of high yielding variety of brinjal	6	6
3.		Brinjal	Evaluation of high yielding variety of brinjal	5	5
4.	Integrated Pest Management	Gram	Management of pod borer in Chick Pea through biological method	5	5
5.	Integrated Disease Management	Brinjal	Mgmt of little leaf of Brinjal	5	5
6.	Post Harvest Technology / Value addition	Sorghum	Increase household consumption of and value addition in Sorghum	10	10
7.	Others (Nutritional security)	Nutri Thali	Nutri- Thali: Eat Right for Nutritional Security	10	10
8.		Sattu	Nutritional supplement for growing children (up to 6 years)	10	10
Total				**70**	**70**

Extension Programmes

Activities	No. of programmes	No. of farmers	No. of Extension Personnel	Total
Advisory Services	842	94076	1024	95100
Diagnostic visits	28	59	7	66
Field Day	9	280	13	293
Group discussions	8	130	26	156
Kisan Ghosthi	26	1574	95	1669
Film Show	8	1439	58	1497
Kisan Mela	1	550	45	595
Exhibition	2	290	60	350
Scientists' visit to farmers field	180	579	51	630
Farm Science Club	2	22	2	24
Celebration of important days	7	285	58	343
Special day celebration	4	35	37	72
Exposure visits	22	165	13	178
Total	1139	99484	1489	100973

Mobile Advisory Services (Whatsapp medium used)

Name of KVK	Message Type	Type of Messages						
		Crop	Livestock	Weather	Marketing	Awareness	Other enterprise	Total
Bhadohi	Text only	415	52	104	23	28	10	**632**
	Total Messages	415	52	104	23	28	10	**632**
	Total farmers Benefitted							92700

Seed & Planting Material Production

	Quintal/Number	Value Rs.
Seed (q)	134.67	297191
Planting material (No.)	14999	13946
Fishery production (No.)	1.08	19440

Weather data 2023

Month	Rainfall (mm)	Temperature ⁰ C		Relative Humidity (%)	
		Maximum	Minimum	Maximum	Minimum
January	8.5	20.5	10.0	100	69
February	0	28.0	12.0	99.8	33
March	52	32.3	17.0	100	29
April	13.5	36.9	21.0	80	17.4
May	16.5	38.2	22.0	84	21.4
June	57.5	39.8	28.4	71.6	33.9
July	190.5	35.1	27.9	99.7	72
August	237	32.9	27.1	99.9	80.4
September	86	33.6	26.5	100	60.2
October	111.5	32.6	21.8	98.1	36.8
November	8	29.5	16.5	97.8	14.6
December	8.5	23.4	12.9	95	-

Glimpses of Activities in KVK, Bhadohi

Data Collection of height & weight at Kansraypur

Field Day of Vegetable Pea (Kashi Mukti)

FLD on tomato (Kashi Aman)

FLD on Oyster Mushroom Production

FLD of Kitchen Gardening

Rural Youth training on Natural farming

Gosthi at NICRA Village Uchetha

Paddy CO-51 demonstration in NICRA Village

Field visit for Arhar Rajendra Arhar-1

Field day in Bhaktapur on Pigeon Pea

CFLD Chickpea Field visit at Bhaktapur

Institutional Activities

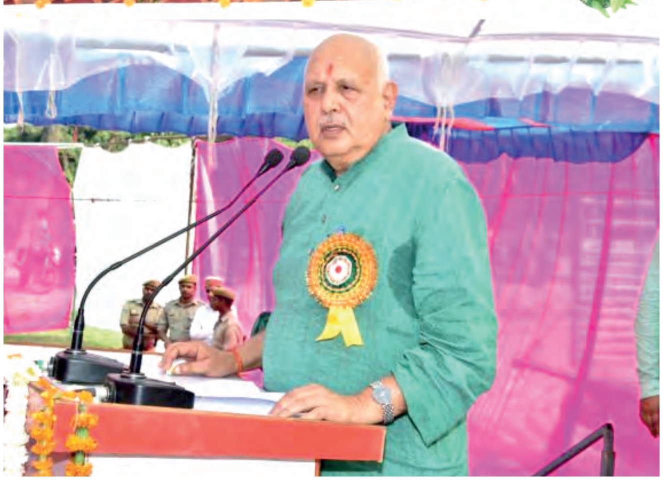
INSTITUTIONAL ACTIVITIES FOR TRANSFER OF TECHNOLOGIES

VIRAT KISAN MELA EVAM KRISHI PRADARSHANI, KRISHI VIGYAN KENDRA, SARGATIA, SEORAHI, DISTT. – KUSHINAGAR – 274 406, U.P.

The ICAR-IIVR-Krishi Vigyan Kendra (KVK), Kushinagar & Deoria, organized a farmer's fair on the theme **"कृषि उद्यमिता की ओर किसानों के बढ़ते कदम"** under the Schedule Castes Sub Plan (SCSP) on 12th March 2023 at Krishi Vigyan Kendra, Sargatia, Seorahi, Kushinagar. The event aimed to disseminate advanced agricultural technologies and practices among the farming community, particularly targeting the Scheduled Castes (SC) community to enhance their agricultural productivity and income. The Kisan Mela was inaugurated by the Chief Guest, Hon'ble Shri Surya Pratap Shahi, Agriculture Minister, Uttar Pradesh. During the inauguration, he also inaugurated the mushroom spawn production unit set up within the KVK Kushinagar premises. Further, he delivered a lecture, thanking KVK Kushinagar for its efforts in agricultural and allied sector development in the district. During the event, Dr. Neeraj Singh, PS & KVK Nodal Officer, ICAR-IIVR, Varanasi, provided an overview of the SCSP scheme and highlighted the role of KVK in the agricultural and allied sector development of the district. Dr. Alok Srivastava, Director, NBAIM, Mau, emphasized the importance of science and technology in agricultural development. Dr. K.G. Mandal, Director, MGIFRI, Motihari, discussed the significance of integrated farming systems. Dr. T.K. Behera, Director, ICAR-IIVR, Varanasi, elaborated the objectives of the Kisan Mela and the SCSP scheme. Special Guest Dr. Aseem Rai, MLA, Tamkuhiraj, spoke about various schemes of the Central and State Government, emphasizing the large-scale cultivation of turmeric in the Dudahi area and the need to adopt it as a side cropping to increase yield. The Kisan Mela witnessed the participation of 3,715 individuals, including farmers, farm women, agripreneurs, rural youth, SC/ST community members, FPO representatives, and extension functionaries from Kushinagar District. Additionally, 35 guests and dignitaries from various government departments of Uttar Pradesh attended the event. A total of 45 stalls were set up by various organizations and institutes showcasing the latest agricultural technologies related to agro-horticultural crops, livestock management, and other relevant fields. These exhibits aimed to provide valuable insights and practical solutions to the farming community. The event received extensive coverage from various print and electronic media ensuring the dissemination of the event's objectives and outcomes to a broader audience. The event underscored the critical role of science, technology, and integrated farming systems in enhancing agricultural productivity and sustainability, particularly for the SC community.

Inauguration of the Mushroom Spawn production Unit, KVK Kushinagar by Hon'ble Shri Surya Pratap Shahi, Agriculture Minister, U.P

Glimpses of Kisan Mela



LIVELIHOOD SECURITY OF SCHEDULED CASTE UNDER SCHEDULED CASTES SUB PLAN (SCSP) COMPONENT

"Scheduled Castes Sub-Plan" has been implemented by ICAR-IIVR including its 3 KVKs among 1307 SC families from 31 villages in Varanasi, Mirzapur, Bhadohi, Deoria and Kushinagar districts of Uttar Pradesh with an objective to promote economic development through improved agricultural technologies. During 2023, scientists of the institute and SMS of KVKs regularly visited to their respective villages and arranged technical discussions with farmers in which they have provided an elaborate knowledge about good agriculture practices for *Rabi*, *Kharif* and *Zaid* season crops. Field demonstrations were also organized to demonstrate the performance of improved vegetable varieties. During the year 2023, seeds of Okra (var. Kashi Chaman; 125 Kg), Cowpea (var. Kashi Kanchan; 125 Kg), Bottle gourd (var. Kashi Kundal; 25 Kg), Sponge gourd (var. Kashi Shreya; 12.5 Kg), Paddy (var. CO-51 and MTU1010: 25.4 q), Maize (var. 1008P: 1.5 q), Sesamum (var. GJT-5; 0.5 q), Green Gram (var. Vitat: 1.12 q), Tomato (250g) were distributed among farmers. Apart from seeds, planting materials for Elephant foot yam (var. Gajendra; 70 q), Turmeric (var. Megha Turmeric 1: 83.0 q), Brinjal (8300 seedlings) and drumstick (801 samplings) were also

भारतीय सब्जी अनुसंधान संस्थान के वैज्ञानिको ने किसानों को वितरण किया सब्जी का पौधा

परिवर्तन दूत,ब्यूरो।

रोहनिया। भारतीय सब्जी अनुसंधान संस्थान शाहंशाहपुर के वैज्ञानिको द्वारा बैंगन व सहजन के पौधों का वितरण। भारतीय सब्जी अनुसंधान संस्थान के निदेशक डॉ तुषार कांति बेहेरा के दिशा-निर्देश मे अनुसूचित जाति उप योजना के अन्तर्गत ग्राम सभा गौरैया में बैंगन किस्म काशी उत्तम, काशी उत्सव, और काशी मनोहर व सहजन किस्म पीकेएम-1 के पौधो का वितरण किया गया तथा किसानों द्वारा उगाई गयी विभिन्न फसलों का निरीक्षण किया गया। जिसका बीज पूर्व मे संस्थान द्वारा उपबलब्ध कराया गया था । इस अवसर पर भारतीय सब्जी अनुसंधान संस्थान के कार्यकारी निदेशक व विभागाध्क्ष डॉ एन राय द्वारा सहजन के पोषण तत्वों के बारे मे विस्तृत जानकारी दी गयी। प्रधान वैज्ञानिक, डॉ त्रिभुवन चौबे द्वारा भारत सरकार के अनुसूचित जाति उप योजना के तहत अनुसूचित जाति के किसानो की आय और आजीविका मे वृद्धि करने के प्रयासो के बारे मे जानकारी दी और किसानो को इन योजनाओ का लाभ उठाने का आग्रह किया। वरिष्ठ वैज्ञानिक डॉ. शैलेश कुमार तिवारी व डॉ. जयदीप हालदार ने बैंगन की उत्पादन तकनीक और कीट नियन्त्रण के बारे मे जानकारी दी । इस अवसर पर संस्थान के प्रधान वैज्ञानिक डॉ. राजेश कुमार सिंह, वैज्ञानिक डॉ राजीव कुमार व डॉ सुहास करकुटे, वाई पी-घ्सर्वेश मिश्र ने सब्जी की उत्पादन तकनीकों के बारे के विस्तृत जानकारी दी । इस अवसर पर गौरैया ग्राम सभा के प्रधान धनंजय मिश्र ने अपने विचार व्यक्त किए तथा नागेन्द्र तिवारी व अन्य किसान उपस्थित रहे ।

भारतीय सब्जी अनुसंधान संस्थान के वैज्ञानिकों द्वारा किसानों को बीज वितरण

●दर्दनाक सड़क हादसा की खबर सुनकर अहरौला पुलिस मौके पर पहुच गयी।

वाराणसी।आराजी लाइन विकास खंड क्षेत्र के शाहंशाहपुर स्थित भारतीय सब्जी अनुसंधान संस्थान में निदेशक डॉ तुषार कान्ति बेहेरा के दिशा निर्देशन में अनुसूचित जाति उप योजना के अन्तर्गत ग्राम सभा गौरैया के अनुसूचित जाति के किसानों को मक्का का संकर बीज किस्म एन एस सी 1008 पी,नेनुआ किस्म काशी श्रेया,लौकी काशी गंगा,कुम्भड़ा किस्म काशी हरित,मिर्च किस्म काशी रतना,मुँग की किस्म विराट,तिल की किस्म जी जे टी 5 के बीज तथा हजारा (रोज केन) का वितरण किया गया।साथ ही संस्थान के वैज्ञानिकों द्वारा वितरित किए गए बीजों के उत्पादन तकनीकी और रोग नियंत्रण के बारे में विस्तृत रूप से जानकारी भी दी।जिसके दौरान संस्थान के निदेशक डॉ तुषार कान्ति बेहेरा ने किसानों को अनुसूचित जाति उप योजना के महत्व के बारे में विस्तृत जानकारी दी।संस्थान के प्रधान वैज्ञानिक डॉ राजेश कुमार सिंह,डॉ त्रिभुवन चौबे,वरिष्ठ वैज्ञानिक डॉ शैलेश कुमार तिवारी,वैज्ञानिक सुहास ककूर्टे व राजीव कुमार,सर्वेश मिश्र,अश्वनी कुमार मिश्र,नागेन्द्र तिवारी इत्यादि किसान उपस्थित रहे। तीन दिवसीय प्रशिक्षण कार्यक्रम का समापन संस्थान में सहजन की उन्नत खेती एवं प्रसंस्करण तथा सब्जी उत्पादन तकनीकों पे चल रहे तीन दिवसीय कार्यक्रम (26-28 जून 2023) का समापन भी हो गया।इस प्रशिक्षण कार्यक्रम में लखनऊ से सोलह किसान प्रवृद्ध फाउंडेशन के सौजन्य से आये थे।इस प्रशिक्षण के समन्वयक डॉ नीरज सिंह,डॉ शुभदीप रॉय,डॉ विद्या सागर थे।संस्थान के निदेशक डॉ टीके बेहेरा ने सहजन का आहार में शामिल करने के लाभों की किसानों से चर्चा की।

किसानों को पौध वितरण

वाराणसी। भारतीय सब्जी अनुसंधान संस्थान, वाराणसी के वैज्ञानिको द्वारा बैगन व सहजन के पौधों का वितरण। भारतीय सब्जी अनुसंधान संस्थान, वाराणसी के निदेशक डॉ तुषार कांति बेहेरा के दिशा-निर्देश मे अनुसूचित जाति उप योजना के अन्तर्गत ग्राम सभा गौरैया में बैंगन किस्म काशी उत्तम, काशी उत्सव, और काशी मनोहर व सहजन किस्म पीकेएम-1 के पौधो का वितरण किया गया तथा किसानों द्वारा उगाई गयी विभिन्न फसलों का निरीक्षण किया गया जिसका कि बीज पूर्व मे संस्थान द्वारा उपबलब्ध कराया गया था । इस अवसर पर भारतीय सब्जी अनुसंधान संस्थान, वाराणसी के कार्यकारी निदेशक व विभागाध्क्ष डॉ एन राय द्वारा सहजन के पोषण तत्वों के बारे मे विस्तृत जानकारी दी गयी ।

बांटे गए सहजन, आम व बैगन के पौधे

जक्खिनी/वाराणसी (एसएनबी)। केंद्र सरकार द्वारा अनूसूचित जाति के कृषकों की आजीविका में सुधार एवं उनके आर्थिक उत्थान के लिए भा.कृ.अनु.सं.-भारतीय सब्जी अनुसंधान संस्थान द्वारा निदेशक डा. तुषार कांति बेहरा के निर्देशन में चलाए जा रहे अनुसूचित जाति उप-योजना के अंतर्गत आराजीलाइन ब्लॉक के ग्रामसभा चंदापुर, जयापुर, पचाई व सिंगही में आज सहजन एवं आम के पौधों का वितरण एवं रोपण किया गया जिसमें इन ग्राम सभाओं के लाभार्थियों ने भाग लिया। संस्थान के प्रधान वैज्ञानिक डा. पीएम सिंह ने अनुसूचित उप योजना के माध्यम से किसानों के आजीविका में सुधार एवं सहजन की पोषक क्षमता के बारे में प्रकाश डाला। प्रधान वैज्ञानिक एवं फसल उत्पादन विभाग के विभागाध्यक्ष डॉ. अनंत बहादुर ने किसानों को सहजन के संतुलित मात्रा में प्रयोग से विभिन्न रोगव्याधियों से सुरक्षित रख सकते है। प्रधान वैज्ञानिक डॉ. अच्युत कुमार सिंह ने सहजन के औषधीय गुणों आए आर्थिक लाभ लेकर महिलाओं को आत्मनिर्भर बनने के गुण बताए। चंदापुर के ग्राम प्रधान प्रतिनिधि राजिंदर प्रसाद ने पौधरोपण एवम भविष्य के कार्यक्रमों में बढ़चढ़ कर हिस्सा लेने के लिए किसानों को प्रेरित किया। एक अन्य कार्यक्रम में अराजीलाईन और मुजाहिदपुर के कृषकों को पोषण सुरक्षा में सहजन का महत्व पर विस्तृत चर्चा की गई और 200 सहजन की पौध का रोपण किया गया। इस अवसर पर प्रधान वैज्ञानिक समन्वयक डॉ. राजेश कुमार एवं वैज्ञानिक डॉ. विद्या सागर, वैज्ञानिक डॉ. नकुल गुप्ता, डॉ. ज्योति देवी, डॉ. भुवनेश्वरी, अमरेश तथा चंद्रशेखर ने उपस्थित होकर लाभार्थियों के खेत में लग रहे धान, सब्जियों इत्यादि का भौतिक सत्यापन भी किया। इस अवसर पर किसानों को बीज उपचार और उससे होने वाले लाभ की भी जानकारी तथा खरीफ में सब्जियों की खेती के बारे में विस्तृत जानकारी भी दी गयी।

Fig. 1: News articles covering about the distribution of seed, planting materials and farm inputs among SC farmers

distributed to selected SC farmers. Moreover, farm inputs like Rose can (200), Hand sprayer (200), Storage drums (130), and Water-soluble fertilizer (3 q) were also distributed among the needy farmers. Training programmes on different aspects of agricultural/ vegetable production/protection practices has been also organized.

CONDUCTING AND MONITORING FRONT LINE DEMONSTRATIONS (FLDS) UNDER TRIBAL SUB PLAN (TSP) ROGRAMME

Tribal Sub Plan (TSP) programme of ICAR-IIVR is operational in the Sonbhadra district of Uttar Pradesh. Under this programme, more than 1400 tribal farm families have been adopted for securing livelihood and nutritional security. Interventions are carried out among the beneficiaries through Front Line Demonstrations (FLDs) of need based technologies. Apart from improved seeds of different seasonal vegetables, seeds of cereals and pulses are also being given for the demonstration purpose. Cowpea variety Kashi Nidhi was demonstrated in 13.75 ha among 295 farmers and 107 q/ha yield was recorded with 37.59% increase in productivity than local variety. Likewise, other improved varieties from ICAR-IIVR like Kashi Harit in pumpkin, Kashi Rakshita in sponge gourd, Kashi Kranti in okra, Kashi Ganga in bottle gourd, BG-10 in bitter gourd, Kashi Madhu in muskmelon, Kashi Anmol in chilli, Kashi Aman in tomato, Kashi Rajhans in French bean, Kashi Ageti in pea were demonstrated at farmers field and average 20 to 30 per cent yield increase was recorded than the local varieties. In cereals paddy variety Saryu-52 was demonstrated in 108.57 ha among 200 farmers and 42q/ha yield was recorded. In case of wheat, improved variety DBW-252 was demonstrated in 66.66 ha among 210 farmers and 53 q/ha yield was recorded. In case of pulses, improved variety of moong var. Virat was demonstrated among 70 farmers. Secondary agriculture was also promoted among the tribal beneficiaries like mushroom cultivation was popularized among tribal farm women.

S.N.	Crop	Variety	Total Seed (kg)	Area (ha)	Yield/ha (q)	No. of Farmer
1.	Cowpea	K. Nidhi	275	13.750	107	295
2.	Pumpkin	K. Harit	11	5.500	243	50
3.	Sponge Gourd	K. Rakshita	2	0.400	231	12
4.	Okra	K. Kranti	47	3.133	120	40
5.	Bottle Gourd	K. Ganga	1	0.333	335	5
6.	Bitter gourd	BG-10	2	0.333	115	35
7.	Muskmelon	K. Madhu	0.4	0.200	200	20
8.	Moong	Virat	100	4.000	53	70
9.	Chilli	K. Anmol	0.4	1.000	180	18
10.	Tomato	K. Aman	0.4	1.143	337	22
11.	Brinjal	K. Sandesh	0.4	1.333	450	11
12.	French bean	K. Rajhansh	50	0.667	148	70
13.	Pea	K. Ageti	1000	6.250	78.5	145
14.	Wheat	DBW-252	8000	66.667	53	210
15.	Paddy	Saryu-52	3800	108.571	42	200
16.	Turmeric	Mega-1	3550	1.8	200	205
17.	Elephant foot yam	Gajendra	4000	1.0	750	142

Fig. 2: Demonstration of cowpea var. Kashi Nidhi

Fig. 3: Demonstration of okra var. Kashi Kranti

Fig. 4: Demonstration of turmeric var. Megha-1

Fig. 5: Mushroom cultivation by tribal farm women

ICAR-IIVR, VARANASI IN NEH REGION FOR PROMOTION OF VEGETABLE-BASED FARMING SYSTEMS UNDER NEH COMPONENT

Physical Output/Achievements

SN	Description		Annual Achievements (2023-24)
1.	Trainings		49
2.	Persons Trained	Male	2261
		Female	2124
3.	Demonstrations		49
4.	No. of Beneficiaries	Male	4255
		Female	3568

Outcome Targets/achievements

SN	Description	Place
1.	Demonstration of organic seed production of vegetable pea var Kashi Nandini	Tripura west
2.	Good Horticultural Practices (GHP) of major vegetable crops, nutrition education and value addition of vegetable crops	CAT, Tripura west
3.	Training on improved nursery raising technology of different vegetables with 60 mesh nylon net and nursery raising of high value vegetable crops by plug tray techniques	CAT, Tripura west
4.	Facilitation of new technologies of vegetables and distribution of Knapsack Sprayer, Garden pipe, Spade and Hand hoe in remote areas of Arunachal Pradesh through farmers meets and inputs distribution programme	CAT, Tripura west
5.	Role of nutritional garden in food security and improving livelihoods	College of Community Science, CAU,West Garo Hills, Meghalaya
6.	Production technology of cool Vegetables	Harigoan,West Garo Hills, Meghalaya
7.	Scientific production technology of Potato	Jetra Village, Chokpot, South Garo Hills, Meghalaya
8.	Training cum awareness programme on cultivation technology of Potato	Jetra Village, Chokpot, South Garo Hills, Meghalaya
9.	Awareness cum training programme on cool season vegetable crops	Harigoan,West Garo Hills, Meghalaya
10.	Awareness on ICAR-IIVR Technologies & Scientific cultivation of Vegetable crops	Hapoli, Lower Subansiri dist. Arunachal Pradesh
11.	Training cum seed distribution programme for farmers from North Baramura, Gandachera, Atharavola, Tripura	College of Agriculture, Tripura
12.	Integrated pest and disease management in Vegetable crops	COH, Bermiok, Sikkim
13.	Importance of Vegetable cultivation	AAU, Jorhat,Assam
14.	Model nutrition garden	AAU, Jorhat, Assam
15.	Commercial aspects of Vegetable Farming	AAU, Jorhat, Assam
16.	One day workshop on Summer Vegetable Crops: Promoting Kashi series vegetables for nutritional diet and food security in Garo hills	MTTC & VTC, CCS, CAU, Tura, Meghalaya

Demonstrations

Demonstration and hands-on-training for nutritional garden for dietary diversity and nutritional security	Jetragre Village, Chokpot, South Garo hills, Meghalaya
Demonstration of improved and disease tolerant varieties of vegetable crops	Gandacherra
Demonstration of Improved and Disease Tolerant Varieties	Gandacherra
Demonstration of quality and improved summer vegetable crop varieties of IIVR, Varanasi	COH, Bermiok, Sikkim
Distribution of quality seed planting materials among farmers	COH, Bermiok, Sikkim
Distribution of quality seed planting materials among farmers	COH, Bermiok, Sikkim
Training cum seed distribution programme	AAU, Jorhat, Assam
Practical aspects of year-round vegetable cultivation	AAU, Jorhat, Assam
Tips for production and retention of vegetable seeds for Farm use	AAU, Jorhat, Assam

Distribution of Vegetable seeds in NEH region

SN	Crop	Seeds (Kg)
1.	Tomato	21.2
2.	Chilli	200.0
3.	Ash gourd	25.0
4.	Okra	855.5
5.	Bottle gourd	90.0
6.	Cowpea	3280.0
7.	Palak	350.0
8.	Indian bean	328.0
9.	Vegetable pea	400.0
10.	Cauliflower	28.0
11.	Brinjal (H)	32.25
12.	Brinjal	110.25
13.	Radish	284.5
14.	Ridge gourd	86.0
15.	Sponge gourd (H)	24.0
16.	Sponge gourd	50.0
17.	Bitter gourd	25.0
18.	Amaranth	12.0
19.	French bean	66.0
20.	Water spinach	5.0
21.	Chenopods	1.0
22.	Carrot	2.0

Kitchen garden /Nutrition garden seed packets distributed

SN	Kitchen garden packets
1.	1600 Comprised of 10 vegetable crops seeds

Quality planting materials distributed

SN	Planting materials	Numbers
1.	Pointed gourd cuttings	200

Distribution of Agricultural inputs like pesticides/ fertilizers/ traps/ small farm implements etc.

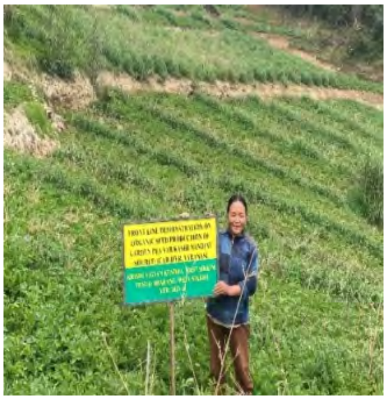
SN	Inputs distributed	No./kg/unit/liter/ml
1.	Garden Spade	160 No.
2.	Garden Hoe	260 No.
3.	Khurpa	960 No.
4.	Hand weeder	170 No.
5.	Hand cultivator	460 No.
6.	Vermicompost	400 Kg
7.	VAM	80 Kg
8.	Trichoderma	160 Kg
9.	*Neem* oil	180 liter
10.	Vermin bed	123 Unit
11.	Low cost poly house	5 Unit
12.	Shade net	5 Unit
13.	Bio-enhancer	27.5 liter
14.	Sprayer	80 No.
15.	Compost	459 Kg
16.	Pro-tray	700 No.

17.	Sagarika seaweed extract	500 ml
18.	Sticky Yellow traps	432 No.
19.	Pheromone traps	342 No.

Location & Beneficiary Details

SN	State	District	Village	Population benefitted
1.	Sikkim	Soreng	Bharang, Gyaba, Sombaria	64
		Namchi	Upper TokalBermiok	530
			Upper Namphing	619
			Daring	608
2.	Arunachal Pradesh	East Siang	Ledung, Namsing, Kiyet, Berung, Napit, Rani village	40
		Shi Yomi District	Didu, Sukodom, Jerelling	40
		Lower Dibang Valley	Desali	40
		Lower Subansiri	Hapoli	1140
3.	Tripura	Dhalai	Gandacherra	35
			Boalkhali	35
		Dhalai district	North Baramura, Gandachera,	879
4.	Meghalaya	West Garo Hills,	Darechikgre, Harigoan, Gimbilgre,	992
		South West Garo Hills	Dopgre, Bhatua, Upper Dopgre, Sangsangre	950
		South Garo Hills	Jetragre	765
		West Garo hills	MTTC & VTC, CCS, CAU, Meghalaya	108
5.	Assam	Jorhat	Elengmora	580
			Neoul Gaon	620
			Banhfolia	740

Glimpses of different activities in NEH region



Front Line Demonstration on Organic Seed Production of Garden Pea var. Kashi Nandini at Sikkim

Data collection and Field Visit at Bharang, West Sikkim

FLD on Vegetable Pea var Kashi Nandini at Sikkim

Performance of vegetable pea var. Kashi Nandini at Farmers field

State level vegetable farmers meet cum input distribution programme held at CHF, CAU, Pasighat, Arunachal Pradesh

VISIT OF UNION AGRICULTURE AND FARMERS WELFARE MINISTER SHRI NARENDRA SINGH TOMAR TO INDIAN INSTITUTE OF VEGETABLE RESEARCH, VARANASI

Hon'ble Union Agriculture and Farmers Welfare Minister, Shri Narendra Singh Tomar ji, visited the ICAR-Indian Institute of Vegetable Research, Varanasi on 09 January, 2023. During the visit, the Honorable Minister interacted with the farmers from selected villages associated with various projects of the Institute and was apprised of the various activities being run by the Institute. The farmers appreciated the seeds received from the projects in their villages, the trainings, field visits, and solutions to agricultural problems provided by the Institute's scientists. They informed the Minister about the benefits of being associated with the Institute. In continuation, the Minister also visited the research area and commended the techniques developed under NICRA such as carrot, tomato, chili, pea, organic and natural farming, grafting, and the tomato varieties grown in summers, Kashi Adbhut and Brimato, and Pomato. He also requested that these to be made available to the farmers as soon as possible. He appreciated the work done by the scientists and urged them to connect the technologies developed by them to more farmers and the general public. He advised the representatives from FPOs to explore opportunities to increase their income by utilizing the technologies developed by the Institute. During his visit, the Minister also participated in plantation activities at the institute and visited the mushroom unit, bee unit, processing unit, etc. The Director of the Institute, Dr. Tushar Kanti Behera, while welcoming the chief guest, informed him about the research and extension of the Indian Institute of Vegetable Research, Varanasi in increasing vegetable production in India. He mentioned that over the last 20 years, more than 100 varieties and technologies of vegetable production have been developed by the Institute. Efforts are being made to increase farmers' income by training them in processing, value addition, and mushroom production.

GLOBAL YOUTH AWARENESS DIALOGUE ON HIGH TEMPERATURE MANAGEMENT IN VEGETABLES UNDER FOOD SECURITY

Under India's G20 Presidency, Youth 20 (Y20) summit meetings were organized across the country. In these meetings, various issues such as employment, education, health, and science and technology are being discussed. As part of this series, a global youth awareness dialogue on high-temperature management in vegetables was organized at the ICAR-Indian Institute of Vegetable Research, Varanasi on 15th June 2023, in collaboration with Y20. The chief guest of this program was Distinguished Professor Dr. P.V. Vara Prasad from Kansas State University, USA. The program was initiated by the Director of the Institute, Dr. T.K.

Behera, who provided an overview of the research work being conducted on vegetables at the institute. Following this, Youth 20 representative and advisor Dr. Prakash Jha, Assistant Professor at Mississippi State University, USA, discussed the activities under Youth 20. He also informed attendees about opportunities and the selection process for doctoral and postdoctoral studies abroad. Dr. P.V. Prasad, while discussing global warming, elaborated on the various effects of high temperature on vegetable crops. He highlighted different aspects of high-temperature management in these crops. All the scientists, staffs and students of the institute attended this programme.

ICAR-INDIAN INSTITUTE OF VEGETABLE RESEARCH, VARANASI CELEBRATED ITS 33RD FOUNDATION DAY

ICAR-Indian Institute of Vegetable Research, Varanasi celebrated 33rd Foundation Day

Dr. Pramod Kumar Mishra, Principal Secretary to the Prime Minister inaugurated the hi-tech nursery and addressed farmers, scientists and school children.

ICAR-Indian Institute of Vegetable Research, Varanasi celebrated its 33rd Foundation Day on 28th September, 2023. The Chief Guest of the function was Dr. Pramod Kumar Mishra, Principal Secretary to the Hon'ble Prime Minister of India. Other special guests present at the function included Shri Devesh Chaturvedi, Additional Chief Secretary of Uttar Pradesh, and Dr. Tilak Raj Sharma, Deputy Director General (Crop Science and Horticultural Science), ICAR, New Delhi. The program began with the inauguration of High-Tech Vegetable Nursery and tree plantation on the institute's campus. In his welcome address, the Director of the Institute, Dr. Tushar Kanti Behera, highlighted the institute's achievements and detailed action plan to doubling farmers' income through vegetable production. In his presidential address, Chief Guest Dr. Pramod Kumar Mishra praised the research work of the Indian Institute of Vegetable Research, noting its significant role in India's vegetable production landscape. He emphasized that farmers can increase their income by diversifying into vegetable cultivation and expressed hope that the high-tech vegetable nursery would provide accessible planting material to benefit thousands of farmers in Uttar Pradesh. He underscored the need to make vegetable farming employment-oriented and called for research on critical topics such as climate change, artificial intelligence, higher product value, and processing. Dr. Devesh Chaturvedi, in his address, highlighted Uttar Pradesh's leading position in vegetable production and noted that farmers in Purvanchal are now earning higher incomes by exporting vegetables abroad. Dr. Tilak Raj Sharma stated that India is setting new benchmarks in vegetable production daily, with ICAR playing a pivotal role. During the event, various publications of the institute were released. Awards were presented to Dr. Pradeep Karmakar in the scientific category, Sudhir Kumar in the technical category, and Dr. Manoj Kumar Pandey from Krishi Vigyan Kendra for their outstanding work over the year. Additionally, awards were distributed to school students. The event was attended by PMO officials, Varanasi Divisional Commissioner Shri Kaushal Raj Sharma, District Magistrate Shri S. Rajalingam, Dr. Sanjay Kumar Singh, Director General of UPCAR Lucknow, officers from the state's agriculture and horticulture departments, scientists, technical staffs and administrative staffs, supporting staffs, RA/SRF/YPs, research scholars and a large number of farmers and school students.

INTERNATIONAL YOGA DAY-2023 CELEBRATED AT INDIAN INSTITUTE OF VEGETABLE RESEARCH, VARANASI

The theme of Yoga Day at ICAR-Indian Institute of Vegetable Research, Varanasi (Uttar Pradesh) was "Use of vegetables in balanced quantities in food and half an hour of yoga every day". On this occasion, a yoga training program was conducted under the chairmanship of the Institute's Director Dr. Tushar Kanti Behera with the help of 02 yoga teachers. All the officers, staffs including RA/SRF/YPs and research students of the institute participated enthusiastically in this program. Suryanamaskar, Vrikshasana, Mayurasana, Anulom Vilom, Kapalbhati, Bhastika, Bhramari *etc*. were mainly demonstrated in the training. Everyone was told in detail about the health benefits of yoga. This program was coordinated by Dr. Anant Bahadur, Principal Scientist, Division of Crop Production, ICAR-IIVR, Varanasi.

VISIT OF PARLIAMENTARY STANDING COMMITTEE ON AGRICULTURE, ANIMAL HUSBANDRY AND FOOD PROCESSING TO INDIAN INSTITUTE OF VEGETABLE RESEARCH, VARANASI

The Parliamentary Standing Committee on Agriculture, Animal Husbandry and Food Processing of the Government of India visited the ICAR-Indian Institute of Vegetable Research, Varanasi on 24 June 2023. The visiting team was led by the Chairman of the Committee, Hon'ble Lok Sabha MP Shri PC Gaddigoudar. A total of 13 MPs of Lok Sabha and Rajya Sabha were in this team, namely A. Ganesh Murthy, Hon'ble MP, Lok Sabha, Kanakamal Katara Hon'ble MP, Lok Sabha, Devji Mansinghram Patel, Hon'ble MP, Lok Sabha, Sharda Anil Kumar Patel, Hon'ble MP, Lok Sabha, Bhimrao Baswantrao Patil, Hon'ble MP, Lok Sabha, Vinayak Bhaurao Raut, Hon'ble MP, Lok Sabha, Pocha Brahmananda Reddy, Hon'ble MP, Lok Sabha, Virendra Singh, Hon'ble MP, Lok Sabha, Ramilaben Becharbhai Bara, Hon'ble MP, Rajya Sabha, Mastan Rao Beeda, Hon'ble MP, Rajya Sabha, Anil Sukhdevrao Bonde, Hon'ble MP, Rajya Sabha, S. Kalyanasundaram, Hon'ble MP, Rajya Sabha, Ram Nath Thakur, Hon'ble MP, Rajya Sabha. This committee reviews and monitors the work of the departments related to agriculture, animal husbandry, and food processing and submits their suggestions to the Government of India. The program began with a welcome address by the Director of the Institute, Dr. Tushar Kanti Behera, who gave a brief introduction to the institute and highlighted its research achievements. The Chairman of the Committee, Mr. P.C. Gaddigoudar, praised the farmer-friendly research activities at the Indian Institute of Vegetable Research and appreciated the steps taken in the interest of farmer welfare. Considering the importance of vegetables in the country, he advised the scientists to disseminate the Institute's work to every corner of the country, so that, the benefits of research can reach farmers' field as quickly and effectively as possible. During the meeting, other committee members also provided important suggestions on issues related to vegetable research and extension. The committee members visited and observed the research fields, various laboratories, seed processing unit, bio-control laboratory, mushroom unit, honey processing unit, and other facilities at the institute. Additionally, all members planted saplings in the institute campus. Dr. Sudhakar Pandey, Assistant Director General of the Indian Council of Agricultural Research, New Delhi, and Dr. Prabhat Kumar, Horticulture Commissioner, Government of India, also participated in the program and shared their suggestions.

AWARDS, HONOURS, RECOGNITIONS AND PATENTS

Awards

- Best Extension Professional Award was conferred on Dr. Shubhadeep Roy by Society of Extension Education (SEE), Agra, 2023.
- Best Oral and Poster Presentation Award conferred on Dr. Swati Sharma on 9th Nov., 2023 by Indian Academy of Horticultural Sciences during 10th Indian Horticultural Conference held at Guwahati.
- Best Oral Presentation Award conferred on Dr. Shubhadeep Roy on 30th Jan., 2023 in International Extension Education Conference held at Varanasi.
- Best Paper award (2023) conferred on Dr. A.N. Tripathi for paper presentation on "*Vedic sahitya me sabjiyon ka aitihasik, aushadhiya evam adhyatmic paridrishya*" in National Symposium on Various Dimensions of Vedic Science during 01-02nd March, 2023 at Vedic Vigyan Kendra, BHU, Varanasi, India.
- Dr. D.R. Bhardwaj received Out Standing Achievement Award in the Field of Vegetable Science during International Conference on Protected Cultivation of Horticultural Crops, Post-Harvest Handling and Digital Agriculture organized by Department of Horticulture, NAI, SHUATS, Prayagraj from 29-30 November, 2023.
- Dr. B.R. Barwale award for excellence in PGR-2023 was conferred on Dr. T.K. Behera by Indian Society of Plant Genetic Resources, New Delhi.
- Dr. R.S. Paroda award 2023 was conferred on Dr. T.K. Behera by Confederation of Horticulture Association of India.
- Dr. N. Rai *et al.*, received Dr. Harbhajan Singh Memorial Award-2022 for best research paper entitled "Embryo rescue of interspecific hybrid *solanum lycopersicum* x *S. neorickii*".
- Dr. N. Rai received Dr. Kirti Singh Memorial Award-2023 by Society for Horticultural Research & Development, Ghaziabad.
- "Young Agricultural Scientist Award" conferred on Dr. Manjunatha Gowda Thondihalu by Dr. Vasanthraj David Foundation, Chennai on 30th September, 2023.

Honours & Recognitions

- Dr. Anant Bahadur was nominated as a member of Institute Management Committee (IMC) of ICAR-CPRI, Shimla for 3 years w.e.f. 02-03-2023.
- Dr. Anant Bahadur was nominated as member of Central Compliance Committee(CCC) team by CPRI, Shimla for the monitoring of Biosafety Research Level 1 (BRL-1) trial of GE potato clonal hybrid KJ66 expressing RB gene for the year23-24.
- Dr. Anant Bahadur and Dr. Swati Sharma acted as Member of Judging Committee for Flower, Foliage, Bonsai and Vegetable entries in Mahamana Pandit Madan Mohan Malaviya Memorial Flower Show held at Malaviya Bhavan, BHU, Varanasi on 25 December, 2023.
- Dr. Anant Bahadur and Dr. Swati Sharma served as Member of Judging Committee for Flower, Foliage, Bonsai and Vegetable entries in Company Bagh Pushp Pradarshani held in February, 2023.
- Dr. Anant Bahadur got the technology registered with ICAR entitled "Brimato", Technology No. ICAR-HS-IIVR-Technology- 2023-048.
- Sh. Anurag Chaurasia served as Editor of the journal "Biology and Fertility of Soils" Springer Nature and the journal "Transgenic Research" Springer Nature.
- Dr. Hare Krishna was nominated as the Editor of the Indian Journal of Horticulture.
- Dr. N. Rai became Fellow of Progressive Horticulture Indian Society of Horticulture Research and Development, Uttarakhnad.
- Dr. Shubhadeep Roy became Fellow of Indian Society of Extension Education (ISEE), New Delhi, 2023.
- Dr. Shubhadeep Roy got the technology registered with ICAR entitled "Seed based technology delivery model through Farmers Producer Organization", Technology No. ICAR-HS-IIVR- Technology-2023-050".
- Dr. Swati Sharma got the technology registered with ICAR entitled "Extension of shelf life of eggplant and capsicum by chitosan coating", Technology No. ICAR-HS-IIVR-Technology-2023-049.
- Dr. Swati Sharma received appreciation certificate for delivering lecture in 21 days workshop conducted by National Agriculture Development Cooperative Ltd. (NADCL).
- Dr. Swati Sharma served as Editorial Board Member for journal Trends in Horticulture, United States in 2023.
- Dr. T.K. Behera served as the Editor of the journals 'Current Science' and 'Agric. Research' (Springer).
- Dr. T.K. Behera was Guest of Honour in XXX Annual Zonal Workshop of U.P. KVKs at IAS, BHU on 30 June 2023 & at NCSC-UP 2023 at Vidya Sanskar Public School, Mirzapur on 01 December 2023.
- Dr. T.K. Behera was 'External Expert in Horticulture' in research programme finalization committee at CAU, Passighat on 16-17 June 2023.

HUMAN RESOURCE DEVELOPMENT

Training and Capacity Building

Training

Name of IIVR Scientists/KVKs SMS	Title of training	Duration	Held at
AN Tripathi	Hands on training on High End Scientific equipment	07-13 February, 2023	SATHI, BHU, Varanasi
Anant Bahadur	Remote Pilot Course	18-20 October, 2023	AMTRON Drone School – EduRade, Tech City, Guwahati
Gangaraj R	112th Foundation Course for Agricultural Research Service (FOCARS)	11 April, 2023 to 10 July, 2023	ICAR-NAARM, Hyderabad
	Institute Orientation training	24 July, 2023 to 23 August, 2023	ICAR-IIVR, Varanasi
	Professional Attachment Training (PAT)	25 August, 2023 to 24 November, 2023	ICAR-CCARI, Goa
Govind Pal	Remote Pilot Course	18-20 October, 2023	AMTRON Drone School – EduRade, Tech City, Guwahati
Hare Krishna	Irrigation and Fertigation Technologies for Sustainable Crop Production	05-22 June, 2023	Israel
Ramesh KB	Institute Orientation training	11 April, 2023 to 10 May, 2023	ICAR-IIVR, Varanasi
	113th Foundation Course for Agricultural Research Service (FOCARS)	18 July, 2023 to 17 October, 2023	ICAR-NAARM, Hyderabad
	Professional Attachment Training (PAT)	20 November, 2023 to 19 February, 2024	ICAR-IIHR, Bengaluru
SG Karkute	Development, Evaluation and Biosafety assessment of Genome Edited Crops: Hands-on Training	20 January, 2023 to 09 February, 2023	ICAR-IIRR, Hyderabad
Shreya Panwar	Orientation Training	24 July, 2023 to 23 August, 2023	ICAR-IIVR, Varanasi
	Professional Attachment Training	25 August, 2023 to 24 November, 2023	CSIR-CFTRI, Mysore
Swati Sharma	R Statistical	1-3 March, 2023 &6-8 March, 2023	ICAR- NAARM, Hyderabad (online)
Yerasu Suresh Reddy	Study visit, consultation meeting and training on DUS testing on tomato in Greenhouses	25-29 September, 2023	Naktuinbouw, the Netherlands.

Important Institute's Meetings/Programmes Organized

Title	Date
Techno-Commercial Assessment and Expert Committee Meeting at ICAR-IIVR, Varanasi	17 May2023
13th Institute Technology Management Committee (ITMC) Meeting at IIVR, Varanasi	29 August, 2023
Research Advisory Committee (RAC) meeting of ICAR-IIVR, Varanasi	4-6 September, 2023
ICAR-IIVR, Varanasi 33rd Foundation day	28 September, 2023

Training and Skill Development of Students, Farmers and Field Functionaries conducted

Sl. No.	Name of training programme	Date	Sponsored by	No. & Nature of participants
1.	Improved Vegetable Cultivation	03-05 January, 2023	ATMA, Arariya ,Bihar	25 Farmers
2.	Vegetable Seed Production and Organic Farming	09-11 January, 2023	ATMA, Purnea, Bihar	42 Farmers
3.	Improved Vegetable Production	06-10 February, 2023	ATMA, Saharsa, Bihar	25 Farmers
4.	Onion Farming and Scientific Vegetable Production Technologies	09-12 January, 2023	NHRDF, Deoria	30 Farmers
5.	Improved Vegetable Production Technologies	01-03 March, 2023	Adarsh Yuva Samiti Hardwar	26 Farmers
6.	Exposure Visit on Improved Vegetable Production Technologies	01-02 February, 2023	ATMA, Balia, UP	40 Farmers
7.	Best Practices and Post-Harvest Processing on Non-Paddy Crops (Vegetables)	09-12 April, 2023	CDAO, Jajpur, Odisha	27 Farmers
8.	Refresher Training Programme (RTP) on "Business Opportunities In Vegetable Crops"	01-03 August, 2023	MANAGE, Hyderabad	44 Farmers
9.	Scientific Vegetable Production Technologies	21-25 August, 2023	ATMA, Seohar, Bihar	40 Farmers
10.	Improved Vegetable Production Technologies	28-30 August, 2023	ATMA, Buxar, Bihar	20 Farmers
11.	Improved Vegetable Production Technologies	04-07 September, 2023	ATMA, Sheikhpura, Bihar	15 Farmers
12.	Commercial Vegetable Cultivation	11-13 September, 2023	ATMA, Rohtas, Bihar	40 Farmers
13.	Organic Vegetable Production	06-10 November, 2023	ATMA, Patna, Bihar	46 Farmers
14.	Improved Vegetable Production Technologies	25-27 September, 2023	ATMA, Aurangabad, Bihar	31 Farmers
15.	High-tech Horticulture/Protected Cultivation	11-15 December, 2023	ATMA, Lohardaga, Jharkhand	25 Farmers
16.	Exposure Visit cum Training on "Improved Vegetable Production Technologies"	07-09 August, 2023	Jharkhand	25 Farmers
17.	One Month Institute Attachment Programme under Rural Horticultural Work Experience (RHWE) Programme for 4th year B.Sc. (Hort.) Students, College of Horticulture, CAU (I), Thenzawl, Mizoram	18 September, 2023 to 17 October, 2023	College of Horticulture, CAU (I), Thenzawl, Mizoram	18 Students
18.	Four Weeks Industrial Training for B.Sc. (Hons) Horticulture students, College of Horticulture (Central Agricultural University), Bermiok, Sikkim	23 January, 2023 to 22 February, 2023	College of Horticulture (Central Agricultural University), Bermiok, Sikkim	18 Students
19.	One Month Institute Attachment Programme "Rural Entrepreneurship Awareness Development Yojana (READY)" for B.Sc. (Hort.) Students	30 November , 2023 to 29 December, 2023	College of Horticulture, CAU, Bermiok, South Sikkim	12 Students
20.	Three weeks Industrial Attachment Programme under Rural Agricultural Work Experience (RAWE) for B.Sc. (Hons.) Ag. Students	4-24 December, 2023	Narayan Institute of Agricultural Sciences, Gopal Narayan Singh Univ., Sasaram, Bihar	20 Students
21.	Exposure Training for B.Sc. (Ag.) Students	24 May, 2023	RPCAU, Samastipur, Bihar	90 Students
22.	Value Addition of Tomato	13-15 February, 2023	ICAR-IIVR	30 Women
23.	Kisan Gosthi	23 February, 2023	SCSP, ICAR-IIVR	50 Farmers
24.	"Processing of Vegetables for Self-Employment and Increasing Profit" in Webinar on "Recent Advances in Agricultural Engineering & Technology for Doubling Farmers Income"	11 September, 2023	Banaras Hindu University, Varanasi & National Agriculture Development Cooperative Ltd. (NADCL) (online)	30 Farmers

25.	"Livelihood Opportunities in Horticulture for Women, Value Addition and Export in webinar on "Livelihood Opportunities in Horticulture: Promoting Women"	20 October, 2023	MANAGE (online)	40 Entrepreneurs
26.	Khadya prasanskaran udyog ki sambhavnayen evam khadya padartha nirman during Mahatma Gandhi Khadya Prasanskaran training	06 January, 2023	Rajkiya Fal Sanrakshan evam Prashikshan Kendra, BHU, Varanasi	20 Women
27.	One Month Institute attachment training programme under Rural Horticultural Work Experience (RHWE) for students of College of Horticulture, CAU (I), Thenzawl, Mizoram.	18 September, 2023 to 17 October, 2 023	ICAR	14 Students
28.	One Month Institute attachment training programme under Rural Entrepreneurship Awareness Development Yojana (READY) for students of College of Horticulture, CAU, Bermiok, South Sikkim	30 November, 2023 to 29 December, 2023	ICAR	12
29.	Orientation training of Scientist in Crop Protection Division, IIVR Varanasi	11-18 April, 023	-	01 Scientist

Training and Skill Development of ICAR/SAUs/State/KVKs Officials conducted:

Name of the Programme	Date	Sponsored by	No.& Nature of Participants
Certified Farm Advisor(CFA)module-II training on "Advanced vegetable production technology for livelihood and nutritional security	13-27 Feb., 2023	MANAGE, Hyderabad	17Officials
Refresher Training on Business opportunities in vegetable crops (online)	01-03 Aug.,2 023	AC&ABC Scheme, MANAGE, Hyderabad and ICAR-IIVR, Varanasi	20 Established Agripreneures
Principles and Production Techniques of Hybrid Seeds in Vegetables	16-30 Jan., 2023	ICAR	20 Technical Officers

Seminar/symposium/conference/workshop attended

Name of Scientist	Title of seminar / symposium / conference / workshop	Duration	Held at
Y Suresh Reddy	International conference on Exploring new hrizons in biotechology (ENB-2023) and Mini-symposium on Recent advances in biotechnological innovations (RABI-2023)	10-12 February, 2023	School of biotechnology, Institute of Sciences, BHU, Varanasi
	National Conference on tomato problems, perspectives, and plant breeding solutions organized from 3-4, Nov.2023 in Bengaluru	3-4 November, 2023	Univ. of Horti. Sciences (UHS) Bagalkot, Karnataka and the Foundation for Advanced Training in Plant Breeding
Jagesh Kumar Tiwari	International Conference on Ecological Perspective of Agricultural& Biological Sciences	20-22 May, 2023	KNI, Sultanpur, UP
	International workshop (Hybrid Mode) on E-Processing and Management of DUS Testing Data in Plant Variety Examination-Using the Example of Rapeseeds/Mustard by PPVFRA, New Delhi	25-26 May, 2023	ICAR-NBPGR, New Delhi
Tribhuvan Chaubey	International Conference on Protected Cultivation of Horticultural Crops, Post-Harvest Handling and Digital Agriculture	29-30 November, 2023	NAI, SHUATS, Prayagraj
TK Behera	85th Scientific Advisory Committee Meeting of NHRDF.	19 May, 2023	NHRDF, New Delhi
	World Veg 50th Anniversary Celebrations	17 August, 2023	ICRISAT Campus, Hyderabad
	Participated and shared insights in National Dialogue for Shaping the future of Indian Horticulture	25-26 August, 2023	NASC Complex, New Delhi
	First Global Symposium on Farmers' Rights	12-15 September, 2023	NASC Complex, New Delhi
	Lead lecture in 12th National Seed Congress-2023	11-13 December, 2023	Aurangabad
	Panel discussion of International Conf. on Frontiers in Tobacco and Commercial Agric. Towards Preparedness for Future Farming	14-16 December, 2023	ICAR-CTRI, Rajahmundry

Anant Bahadur	First Technical Advisory Committee(TAC) meeting	10-11 January, 2023	ICAR-Central Inland Fisheries Research Institute, Barrackpore, Kolkata
	International Conference on Ecological Prospective of Agriculture and Biological Sciences (EPABS-2023)	21st May, 2023	KNIPSS, Sultanpur
	International Conference on Natural Resource Management & Sustainability	26-30 November, 2023	Udayana University, Bali, Indonesia
Anant Bahadur, Achuit Kr. Singh, Jagesh Kr. Tiwari and Swati Sharma	10th Indian Horticultural Congress ,Guwahati on "Unleashing Horticultural Potential for Self- Reliant India"	6-9 November, 2023	AAU, Guwahati
Shubhadeep Roy	ISEE National Seminar on Evolving extension science towards secondary agriculture for sustainable development, UAS, Bengalore,22- 24 June 2023	22-24 June, 2023	Indian Society of Extension Education (ISEE), New Delhi
Shubhadeep Roy and Swati Sharma	International Extension Education Conference (IEEC BHU- 2023) on Innovative applications in agricultural extension for sustainable food and environmental security, Dept. of Extension Education, IAS, BHU, Varanasi	27-30 January, 2023	Dept. of Agricultural Extension and Communication, IAS, BHU, Varanasi
Swati Sharma	Future of Indian Agriculture: Challenges and opportunities	24 May, 2023	MPUAT, Udaipur(online)
TK Behera, Rajesh Kumar, Neeraj Singh, DR Bhardwaj, PM Singh, N. Rai, Kuldeep Srivastava, K. Nagendran, M. Gowda T and Swati Sharma	41st AICRP(VC) annual group meeting	3-5 June, 2023	SKUAS&T, Srinagar, J&K
Rajeev Kumar	National Conference "Physiological and Molecular Approaches for Climate Smart Agriculture".	9-11 December, 2023	ICAR-IARI, New Delhi
K. Nagendran	National conference on "Advancements in Global Virus Research Towards One Health (VIROCON-2023)"	01-03December,2023	NRCB. Trichy, Tamil Nadu
Jaydeep	15th IUPAC International Congress of crop Protection Chemistry: Futuristic Approaches towards seed to market strategies"	14-17 March, 2023	National Agricultural Science Complex (NASC), New Delhi.
A.N. Tripathi	Hands on training on High End Scientific equipment	07-13 February, 2023	SATHI, BHU, Varanasi
Gangaraj R	XXII Biennial National Symposium on "Climate Smart Agronomy for Resilient Production Systems and Livelihood Security" at ICAR-Central Coastal Agricultural Research Institute, Goa	22–24 November, 2023	Indian Society of Agronomy, IARI, New Delhi
A.N. Tripathi	International Conference on Communication and dissemination of Traditional Knowledge (CDTK-2023) and Workshop on Role of Taxonomical Identification and Authentication of Plants and Crude Drugs in Traditional Medicine and Research	14-15 February, 2023	CSIR-NIScPR, New Delhi
	Agriculture Science Congress on Transformation of Agri Food Systems for Achieving Sustainable Development Goals	10-13 October, 2023	Kochi, Kerala
	National Symposium on Plant Pathology: Sustainable Approaches for Food Security and Human Health	08-09 December, 2023	BHU, Varanasi
	National Childrens Science Congress, UP (East)	01-03 December, 2023	Vidya Sanskar Public School, Mirzapur

PUBLICATIONS

Research Papers

1. Akansha, Tiwari JK, Karkute SG, Tiwari SK, Singh M (2023). Brinjal: breeding and genomics. *Vegetable Science* (Special Issue), 50: 166-176. [NAAS- 5.54]

2. Bahadur A, Kumar R, Krishna H and Behera TK (2023). Abiotic stress in vegetable crops: challenges and strategies. *Journal of Biotechnology and Bioresearch*, 5(1): 640-648. [NAAS- 6.69]

3. Behera TK, Devi J, Tiwari JK, Singh BK (2023). Vegetable breeding: status and strategies. *Vegetable Science* (Special Issue), 50: 131-145. [NAAS- 5.54]

4. Devi J, Dubey RK and Sanwal SK (2023). Kashi Tripti: A newly developed high-yielding mid-season edible-podded variety of vegetable pea. *Vegetable Science,* 50(2): 392-394. [NAAS- 5.54]

5. Devi J, Dubey RK, Sagar V, Verma RK, Singh PM and Behera TK (2023). Vegetable peas (*Pisum sativum* L.) diversity: an analysis of available elite germplasm resources with relevance to crop improvement. *Spanish Journal of Agricultural Research* 21 (2) e0701. [NAAS- 6.90]

6. Devi J, Dubey RK, Sanwal SK, Tripathi AN and Chandra S (2023). Kashi Purvi: A newly developed high-yielding early variety of vegetable pea (*Pisum sativum* var. hortense L.) *Vegetable Science,* 50(1): 118-120. [NAAS- 5.54].

7. Devi J, Sagar V, Mishra GP, Jha PK, Gupta N, Dubey RK, Singh PM, Behera TK, Prasad PVV (2023). Heat stress tolerance in peas (*Pisum sativum* L.): current status and way forward. *Frontiers in Plant Science* 13:1108276. [NAAS- 11.6]

8. Divekar PA, Majumder S, Halder J, Kedar SC and Singh V (2023). Sustainable pest management in cabbage using botanicals: Characterization, Effectiveness and Economic Appraisal. *Journal of Plant Diseases and Protection*. https://doi.org/10.1007/s41348-023-00812-x. [NAAS- 7.85]

9. Divekar PA, Mishra AS, Karkute S, Tiwari SK (2023). Screening of brinjal genotypes for resistance against shoot and fruit borer, *Leucinodes orbonalis* Guenee (Lepidoptera: Pyralidae). *The Pharma Innovation Journal.* 12(8): 2801-2804. [NAAS- 5.23]

10. Divekar PA, Rani V, Majumder S, Karkute SG, Molla KA, Pandey KK, Behera TK and Govindharaj GPP (2023). Protease inhibitors: an induced plant defense mechanism against herbivores. *Journal of Plant Growth Regulation*, *42*(10), pp: 6057-6073. [NAAS- 10.80]

11. Divekar PA, Singh K, Verma CK, Rai AB, Singh B, Yadav S and Karkute SG (2023). Assessment of bee flora and development of a floral calendar in relation to pharmaceutical potential of honey and bee pollen in Eastern Uttar Pradesh, India. *Annals of Phytomedicine,* 12: 1-844-855. [NAAS- 8.70]

12. Divekar PA, Singh K, Yadav S, Manimurugan C,Patel SK, Karkute SG, Majumdar S and Singh V (2023). Diversity and foraging behaviour of insect pollinators in Cauliflower. *Ecology, Environment & Conservation,* 29(2):964-971. [NAAS- 5.41]

13. Divekar Pratap A, Patel Sampat Kumar, Manimurugan C, Kushwaha Motilal and Singh Vikas (2023). Bio-efficacy of newer insecticides cyantraniliprole and flonicamid for the management of mustard aphid *Lipaphis erysimi* (Kaltenbach) in cabbage. *The Pharma Innovation Journal*, 12(8): 2805-2809. [NAAS- 5.23]

14. Divekar Pratap A, Patel Sampat Kumar, Manimurugan C, Singh Vikas (2023). Insect pollinator diversity and their foraging behaviour in Radish, *Raphanus sativus* L. *Emergent Life Sciences Research,* 9(2): 68-76. [NAAS- 5.41]

15. Gowda MT, Prasanna R, Kundu A, Rana VS and Chawla G (2023). Characterization and evaluation of native rhizobacteria isolated from *Meloidogyne incognita*-infected tomato (*Solanum lycopersicum*). *Indian Journal of Agricultural Sciences*, 93(2): 175–180. [NAAS- 6.37].

16. Gowda MT, Prasanna R, Kundu A, Rana VS, Rao U and Chawla G (2023). Differential effects of rhizobacteria from uninfected and infected tomato on *Meloidogyne incognita* under protected cultivation. *Journal of Basic Microbiology*, 63 (6): 604-621. [NAAS- 8.65]

17. Gowda MT, Prasanna R, Rao U, Somvanshi VS, Singh PK, Singh AK and Chawla G (2023). Microbiome transplant can effectively manage root-knot nematode infectivity in tomato. *Applied Soil Ecology*, 190: 105020. [NAAS- 11.51]

18. Gupta N, Kumar R, Singh PM, Chaubey T, Karkute SG, Rai N, Behera TK (2023). Physiological effect of fruit load management and post-harvest ripening on seed yield and quality in summer squash (*Cucurbita pepo* L.). *Vegetable Science,* 50(2): 1-7 [NAAS- 5.54]

19. Gupta N, Singh PM, Kumar R, Chaubey T, Singh V (2023). Physiological basis of post-harvest ripening and standardization of seed extraction in ash

gourd. *Indian Journal of Horticulture,* 80(2): 153-158 [NAAS- 5.58]

20. Halder J, Majumder S and Adak T (2023). Bioefficacy against Major Sucking Pest Complex and Residue Dynamics of Fipronil in Green Chilli (*Capsicum annum* Linn.). *Pesticide Research Journal*, 35(2):214-221. [NAAS: 5.49]

21. Halder J, Majumder S, and Pandey KK (2023). Whether the addition of neem oil increases the bioefficacy of entomopathogenic fungi against sucking pests? A case study from eggplant ecosystem. *Munis Entomology & Zoology*, 18(1):409-417. [NAAS - NA]

22. Halder J, Srivastava K and Rai AB (2023). Irrigation, a potential tool for insect pest management in horticultural crops — a review. *Current Horticulture*, 11(1):3-7. [NAAS: 4.53].

23. Kalia P, Singh BK, Bhuvaneswari S, Patel V, Selvakumar R (2023). Carrot: Breeding and genomics. *Vegetable Science* (Special Issue), 50: 221-230 [NAAS- 5.54]

24. Karkute SG, Singh AK, Divekar PA, Gupta N, & Tiwari SK (2023). Identification and in-silico characterization of RPN10 gene as a candidate for genome editing to develop little leaf disease resistance in brinjal. *Vegetable Science* 50(2): 282-287. [NAAS- 5.54]

25. Karkute SG, Tribhuvan KU, Yadav S (2023). Nutrition rich fruits and vegetables: status and opportunities in the era of genome editing. *Journal of Allbiosolution* 5 (1):1-8. [NAAS - NA]

26. Kumar R, Paul V, Pandey R, Sahoo RN and Gupta VK (2023). Reflectance-based non-destructive assessment of total carotenoids in tomato fruits. *Plant Physiology Reports*, 28: 152-160. [NAAS- 7.7]

27. Kumar RV, Yadav BK, Bhatt BS, Krishna R, Krishnan N, Karkute SG, Kumar S, Singh B, Singh AK (2023). Diverse begomovirus-betasatellite complexes cause tomato leaf curl disease in the western India. *Virus Research,* 328:199079. [NAAS-11]

28. Majumder S, Pandey J, Bhadwaj DR, Pandey KK and Behera TK (2023). Effectiveness of common household methods for removal of deltamethrin from vegetables. *Vegetable Science*, 50(2), 383-388. [NAAS- 5.54]

29. Majumder S, Pandey J, Divekar PA, Ali EO, Pandey KK, and Behera TK (2023). Dissipation kinetics, food safety evaluation and decontamination of chlorantraniliprole in cowpea. *Journal of Environmental Science and Health, Part B*, 1-10. [NAAS- 8.0]

30. Majumder S, Rani AT, Divekar PA, Halder J, Pandey KK and T K Behera (2023). Field bioefficacy and residue dynamics of Chlorantraniliprole (18.50% SC) in okra (*Abelmoschus esculentus*). *Indian Journal of Agricultural Sciences*, 93 (3): 314–317. [NAAS- 6.40]

31. Majumder S, Reddy BR, Pandey J, Paul A, Kumar A and Banerjee K (2024). Pesticide Residue and Bio-pesticides in Vegetable Crops. *Vegetable Science*, 51: 77-96. [NAAS- 5.54]

32. Nagendran K, Kumari S, Chaubey T, Kumar RV, Chinnappa M, Dubey V, Pandey KK, Singh J and Singh AK (2023). Study on mosaic disease of sponge gourd (*Luffa cylindrica* L.) caused by tomato leaf curl New Delhi virus. *Journal of Plant Pathology*, 105(2): 573-580. [NAAS- 8.2]

33. Nagendran K, Kumari S, Pandey S, Karmakar P, Chaubey T, Kumar R, Vignesh S, Karthikeyan G and Behera TK (2023). Emergence of yellowing disease in cucurbitaceous vegetables caused by Crinivirus and Polerovirus in India. *Virology*, 587: 109876. [NAAS- 9.7]

34. Pal G, Roy S, Singh N, Singh PM, Yerasu SR, Yadava RB and Behera TK (2023). A study on economic impact assessment of tomato var. Kashi Aman using the economic surplus model. *Vegetable Science,* 50(1): 46-51 [NAAS- 5.54]

35. Prasanna HC, Rai N, Hussain Z, Yerasu SR, Tiwari JK (2023). Tomato: Breeding and Genomics. *Vegetable Science* (Special Issue), 50:146-155. [NAAS- 5.54]

36. Rai AB and Halder J (2023). Insect pests of underutilized vegetable and their management: An appraisal. *Current Horticulture*, 13(3):9-22. [NAAS: 4.53]

37. Ramesh KB, Zanwar PR, Kelageri SS and Tukaram NA (2023). Management of tomato leaf miner *Tuta absoluta* (Meyrick) under protected cultivation. *Journal of Entomological Research*, 47(3): 517-522 [NAAS- 5.63]

38. Ramesh KB, Zanwar PR, Tukaram NA and Kelageri SS (2023). Survey and seasonal incidence studies for new invasive tomato leafminer *Tuta absoluta* (Meyrick). *Journal of Entomological Research*, 47(2): 393-398. [NAAS- 5.63]

39. Reddy MK, Kumar R, Ponnam N, Prasad I, Barik SP, Pydi R, Timmarao S, Narigapalli P, Shaik M and Pasupula K (2023). Chili: breeding and genomics. *Vegetable Science*, 50 (Spl.): 177-188. [NAAS- 5.54]

40. Sangeeta, Kumar RV, Yadav BK, Bhatt BS, Krishna R, Krishnan N, Karkute SG, Kumar S, Singh B, Singh AK (2023). Diverse begomovirus-betasatellite complexes cause tomato leaf curl disease in the western India. *Virus Research*, 328: 1729-1764. [NAAS- 12.29]

41. Sharma A, Devi J, Srishti, Dubey R K, Prashar A, Singh V, Sharma A (2023). Advances in pea breeding and genomics: from traditional techniques to modern approaches. *Vegetable Science,* 50(1): 1-10. [NAAS- 5.54]

42. Sharma S, Singh BK, Singh SK, Kole B and Behera TK (2023). Preliminary studies on colour and sensory profiling of selected carrot genotype. *National Academy Science Letters*, DOI: 10.1007/s40009-023-01332-w. [NAAS-7.10].

43. Sharma S, Singh BK, Singh SK, Koley B, Behera TK (2023). Preliminary studies on colour and sensory profiling of selected carrot genotype. *National Academy of Science Letters-India* doi.org/10.1007/s40009-023-01332-w. [NAAS – 6.65]

44. Sharma S, Sinha R, Singh AK, Meena Y, Pongener A, Sharma R, Behera TK and Barman K (2023). An umbrella review on ethnomedicinal, pharmacological and phytochemical profile of pointed gourd (*Trichosanthes dioica* Roxb.): A bioactive healthy vegetable of Indian subcontinent. *Food Chemistry Advances*, 3: 100433. [NAAS - NA]

45. Singh AK, Kushwaha C, Shikha K, Chand R, Mishra GP, Dikshit HK, Devi J, Aski MS, Kumar S, Gupta S, Nair RM (2023). Rust (*Uromycesviciae-fabae* Pers. de-Bary) of pea (*Pisum sativum* L.): present status and future resistance breeding opportunities. *Genes*, 14: 374. [NAAS- 9.5]

46. Singh B, Chaubey T, Pandey S, Singh R, Upadhyay D, Jha A & Pandey S (2023). Categorization of Diverse and Stable Extant Cultivars of Brinjal by using Pheno-morphometric DUS Characters. *Indian Journal of Plant Genetic Resources,* 36(01): 1-18. [NAAS- 5.17]

47. Singh BK and Karmakar P (2023). VRCAR-252 (INGR22088): Anthocyanin rich petaloid-CMS line of black carrot. *Vegetable Science,* 50(1):129-130. [NAAS- 5.54]

48. Singh BK, Karmakar P and Bhuvaneswari S (2023). VRCAR-214 (INGR22160): A petaloid-CMS line of red coloured tropical carrot. *Vegetable Science,* 50(2): 289-291. [NAAS- 5.54]

49. Singh DP, Bisen MS,Prabha R, Maurya S, Yerasu SR,Shukla R, Tiwari JK, Chaturvedi KK, Farooqi MS, Srivastava S,Rai A, Sarma BK, Rai N, Singh PM, Behera TK, Farag MA (2023). Untargeted Metabolomics of *Alternaria solani*-Challenged Wild Tomato Species *Solanum cheesmaniae* Revealed Key Metabolite Biomarkers and Insight into Altered Metabolic Pathways. *Metabolite*s, 13: 585. [NAAS-10.1]

50. Singh DP, Maurya S, Yerasu SR, Bisen MS, Farag MA, Prabha R, Shukla R, Chaturvedi KK, Farooqi MS, Srivastava S, Rai A, Sarma BK, Rai N and Behera TK (2023). Metabolomics of early blight (*Alternaria solani*) susceptible tomato (*Solanum lycopersicum*) unfolds key biomarker metabolitesand involved metabolic pathways. *Scientific Reports,* 13:21023. [NAAS-10.6].

51. Tiwari **JK**, Rai N, Singh MK, Mishra LK, Mishra G, Behera TK (2023). Characterization of tomato lines for yield components, processing traits and disease resistance based on phenotype and molecular markers. *Vegetable Science,* 50(2): 302-309. [NAAS-5.54]

52. Tiwari JK, Singh AK, Behera TK (2023). CRISPR/Cas genome editing in tomato improvement: Advances and applications. *Frontiers in Plant Science* 14:1121209. [NAAS- 11.60]

53. Yerasu SR, Gowda MT, Krishna R, Prasanna HC, Tiwari JK, Rai N, Behera TK (2023). Development of interspecific hybrids through embryo rescue for heat-stable nematode resistance (*Mi-9* gene) from *Solanum arcanum* in tomato. *Plant Cell, Tissue and Organ Culture,* 154: 703–711. [NAAS- 8.73]

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Book chapters/ Proceeding chapters

1. Bahadur A and Singh B (2023). Abiotic stress in vegetables: Challenges and strategies. *In: Singh NP, Kumar M, Singh NV and Singh Y (Eds.) Climate resilient agriculture for sustainable production,* pp: 13-38 (ISBN: 9789391734633).

2. Devi J, Dubey R K, Sagar V, Verma R K, Singh P M and Singh B (2023). Vegetable Soybean. *In: Dubey R K and Singh J (eds.). Production Technology of Underexploited Vegetable Crops, Kalyani Publishers, Ludhiana,* pp: 355-366. (ISBN: 9789355403414).

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16. Singh B and Singh SK 2023. Organic farming in vegetables: an opportunity for sustainable production and livelihood enhancement. *In: Singh DP, Prakash HG, Swapna M and Solomon S (Eds.) Organic crop production management: focus on India with global implication, CRC, Apple Academic Press,* pp: 243-266 (ISBN: 9781774910580).

17. Tripathi, AN (2023). Emerging and Remerging Diseases and Their Innovative Management in Jute and Allied Fiber Crops under Small Farm. *In: Amitav Rakshit et al (Eds). Innovation in small farm agriculture improving livelihoods and sustianability. CRC press,* pp: 1210-137.

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2. Halder Jaydeep and G. Sivakumar (2023). Ecofriendly management of major insect pests of bitter gourd. In: Abstract Book of International Conference on "Protected cultivation of horticultural crops, post-harvest handling and digital agriculture" held at SHUATS, Prayagraj (Allahabad)-211007, Uttar Pradesh from 29-30 November, 2023, pp: 130.

3. Halder Jaydeep, Majumder Sujan and Adak Totan (2023). Fipronil: Bioefficacy against sucking pest complex and residue dynamics in green chilli (*Capsisum annum* Linn.). *In: Abstract Book of 15th IUPAC International Congress of crop Protection Chemistry: Futuristic Approaches towards seed to market strategies" held at NASC, New Delhi from 14-17 March, 2023,* pp: 249.

4. Kumar R, Karmakar P, Bahadur A, Verma RK, Krishna H and Behera TK (2023). Screening of okra genotypes for moisture deficit stress tolerance. *In: Abstract Book of National Conference on Physiological and Molecular Approaches for Climate Smart Agriculture, December 9-11, 2023,* pp: 157.

5. Kumar R, Paul V, Pandey R and Sahoo RN (2023). Reflectance based non-destructive determination of total carotenoids in tomato (*Solanum lycopersicum*) fruits. *In: Abstract Book of National Conference on Physiological and Molecular Approaches for Climate Smart Agriculture, December 9-11, 2023,* pp: 83.

6. Majumder S, Paul A, Divekar PA, Halder JA, Pandey KK and Behera TK (2023). Persistence and safety evaluation of Chlorantraniliprole in brinjal fruit and soil. *In: Abstract Book of 15th IUPAC International Congress of crop Protection Chemistry: Futuristic Approaches towards seed to market strategies" March 14-17, 2023,* pp: 346.

7. Nagendran K, Kumari Shweta, Karmakar Pradip, Chaubey T, Singh AK and Pandey S (2023). Emergence of Crinivirus and Polerovirus causing yellowing disease on cucurbitaceous vegetables in India. *In: Abstract Book of National conference on "Advancements in global virus research towards one health (VIROCON-2023)" December 1-3, 2023,* pp: 84.

8. Tripathi AN, Singh Vivek, Singh Shvetansh, Pandey KK, Singh AN and Behera TK (2023). Current status of emerging fungal diseases of vegetable crops: An Apprisal. *In: Abstract Book of National Symposium on Plant Pathology: Sustainable Approaches for Food Security and Human Healthn, 8-9, December 2023,* pp: 19.

9. Tripathi AN, Tiwari SK, Singh SK and Behera TK (2023). Detection, identification and chemo-sensitivity of seed borne pathogens in vegetable

crop seeds. *In: Abstract Book of XVI Agricultural Science Congress & ASC Expo' on 10-13 October, 2023,* pp: 288.

10. Tripathi, AN 2023. Traditional knowledge in agri-horti culture and its relevance: Indian perspective. *In: Abstract Book of International Conference on Communication and dissemination of Traditional Knowledge (CDTK-2023), 14-15 February*, pp: 100.

11. Yerasu SR, Manjunath TG, Prasanna HC, Rai N and Behera TK (2023). Development of multiple disease resistant tomato lines through marker assisted selection. *In: Abstract Book of International conference on Exploring new hrizons in biotechology (ENB-2023) and Mini-symposium on Recent advances in biotechnological innovations (RABI-2023), 10–12 February, 2023,* pp: 183.

Radio Talks (AIR): 12

TV Talk: 02

APPOINTMENTS, TRANSFERS, PROMOTION, SUPERANNUATION AND RESIGNATION

Appointment

- Dr. Rajesh Kumar Singh, Principal Scientist joined as Head at ICAR-Central Potato Research Institute, Shimla Regional Station, Modipuram (U.P.) w.e.f. 14.11.2023.
- Dr. G.K. Choudhary, SMS (AS) KVK, Bhadohi, ICAR-IIVR, Varanasi relieved from his duties at this institute on 20.04.2023 to join at Bihar Animal Sciences University, Patna, Bihar.
- Dr. Manoj K. Pandey, SMS (PP) KVK, Bhadohi, ICAR-IIVR, Varanasi relieved from his duties at this institute on 20.10.2023 to join at KVK Churachandpur-ICAR-Research Complex for NEH Region, Umiam, Meghalaya.

Joining

- Dr. J.P. Gupta, Senor Technical Officer joined ICAR-IIVR, Varanasi Regional Research Station, Sargatia, Kushinagar w.e.f. 02.03.2023.
- Dr. Ramesh K.B., Scientist (Agricultural Entomology) joined ICAR-IIVR, Varanasi Regional Research Station, Sargatia, Kushinagar w.e.f. 11.04.2023.
- Dr. N. Rai, Principal Scientist joined as Head, Vegetable Improvement Division, ICAR-IIVR, Varanasi w.e.f. 06.07.2023.
- Dr. Anant Bahadur, Principal Scientist joined as Head, Vegetable Production Division, ICAR-IIVR, Varanasi w.e.f. 06.07.2023.
- Dr. A. N. Singh joined as Principal Scientist& Head, Vegetable Protection Division, ICAR-IIVR, Varanasi w.e.f. 07.07.2023.
- Mr. Gangaraj R., Scientist (Plant Pathology) joined ICAR-IIVR, Varanasi, Regional Research Station, Sargatia, Kushinagar w.e.f. 21.07.2023.
- Ms. Shreya Panwar, Scientist (Food Technology) joined ICAR-IIVR, Varanasi w.e.f. 21.07.2023.
- Dr. Dharam Vir Singh joined as Senior Scientist cum Programme Coordinator K.V.K., Sargatia, Kushinagar of ICAR-IIVR, Varanasi on26.09.2023.
- Dr. Mandhata Singh joined as Senior Scientist cum Programme Coordinator, K.V.K., Deoria, of ICAR- IIVR, Varanasi w.e.f. 27.09.2023.
- Dr. Rajesh Kumar, Principal Scientist joined as Project Coordinator, AICRP (Vegetable Crops), ICAR-IIVR, Varanasi w.e.f. 11.11.2023.

Transfer

- Dr. Vijaya Rani, Scientist (Agril. Microbiology) transferred from ICAR-IIVR, Varanasi and relieved from her duties at this Institute on 08.12.2023 to join at ICAR-IARI, New Delhi.
- Dr. B. Rajashekhar Reddy, Scientist transferred from ICAR-IIVR, Varanasi and relieved from his duties at this Institute on 13.12.2023 to join at ICAR-CTRI, Rajahmundry.
- Dr. Nagendran Krishnan, Scientist (Plant Pathology) transferred from ICAR-IIVR, Varanasi and relieved from his duties at this Institute on 22.12.2023 to join at ICAR-NRC for Banana, Tiruchirapalli.

Supperannuation

- Sh. Ram Ji Giri, Administrative Officer, ICAR-IIVR, Varanasi superannuated from service on 31.07.2023.
- Dr. S.N.S. Chaurasia, Principal Scientist, ICAR-IIVR, Varanasi superannuated from service on 31.08.2023.

Promotion

- Shri Rajendra Kumar promoted from Rs9300-34800 + 4200 to Rs. 9300-34800 + 4600 w.e.f. from 29.06.2021 as Technical Officer (T-5), ICAR-IIVR, Varanasi vide office order dated 22.02.2023.
- Shri Manoj Kumar promoted from Rs9300-34800+ 4200 to Rs. 9300-34800 +4600 w.e.f. from 27.07.2021 As Technical Officer (T-5), ICAR-IIVR, Varanasi vide office order dated 22.02.2023.
- Shri Ram Ashray promoted from Rs9300-34800+ 4200/- to Rs. 9300-34800 +4600/- w.e.f. from 03.08.2021 as Technical Officer (T-5), ICAR-IIVR, Varanasi vide office order dated 22.02.2023.
- Shri Bharat Singh promoted from Rs 5200-20200 + 2400 to Rs. 5200-20200+2800 w.e.f. from 14.02.2021 As Technical Assistant (T-3) Driver, ICAR-IIVR, Varanasi vide office order dated 22.02.2023.
- Shri Sharad Chand Rai promoted from Rs 5200-20200 + 2400 to Rs. 5200-20200 + 2800 w.e.f. from 15.02.2021 as Technical Assistant (T-3) Driver, ICAR-IIVR, Varanasi vide office order dated 22.02.2023.

- Shri Sanjay Kumar Yadav promoted from Rs 5200-20200 + 2400 to Rs. 5200-20200 + 2800 w.e.f. from 15.02.2021 as Technical Assistant (T-3) Driver, ICAR-IIVR, Varanasi vide office order dated 22.02.2023.
- Shri Pramod Paswan promoted from Rs 5200-20200 + 2400 to Rs. 5200-20200 + 2800 w.e.f. from 18.02.2021 as Technical Assistant (T-3) Driver, ICAR-IIVR, Varanasi vide office order dated 22.02.2023.
- Shri Pankaj Kumar Singh promoted from Rs. 5200-20200+2400/-to Rs. 5200-20200+2800/- w.e.f. from 14.02.2021 as Technical Assistant (T- 3) Driver, ICAR-IIVR, Varanasi vide office order dated 22.02.2023.
- Shri Satish Kumar Singh promoted from Rs. 5200-20200 + 2400 to Rs. 5200-20200 + 2800 w.e.f. from 17.02.2021 as Technical Assistant (T-3) Driver, ICAR-IIVR, Varanasi vide office order dated 22.02.2023.
- Dr. Shailesh Kumar Tiwari promoted from Rs. 15600-39100 + 8000 to Rs. 37400-67000+9000 w.e.f. from 23.06.2021 as Senior Scientist, ICAR - IIVR, Varanasi vide office order dated 24.03.2023.
- Dr. Yerasu Suresh Reddy promoted from Rs 15600-39100+7000 to Rs. 15600-39100+8000 w.e.f. from 27.04.2020 as Senior Scientist, ICAR-IIVR, Varanasi Vide office order dated 24.03.2023.
- Dr. Vidya Sagar promoted from Rs.15600-39100+6000 to Rs.15600-39100+7000 w.e.f. from 05.01.2021 as Scientist, ICAR-IIVR, Varanasi vide Office order dated 24.03.2023.
- Dr. Sujan Majumdar promoted from Rs. 15600-39100+6000 to Rs. 15600-39100+7000 w.e.f. from 02.07.2022 as Scientist ICAR-IIVR, Varanasi vide Office order dated 21.07.2023.

Demise

- Shri Virendra Prasad Gond, Skilled Supporting Staff, ICAR-IIVR, Varanasi expired on 08.11.2023.

CLASSIFIED ABSTRACTS OF EXPENDITURE

ICAR-Indian Institute of Vegetable Research (plan)

(In Lakhs)

Sub-head	Plan	
	Provision made in RE	Expenditure
Establishment Charges	1947.33	1947.33
Wages	-	-
O.T.A.	-	-
T.A.	10.20	10.20
Other Charges (Contingency)	470.29	470.29
H.R.D.	2.17	2.17
Works	100.56	100.56
Equipment	10.00	10.00
Library	10.00	10.00
Vehicle	-	-
Annual Repairs /Maintenance	-	-
Furniture & Fixture	20.00	20.00
Information Technology	10.00	10.00
TSP NEH	62.4	62.4
Total	2642.95	2642.95

Revenue generation

(In Lakhs)

Particulars	Target	Revenue generation
IIVR	100.00	125.20

Krishi Vigyan Kendra (plan)

(In Lakhs)

KVKs	RE	Expenditure
KVK, Kushinagar	131.75	109.25
KVK, Deoria	84.45	70.12
KVK, Sant Ravidas Nagar	135.55	128.28
Total	341.75	307.65

EXTERNALLY FUNDED PROJECTS (Upto 31.03.2023)

(Rs. In lakhs)

S.N.	Name of project	Funding agency	Duration of projects	Allocation & Expenditure	
				Allocation	Expenditure
	VEGETABLE IMPROVEMENT				
1.	National Innovations in Climate Resilient Agriculture (NICRA)	ICAR	2017-2023	38.00	37.95
2.	CRP on Hybrid Technology Project	ICAR	2021-2026	15.60	15.57
3.	CRP on Agrobiodiversity	ICAR	2017-2023	16.00	16.00
4.	Agri Business Incubator (ABI)	ICAR	2017-2023	3.50	3.44
5.	Zonal Technology Management Unit (ZTMU)	ICAR	2017-2023	6.00	5.99
6.	Discovery of novel genes and QTLs conferring resistance to ToLCNDV disease from indigenous sources, genome-wide transcriptional dynamics and allele mining of the candidate genes in Cucurbitaceous vegetables.	NASF, ICAR	2022-2023	12.28	9.16
7.	Monecious sex expression in muskmelon (Cucumis melo L.): Inheritance and molecular mapping of monoecisum using linked markers.	DST-SERB	2019-2023	4.00	1.50
8.	Identification of suitable varieties/hybrids of cucurbitaceous crops and development of production protocol for better livelihood of river bed (diara land) farming community.	UPCAR	2009-2023	6.13	6.13
9.	Development and evaluation of annual moringa for food fodder and nutritional content in U.P.	UPCAR	2020-2023	3.04	3.04
10.	Proteomics and metabolomics of stress-challenged tomato for functional metabolic clues of plant responses, crop quality and yield	CABin ICAR	2021-2023	20.00	19.00
11.	Dus Testing of Vegetable Crops	PPV&FRA	Jan. to June, 2022	6.24	5.82
12.	Development of DUS test guidelines for Sponge Gourd (Luffa cylindrical)"	PPV&FRA	2022-2023	8.10	5.61
13.	DUS Testing in Pointed gourd	PPV&FRA	2021-2023	5.95	3.28
14.	DUS testing of Okra	PPV&FRA	2022-2023	5.50	5.49
15.	DUS testing of Brinjal	PPV&FRA	2022-2023	5.50	4.70
16.	DUS testing of cucumber and pumpkin	PPV&FRA	2022-2023	6.13	4.18
17.	DUS testing of Tomato	PPV&FRA	2022-2023	6.13	4.12
18.	DUS testing of Bitter gourd and Bottle gourd	PPV&FRA	2022-2023	5.50	5.20
19.	DUS testing of Vegetable pea and French bean	PPV&FRA	2022-2023	5.50	5.38
	VEGETABLE PRODUCTION				
20.	Network Project on precision Agriculture (NePPA)	ICAR	2021-2026	16.36	16.60
21.	Biotech Kisan (Kisan Innovationm and Science Application Network) Hub Project	DBT	2020-2023	63.00	63.00
22.	Farmer FIRST Program on "Intervention of Improved Agricultural Technologies for Livelihood and Nutritional Security Adhering Local Resources and Working Knowledge of the Farmers	ICAR	2016-2026	45.00	43.80
23.	ICAR-NASF Project "Development and validation of need based delivery model through Farmer Producer organization (FPO) in Eastern Region of India".	ICAR	2019-2023	5.85	5.85
24.	ICAR-NASF Aquaponics	ICAR	-	-	-
	VEGETABLE PROTECTION				
25.	Establishment of biocontrol development center for production and promotion of bioagents to manage soil-borne diseases in vegetable crops	RKVY	2021-2023	165.50	140.30
26.	Establishment of a referral laboratory for pesticide residue analysis in vegetable crop	RKVY	2022-2023	333.00	-

27.	Resistance monitoring studies in tomato early blight (*Alternaria solanai*) for azoxystrobin fungicide	Syngenta India Ltd	2021-2023	15.00	12.00
28.	Base line study of tomato powdery mildew pathogen against a fungicide molecule (Adepidyn)	Syngenta India Ltd	2022-2024	15.88	-
29.	Evaluation of BIPM practices against sucking pests and fruit flies Zeugodacus cucurbitae in bitter gourd (AICRP on Biological control of crop pests)	ICAR-NBAIR	2018 - 2021	2.01	1.36

EXTERNALLY FUNDED PROJECTS (From 01.04.2023)

(Rs. In lakhs)

S. N.	Name of project	Funding Agency	Duration of projects	Allocation & Expenditure	
				Allocation	Expenditure
	VEGETABLE IMPROVEMENT				
1.	National Innovations in Climate Resilient Agriculture (NICRA)	ICAR	2017-2026	43.699	44.43849
2.	CRP on Hybrid Technology	ICAR	2021-2026	17.57	17.55239
3.	CRP on Agrobiodiversity	ICAR	2017-2025	23.50	23.47124
4.	Agri Business Incubator (ABI)	ICAR	2017-2025	2.00	1.99993
5.	Zonal Technology Management Unit (ZTMU)	ICAR	2017-2025	5.50	5.45757
6.	ICAR-LBS Award	ICAR	2022-2024	10.00	9.98562
7.	Discovery of novel genes and QTLs conferring resistance to ToLCNDV disease from indigenous sources, genome-wide transcriptional dynamics and allele mining of the candidate genes in Cucurbitaceous vegetables.	NASF, ICAR	2022-2025	13.54658	13.36132
8.	Identification of suitable varieties/hybrids of cucurbitaceous crops and development of production protocol for better livelihood of river bed (diara land) farming community.	UPCAR	2009-2024	4.77458	4.76625
9.	Development and evaluation of annual moringa for food fodder and nutritional content in U.P.	UPCAR	2020-2023	1.86	1.89
10.	Proteomics and metabolomics of stress-challenged tomato for functional metabolic clues of plant responses, crop quality and yield	CABin ICAR	2021-2026	22.00	21.84409
11.	Strengthening quality seed production of vegetable crops	MIDH	2021-2024	6.00	6.00
12.	DUS Testing in Pointed gourd	PPV&FRA	2021-2025	5.67092	5.52064
13.	DUS testing of Okra	PPV&FRA	2022-2025	6.35	6.16593
14.	DUS testing of Brinjal	PPV&FRA	2022-2025	6.35	6.13057
15.	DUS testing of cucumber and pumpkin	PPV&FRA	2022-2025	7.10600	7.04881
16.	DUS testing of Tomato	PPV&FRA	2022-2025	8.10600	7.25942
17.	DUS testing of Bitter gourd and Bottle gourd	PPV&FRA	2022-2025	6.35	5.98689
18.	DUS testing of Vegetable pea and French bean	PPV&FRA	2022-2025	6.35	6.13947
19.	DUS testing of Ash gourd, Snake gourd and Ivy gourd	PPV&FRA	2023-2025	7.30	5.68.351
20.	FielD heat: adapting tomato germplasm to the dry and humid heat of the Indian monsoonal climate"	DBT	2023-2027	38.83379	38.83379
21.	Genome-wide SNP discovery for development of high-density genetic map and QTL mapping of multi-flowering and yield associated traits in vegetable pea (Pisum sativam L.)	SERB	2023-2025	18.70520	13.17428
	VEGETABLE PRODUCTION				
22.	Network Project on precision Agriculture (NePPA)	ICAR	2021-2026	49.50	47.92
23.	NASF - Sensor-based integrated vertical farming for horticultural crops and aquaponic system	NASF, ICAR	2023-2026	17.73	16.92
24.	Farmer FIRST Program on "Intervention of Improved Agricultural Technologies for Livelihood and Nutritional Security Adhering Local Resources and Working Knowledge of the Farmers	ICAR	2016-2026	-	-
25.	Paid up trial for evaluation of the Nano-Urea on cabbage crop for one season (Rabi, 2023-24)	Coromondel Pvt. Ltd., Secunderabad	2023-2024	7.70	2.00
26.	Paid up trial on Kharif (Okra) for evaluation of the Nano Urea	Coromondel Pvt. Ltd., Secunderabad	2023-2024	7.70	6.70
27.	Paid-up trial on summer/kharif vegetables for evaluation of the Nano DAP	Coromondel Pvt. Ltd., Secunderabad	2023-2024	12.00	9.00

VEGETABLE PROTECTION					
28.	Establishment of biocontrol development center for production and promotion of bioagents to manage soil-borne diseases in vegetable crops	RKVY	2022-2023	165.5	148.8
29.	AICRP on Biological control of crop pests	ICAR-NBAIR, Bangalore	2023-2024	1.25	1.25
30.	Strengthening and Setting up of Nucleus stock Development centre in Existing Apiculture unit and Development of Agri-Start-ups	ICAR	2023-2025	16.31	6.35582
31.	Establishment of a referral laboratory for pesticide residue analysis in vegetable crop	RKVY	2022-2023	163.0	131.5
32.	Resistance monitoring studies in tomato early blight (*Alternaria solanai*) for azoxystrobin fungicide	Syngenta India Ltd	2021-2024	15.00	14.00
33.	Baseline study of tomato powdery mildew pathogen against a fungicide molecule (Adepidyn)	Syngenta India Ltd	2022-2024	15.888	11.00
34.	Testing and resistance monitoring studies in tomato early blight (*Alternaria* spp.) of *pydiflumetofen* in tomato	Syngenta India Ltd	2023-2025	15.004	-

STAFF STRENGTH
(as on 31.12.2023)

S.N.	Category	Sanctioned Strength	Staff in Position	Vacant
(A) SCIENTIFIC				
1.	Director	01	01	-
2.	Scientist	44	31	13
3.	Senior Scientist	12	08	04
4.	Principal Scientist	01	-	01
5.	HoD	03	03	-
6.	HoRC	01	-	01
7.	PC	01	01	-
	Total	63	44	19
(B) TECHNICAL				
1.	Category-I	11	10	01
2.	Category-II	15	10	05
	Total	26	20	06
(C) ADMINISTRATIVE				
1.	Chief Administrative Officer	01	01	-
2.	Dy. Dir. (F)/ Comptroller	01	-	01
3.	Principal Private Secretary	01	-	01
4.	Administrative Officer	01	-	01
5.	Finance & Accounts Officer	01	01	-
6.	Assistant Administrative Officer	03	03	-
7.	Assistant Finance & Accounts Officer	01	-	01
8.	Private Secretary	02	-	02
9.	Assistant	09	04	05
10.	Personal Assistant	03	01	02
11.	U.D.C.	04	-	04
12.	L.D.C.	05	01	04
	TOTAL	**32**	**11**	**21**
(D) SKILLED SUPPORTING STAFF				
1.	S.S.S	16	14	02
	TOTAL	**16**	**14**	**02**
	Grand Total	**137**	**91**	**46**

STAFF STRENGTH OF KRISHI VIGYAN KENDRAS

(as on 31.12.2023)

KVK Sargatia, Kushinagar

Sl. No.	Designation	Sanctioned strength	Staff in position	Vacant
1.	Programme Coordinator	01	01	-
2.	Subject Matter Specialist	06	04	02
3.	Farm Manager	01	01	-
4.	Programme Assistant	01	01	-
5.	Programme Assistant (Computer)	01	-	01
6.	Assistant	01	-	01
7.	Stenographer Gr. III	01	-	01
8.	Driver (T-1)	02	02	-
9.	SSS	02	-	02
	Total	**16**	**09**	**07**

KVK Deoria

Sl. No.	Designation	Sanctioned strength	Staff in position	Vacant
1.	Programme Coordinator	01	01	-
2.	Subject Matter Specialist	06	03	03
3.	Farm Manager	01	01	-
4.	Programme Assistant	01	-	01
5.	Programme Assistant (Computer)	01	-	01
6.	Assistant	01	-	01
7.	Stenographer Gr. III	01	-	01
8.	Driver (T-1)	02	02	-
9.	SSS	02	-	02
	Total	**16**	**07**	**09**

KVK Bhadohi

Sl. No.	Designation	Sanctioned strength	Staff in position	Vacant
1.	Programme Coordinator	01	01	-
2.	Subject Matter Specialist	06	02	04
3.	Farm Manager	01	01	-
4.	Programme Assistant	01	01	-
5.	Programme Assistant (Computer)	01	-	01
6.	Assistant	01	-	01
7.	Stenographer Gr. III	01	-	01
8.	Driver (T-1)	02	01	01
9.	SSS	02	-	02
	Total	**16**	**06**	**10**

STAFF IN POSITION
(as on 31.12.2023)

Sl. No.	Name	Designation	Email
1.	Dr. Tushar Kanti Behera	Director	director.iivr@icar.gov.in
Director's Cell			
2.	Sh. Ajay Uniyal	Personal Assistant	Ajay.uniyal1@gmail.com
Project Coordinator Cell			
3.	Dr. Rajesh Kumar	Project Coordinator	rajes74@gmail.com
4.	Dr. T. Chaubey	Principal Scientist	tchaubeyiivr@gmail.com
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6.	Sh. Ashutosh Goswami	Assistant Chief Technical Officer	ashutosh12031972@gmail.com
Division of Vegetable Improvement			
7.	Dr. Nagendra Rai	Principal Scientist & Head	nrai1964@gmail.com
8.	Dr. P.M. Singh	Principal Scientist	pmsiivr@gmail.com
9.	Dr. D.R. Bhardwaj	Principal Scientist	dram_iivr@yahoo.com
10.	Dr. Dhananjay Pratap Singh	Principal Scientist	dpsfarm@rediffmail.com
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Vehicle Section			
68.	Sh. Rajendra Kumar	Technical Officer	-
69.	Sh. Manoj Kumar	Technical Officer	-
70.	Sh. Ram Ashrey	Technical Officer	-
71.	Sh. Sanjay Singh	Technical Officer	-
Skilled Supporting Staff (SSS)			
72.	Sh. Shiv Kumar	SSS	-
73.	Sh. Kailash Singh	SSS	-
74.	Sh. S.P. Mishra	SSS	-
75.	Sh. Naraini Singh	SSS	-
76.	Sh. S.K. Pandey	SSS	-
77.	Sh. Arun Kumar	SSS	aruniivr@gmail.com
78.	Sh. Ramraj	SSS	ramraj.iivr@gmail.com
79.	Sh. Suresh Kumar Yadav	SSS	-
80.	Sh. Suresh Kumar	SSS	-
81.	Sh. Kamlesh Kumar Singh	SSS	-
82.	Sh. Anil Kumar Suman	SSS	-
83.	Sh. Ram Kunwar Chaubey	SSS	-
84.	Sh. Jata Shankar Pandey	SSS	-
85.	Sh. Shivaji Mishra	SSS	-
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86.	Dr. Vikas Singh	Senior Scientist & I/C	vikaschf@gmail.com
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Krishi Vigyan Kendra, Sargatia, Kushinagar			
92.	Dr. Dharam Vir Singh	Senior Scientist cum Programme Coordinator	-
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100.	Sh. Satish Kumar Singh	(T-3) Driver	sks.kvkkushinagar@gmail.com
Krishi Vigyan Kendra, Deoria			
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Annexure I

RESEARCH ADVISORY COMMITTEE

Dr. T.A. More Ex- Vice Chancellor MPKV, Rahuri	Chairman
Dr. Subodh Joshi Former PS Division of Vegetable Science IARI, New Delhi	Member
Dr. M. Prabhakar, Former Head Division of Vegetable Crops IIHR, Bengaluru	Member
Dr. Pratibha Sharma Former Head IARI, New Delhi	Member
Dr. D. Patnayak PS, NIPB, New Delhi	Member
Dr. N. K. Pandey Head Division of Social Science, CPRI, Shimla	Member
Asstt. Director General (HS-I) ICAR, Krishi Anusandhan Bhawan-II, New Delhi	Ex- officio Member
Dr. T. K. Behera Director ICAR-IIVR, Varanasi	Ex- officio Member
Dr. N. Rai Principal Scientist & Head Division of Vegetable Improvement ICAR-IIVR, Varanasi	Member Secretary

Annexure II

INSTITUTE MANAGEMENT COMMITTEE

Dr. T.K. Behera Director ICAR-IIVR, Varanasi	Chairman
Sh. J.K. Singh Nominee Director of Horticulture, Govt. of UP, 2-Sapru Marg, Lucknow	Member (ex-officio)
Director of Horticulture Govt. of Bihar, IInd Floor, Krishi Bhawan Mithapur, Patna, Bihar-800001	Member (ex-officio)
Dr. Amit Singh Nominee Vice Chancellor, NDUA&T, Ayodhya	Member (ex-officio)
Dr. H.C. Prasanna Principal Scientist, ICAR-IIHR, Bengaluru	Member (DG Nominee)
Dr. Achuit Kumar Singh Principal Scientist, ICAR-IIVR, Varanasi	Member (DG Nominee)
Dr. Arvind Nath Singh Principal Scientist, ICAR-IISS, Mau	Member (DG Nominee)
Dr. Ram Ashray Principal Scientist Division of Post-Harvest Technology, ICAR-IARI, New Delhi	Member (DG Nominee)
Dr. Vikramaditya Pandey ADG (Hort. Sci.-I) Horticulture Division of ICAR, New Delhi	Member (DG Nominee)
Shri D.K. Agnihotri Sr. Finance & Accounts Officer ICAR-CISH, Lucknow	Member (Nominee of AS&FA, DARE/ICAR)
Shri Sujit Kumar Singh CAO, ICAR-IIVR, Varanasi	Member Secretary
Dr. P.M. Singh Principal Scientist & I/C Head Crop Improvement Division, ICAR-IIVR, Varanasi	Special Invitee

Dr. S.N.S. Chaurasiya Principal Scientist & I/C Head Crop Production Division, ICAR-IIVR, Varanasi	Special Invitee
Dr. K.K. Pandey Principal Scientist & I/C Head Crop Protection Division, ICAR-IIVR, Varanasi	Special Invitee
Dr. Neeraj Singh Principal Scientist, ICAR-IIVR, Varanasi	Special Invitee
Dr. Rajesh Kumar Principal Scientist, ICAR-IIVR, Varanasi	Special Invitee
Shri Gaurav Srivastava F&AO, ICAR-IIVR, Varanasi	Special Invitee

Annexure III

LIST OF ONGOING RESEARCH PROJECTS

(Up to 31.03.2023)

A. Institutional

MEGA PROGRAMME-1: INTEGRATED GENE MANAGEMENT			
Mega-Programme Leader: Dr. Nagendra Rai			
Code	**Title of the project**	**P.I.**	**Co-PIs & Associates**
1.1	Genetic Improvement of Tomato	YS Reddy	N. Rai and Jagesh K. Tiwari **Associates:** PA Divekar (Insects), KK Pandey (Diseases), K Nagendran (Viruses), Swati Sharma (Processing screening) and M Gowda T (Nematodes)
1..2	Genetic Improvement of Brinjal	SK Tiwari	Suhas G Karkute **Associates:** PA Divekar (Insects) and AN Tripathi (Diseases)
1.3	Genetic Improvement of Chilli	Rajesh Kumar	Indivar Prasad, Achuit K. Singh, DP Singh and Suhas G Karkute **Associates:** KK Pandey (Diseases), K Nagendran (Viruses), Kuldeep Srivastava (Insects) and M Gowda T (Nematodes)
1.4	Genetic Improvement of Vegetable Pea	Jyoti Devi	RK Dubey **Associates:** AN Tripathi (Diseases), and PA Divekar (Insects)
1.5	Genetic Improvement of Cowpea	B R. Reddy	N Rai **Associates:** PA Divekar (Insects), AN Tripathi (Diseases) and K. Nagendran (Viruses)
1.6	Genetic Improvement of Indian bean and French bean	N Rai	BR Reddy, Rajeev Kumar, SK Singh **Associates:** Sudarshan Maurya (Diseases) and PA Divekar (Insects)
1.7	Genetic Improvement of seed propagated gourds (Bitter gourd, Bottle gourd and Ash gourd)	DR Bhardwaj	TK Behera and Sudhakar Pandey, **Associates:** Vikas Singh (RRS), KK Pandey (Diseases), Kuldeep Srivastava (Insects), and M Gowda T (Nematodes)
1.8	Genetic Improvement of Luffa [Sponge gourd, Ridge gourd and Satputia]	T Chaubey	Sudhakar Pandey and RK Dubey **Associates:** DP Singh (pathway mapping aromatic line) and J Halder (Insects)
1.9	Genetic Improvement of Pumpkins and Cucumber	Sudhakar Pandey	DR Bhardwaj, T Chaubey and Vikas Singh **Associates:** J Halder (Insects), AN Tripathi (Diseases) and K Nagendran (Viruses)
1.10	Genetic Improvement of Melons	T K Behera	Sudhakar Pandey, Pradip Karmakar and Vikas Singh **Associates:** K Nagendran (Viruses) and Sudarshan Maurya (Diseases)
1.11	Genetic Improvement of Okra	Pradip Karmakar	Achuit K Singh and Vidya Sagar **Associates:** J Halder (Insects), and K Nagendran (Diseases/Viruses)
1.12	Genetic Improvement of Cole crops and Root crops	B K Singh	P Karmakar and Bhuvaneswari,S. Associates: Kuldeep Srivastava (Insects) and Sudarshan Maurya (Diseases)

1.13	Biotechnological interventions including transgenics for managing stresses in vegetables	Achuit Kumar Singh	Sudhakar Pandey, DP Singh, SK Tiwari, YS Reddy, Jyoti Devi, Vidya Sagar, Indivar Prasad, Jagesh K. Tiwari and Suhas G. Karkute **Associate:** K Nagendran
1.14	Genetic Improvement of Underexploited & Future vegetables [Leafy vegetables, aquatic vegetables, sweet corn, baby corn, cluster bean, winged bean, Faba bean, vegetable soybean etc.]	R K Dubey	RK Singh, B K Singh, Jyoti Devi, YS Reddy, Vidya Sagar, Indivar Prasad and Swati Sharma. **Associates:** P.A Divekar (Insects) and AN Tripathi (Diseases)
1.15	Genetic Improvement of clonally propagated & perennial vegetables [Pointed gourd, spine gourd, ivy gourd, sweet gourd, basella, moringa etc.]	Vikas Singh	DR Bhardwaj, P Karmakar and Vidya Sagar **Associates:** J Halder (Insects) and Sudarshan Maurya (Diseases)
MEGA PROGRAMME-2: SEED ENHANCEMENT IN VEGETABLES			
Mega-Programme leader: Dr. P.M. Singh			
2.1	Priming, coating, ovule conversion and seed enhancement	PM Singh	Rajesh Kumar, T Chaubey, Vikas Singh and Nakul Gupta **Associate:** J Halder and AN Tripathi
2.2	Pollination studies for seed augmentation in vegetables including support of honeybees	Rajesh Kumar	PM Singh, T Chaubey, Nakul Gupta, J. Halder and PA Divekar **Associate:** AN Tripathi
2.3	Drying and storage studies on vegetable seeds	Nakul Gupta	PM Singh, Rajesh Kumar and S. Roy
MEGA PROGRAMME-3: PRODUCTIVITY ENHANCEMENT THROUGH BETTER RESOURCE MANAGEMENT			
Mega-Programme Leader: Dr. SNS Chaurasia			
3.1	Technologies for protected vegetable production	SNS Chaurasia	Hare Krishna, R.B. Yadava (upto 31/10/22), Anant Bahadur, Swati Sharma and Rajeev Kumar **Associates:** KK Pandey, Kuldeep Srivastava
3.10	Agronomic biofortification studies in vegetable crops	RB Yadava (upto 31/10/22) Hare Krishna (w.e.f. 01/11/2022)	Hare Krishna and Rajeev Kumar
3.11	Development of Agro-techniques for organic farming in vegetable crops	SK Singh	RB Yadava (upto 31/10/22), Swati Sharma and Rajesh Kumar Singh **Associates:** KK Pandey, Jaydeep Halder, A.N Tripathi, Vijaya Rani and Kuldeep Srivastava
3.12	Improving water productivity of vegetable crops sequence through drip irrigation system	Anant Bahadur	**Associates:** Jaydeep Halder
3.13	Enhancing productivity, quality and tolerance to biotic and abiotic stresses in vegetables by grafting technology	Anant Bahadur	Hare Krishna, Rajeev Kumar **Associates:** AN Tripathi
3.17	Bio-regulator induced drought stress tolerance in Okra (*Abelmoschus esculentus*)	Rajeev Kumar	Anant Bahadur and Pradip Karmakar
MEGA PROGRAMME-4: POST HARVEST MANAGEMENT AND VALUE ADDITION			
Mega-Programme Leader: Dr. Swati Sharma			
4.4	Influence of polyamines on postharvest senescence and quality of high value vegetables	Swati Sharma	Hare Krishna

MEGA PROGRAMME 5: PRIORITIZATION OF R&D NEEDS AND IMPACT ANALYSIS OF TECHNOLOGIES DEVELOPED BY ICAR-IIVR			
Mega-Programme Leader: Dr. Neeraj Singh			
5.4	Empowering rural youth for vegetable based entrepreneurship	Shubhadeep Roy	Neeraj Singh
5.5	Economic impact assessment of IIVR developed technologies	Govind Pal	Shubhadeep Roy and Neeraj Singh
5.6	Development and promotion of nutri- garden module for rural households	Neeraj Singh	SNS Chaurasia and Shubhadeep Roy
MEGA PROGRAMME-6: INTEGRATED PLANT HEALTH MANAGEMENT			
Mega-Programme Leader: Dr. K.K. Pandey			
6.1	Bio-intensive management of major insect pests of vegetables in the current scenario of weather change	Kuldeep Srivastava	Jaydeep Halder, PA Divekar, K Nagendran and Sujan Majumder **Associates:** Neeraj Singh
6.2	Toxicological investigations on the novel insecticide molecules and plant origin insecticides against major insect pests of vegetables.	PA Divekar	Kuldeep Srivastava, Jaydeep Halder, Sujan Majumder and Manjunatha Gowda T (*w.e.f.* 19.8.2022).
6.3	Biological control of major insect pests of vegetable crops	Jaydeep Halder	Kuldeep Srivastava, AN Tripathi, P.A. Divekar, Suhas Karkute and Manjunatha Gowda T (*w.e.f.* 19.8.2022).
6.4	Development of effective integrated management package for important fungal diseases of vegetable crops	KK Pandey	Vijaya Rani, AN Tripathi and Anurag Chaurasia
6.5	Bio-prospecting of microorganisms associated with vegetables against plant pathogens	Sudarshan Maurya	KK Pandey, AN Tripathi, Anurag Chaurasia and Vijaya Rani
6.6	Management of important bacterial diseases of vegetable crops	AN Tripathi	Vijaya Rani
6.7	Characterization of viruses infecting vegetable crops and their management	K. Nagendran	KK Pandey **Associates**: Achuit K Singh
6.9	Management of plant parasitic nematodes infecting vegetable crops	Manjunatha Gowda T (w.e.f.19.8.2022)	KK Pandey, Jaydeep Halder, **Associate:** Shubhadeep Roy
6.10	Pest and disease dynamics and behavior modifying strategies for major insect pests of important vegetable crops in relation to changing weather scenario	PA Divekar	Jaydeep Halder, Kuldeep Srivastava and Sudarshan Maurya
6.12	Bio-management of postharvest diseases in major vegetable crops	Vijaya Rani	Sudarshan Maurya and Sujan Majumder **Associate:** Swati Sharma
6.13	Residue dynamics, safety evaluation and decontamination of chlorantraniliprole, deltamethrin, azoxystrobin and kresoxim methyl in tomato, brinjal and chilli	Sujan Majumder	Vijaya Rani, PA Divekar, KK Pandey and J Halder

B. Externally Funded

S.N.	Title of the project	P.I.	Co-PIs & Associates
DIVISION OF VEGETABLE IMPROVEMENT			
1.	National Innovations in Climate Resilient Agriculture (NICRA)	P.M. Singh	N.Rai, Anant Bahadur and Achuit Kumar Singh
2.	CRP on Hybrid Technology Project	N. Rai	Y. S. Reddy, Jagesh Kumar Tiwari and Manjunat Gowda T.
3.	CRP on Agrobiodiversity	S.K. Tiwari	P. Karmakar, Vidya Sagar and Bhuvaneswari S.
4.	Agri Business Incubator (ABI)	P.M. Singh	SK Tiwari, Shubhdeep Roy and Neeraj Singh
5.	Zonal Technology Management Unit (ZTMU)	P.M. Singh	SK Tiwari, Shubhdeep Roy and Neeraj Singh
6.	Discovery of novel genes and QTLs conferring resistance to ToLCNDV disease from indigenous sources, genome-wide transcriptional dynamics and allele mining of the candidate genes in Cucurbitaceous vegetables	Sudhakar Pandey	T.K. Behera, Pradip Karmakar, Achuit Kumar Singh and Vidya Sagar
7.	Monecious sex expression in muskmelon (Cucumis melo L.): Inheritance and molecular mapping of monoecisum using linked markers	Pradip Karmakar	-
8.	Identification of suitable varieties/hybrids of cucurbitaceous crops and development of production protocol for better livelihood of river bed (diara land) farming community.	Sudhakar Pandey	K.K. Pandey, R.K. Dubey and Rajneesh Srivastava
9.	Development and evaluation of annual moringa for food fodder and nutritional content in U.P.	Vidya Sagar	-
10.	Proteomics and metabolomics of stress-challenged tomato for functional metabolic clues of plant responses, crop quality and yield	D.P. Singh	Sudarshan Maurya and Y.S. Reddy
11.	Dus Testing of Vegetable Crops	Sudhakar Pandey	T. Chaubey
12.	Development of DUS test guidelines for Sponge Gourd (*Luffa cylindrica*)”	T. Chaubey	R.K. Dubey
13.	DUS Testing in Pointed gourd	Pradip Karmakar	-
14.	DUS testing of Okra	Pradip Karmakar	Vidya Sagar
15.	DUS testing of Brinjal	S.K. Tiwari	Bhuvaneswari S.
16.	DUS testing of cucumber and pumpkin	Sudhakar Pandey	T. Chaubey
17.	DUS testing of Tomato	Y.S. Reddy	Jagesh Kumar Tiwari
18.	DUS testing of Bitter gourd and Bottle gourd	D.R. Bhardwaj	Nakul Gupta
19.	DUS testing of Vegetable pea and French bean	B.R. Reddy	R.K. Dubey
DIVISION OF VEGETABLE PRODUCTION			
20.	Network Project on precision Agriculture (NePPA)	Anant Bahadur	Hare Krishna, Rajeev Kumar. S.K. Singh and Swati Sharma
21.	Biotech Kisan (Kisan Innovation and Science Application Network) Hub Project	Neeraj Singh	-
22.	Farmer FIRST Program on “Intervention of Improved Agricultural Technologies for Livelihood and Nutritional Security Adhering Local Resources and Working Knowledge of the Farmers	Neeraj Singh	Shubhadeep Roy, S.K. Singh and D.R. Bhardwaj
23.	ICAR-NASF Project “Development and validation of need based delivery model through Farmer Producer organization (FPO) in Eastern Region of India”	Shubhadeep Roy	Neeraj Singh, Hare Krishna, Sudarshan Maurya and A.N. Tripathi
24.	NASF-Sensor-based integrated vertical farming for horticultural crops and aquaponic system	Hare Krishna	Anant Bahadur and Swati Sharma
DIVISION OF VEGETABLE PROTECTION			
25.	Establishment of biocontrol development center for production and promotion of bioagents to manage soil-borne diseases in vegetable crops	K.K. Pandey	Sudarshan Maurya, K. Nagendran and Vijaya Rani

26.	Establishment of a referral laboratory for pesticide residue analysis in vegetable crop	Sujan Majumder	K.K. Pandey, Sudarshan Maurya, Nagendran K. and Pratap Divekar
27.	Resistance monitoring studies in tomato early blight (*Alternaria solanai*) for azoxystrobin fungicide	A.N. Tripathi	-
28.	Base line study of tomato powdery mildew pathogen against a fungicide molecule (Adepidyn)	A.N. Tripathi	-
29.	Evaluation of BIPM practices against sucking pests and fruit flies Zeugodacus cucurbitae in bitter gourd (AICRP on Biological control of crop pests)	J. Halder	-

LIST OF ONGOING RESEARCH PROJECTS

(w.e.f. 01.04.2023)

A. Institutional

DIVISION OF VEGETABLE IMPROVEMENT			
Code	**Title of the project**	**P.I.**	**Co-PIs & Members**
1	Improvement of Cucurbitaceous crops for stress tolerance, yield and quality traits	T.K. Behera	D. R. Bhardwaj, T. Chaubey, Vikas Singh, Nakul Gupta, Hiranmoy Das,Vidya Sagar, P. Karmakar, K. Nagendran (upto 22.12.23), Sudarshan Maurya and A.N. Singh (w.e.f. 07.07.2023)
2	Improvement of Okra for stress tolerance, yield and qualitytraits	Pradip Karmakar	B.K. Singh, Vidya Sagar and Hiranmoy Das **Members:** Pratap A. Divekar, K Nagendran (upto 22.12.23) and Rajeev Kumar
3	Improvement of Solanaceous vegetable crops for stress tolerance, yield and qualitytraits	Jagesh K.Tiwari	N. Rai, Y.S. Reddy, D.P. Singh, Shreya Panwar, S.K.Tiwari, Bhuvaneswari S., Rajesh Kumar, Indivar Prasad, Subas G Karkute, K. Nagendran (upto 22.12.23) and Kuldeep Srivastava **Members:** Pratap A. Divekar, A.N.Tripathi, Hiranmoy Das and Rajeev Kumar
4	Improvement of leguminous vegetable crops for stress tolerance, yield and quality traits	Rakesh K. Dubey	Jyoti Devi, B.R. Reddy (upto 13.12.2023), N. Rai and Indivar Prasad **Members:** Sudarshan Maurya andJaydeep Halder
5	Improvement of Cauliflower & Carrot for stress tolerance andquality traits	B.K. Singh	Jyoti Devi and Bhuvaneswari S. **Member:** Pratap A. Divekar
6	Biotechnological Interventions for Management of Stresses, yield and Quality in Vegetable crops	Achuit K. Singh	D.P. Singh, Suhas G. Karkute, Jagesh K. Tiwari, S.K. Tiwari, BhuvaneswariS. and Y.S. Reddy **Member:** K. Nagendran (upto 22.12.23)
7	Seed management perspectives in vegetable crops	Nakul Gupta	T. Chaubey, P.M. Singh, Rajesh K. Singh (upto 13.11.2023), Rajesh Kumar, Vikas Singh, Gang Raj (w.e.f. 21.07.2023), Ramesh K.B. (w.e.f. 11.04.2023) and K. Srivastava **Members:** Achuit K. Singh and S.K. Tiwari
8	Maintenance and Promotion of ICAR-IIVR Varieties / Hybrids	Neeraj Singh	T.K. Behera, N. Rai, D.R. Bhardwaj, Rajesh K. Singh (upto 13.11.2023), Rajesh Kumar, T. Chaubey, D.P. Singh, Rakesh K. Dubey, Vikas Singh, B.K. Singh, Jagesh K. Tiwari, S.K. Tiwari, PradeepKarmakar, Y.S. Reddy, Indivar Prasad,Bhuvneswari S, Jyoti Devi, B.R. Reddy (upto 13.12.2023), Nakul Gupta, Vidya Sagar, K.K. Pandey, Govind Pal and Shubhadeep Roy
DIVISION OF VEGETABLE PRODUCTION			
3.1	Precision farming in high value vegetable crops	Hare Krishna	Anant Bahadur, S.K. Singh, GovindPal, Vidya Sagar, Swati Sharma, Rajeev Kumar and Shreya Panwar (w.e.f. 21.07.2023) **Members:** N. Rai, Kuldeep Srivastava and Sudarshan Maurya
3.10	Harnessing grafting techniques and bio-regulators to improve vegetable crops resilience against abiotic stresses	Rajeev Kumar	Anant Bahadur, Pradip Karmakar and Shreya Panwar (w.e.f. 21.07.2023) **Members:** Hare Krishna, Sudarshan Maurya and Bhuvaneshwari S.

3.11	Development of technologies for production of vegetables under organic farming	SK Singh	Swati Sharma, A.N. Tripathi and Nakul Gupta **Members:** Jaydeep Halder, S.K. Tiwari, Pradip Karmakar, B.K. Singh and Sujan Majumdar
3.12	Exploration of vegetables forprocessing amenability, bioactive potential and development of value added products	Swati Sharma	Hare Krishna, S.K. Singh, Shreya Panwar (w.e.f. 21.07.2023), Rajeev Kumar and Indivar Prasad
3.13	Validation and economic impact of technologies developed at ICAR-IIVR	Shubhadeep Roy	Neeraj Singh, Govind Pal, Sudarshan Maurya, S.K. Singh and Hiranmoy Das **Members:** P.M. Singh and Kuldeep Srivastava
DIVISION OF VEGETABLE OF PROTECTION			
6.1	Integrated insect pest management of major vegetables for safer vegetable production	J. Halder	P.A. Divekar, A.N. Singh (w.e.f. 07.07.2023), Ramesh K.B. (w.e.f. 11.04.2023), M. Gowda T., A.N. Tripathi and Suhas G. Karkute **Member:** Rajeev Kumar
6.2	Characterization and integrated management of plant pathogens (diseases) of vegetable crops	A.N. Tripathi	A.N. Singh (w.e.f. 07.07.2023), K.K. Pandey,Sudarshan Maurya, Anurag Chaurasia, Vijaya Rani (upto 08.12.2023), Gangaraj R. (w.e.f. 21.07.2023) and S.K. Singh **Members:** S. Roy and H. Das
6.3	Diagnostics of viruses infecting vegetable crops and its management through novel strategies	K. Nagendran (upto 22.12.2023) P.A. Divekar (w.e.f. 23.12.2023)	H. Das and Shweta Kumari (after study leave) **Member:** Achuit K. Singh
6.4	Bio-intensive management of root-knot nematode in vegetable crops	M. Gowda T.	K.K. Pandey, Anurag Chaurasia,Sujan Majumder and D.R. Bhardwaj **Members:** Hare Krishna, Jaydeep Halder and Y.S. Reddy
6.5	Residue analysis and risk assessment of pesticides in vegetable crops	Sujan Majumder	Kuldeep Srivastava, K.K. Pandey, Sudarshan Maurya, Jaydeep Halder, Anurag Chaurasia, Vijaya Rani (upto 08.12.2023) and Shreya Panwar (w.e.f. 21.07.2023)
6.6	Integration of compatible components to develop crop-specific module for the insect-pest and disease management (IPDM) in vegetables	P.A. Divekar	A.N. Singh (w.e.f. 07.07.2023), K. Srivastava, J. Halder, S. Maurya, K. Nagendran (upto 22.12.2023), M. Gowda T., Sujan Majumder, Vijaya Rani (upto 08.12.2023), Ramesh K.B. (w.e.f. 11.04.2023), Gangaraj R. (w.e.f. 21.07.2023) and Shubhadeep Roy

B. Externally Funded

S.N.	Title of the project	P.I.	Co-PIs & Members
	DIVISION OF VEGETABLE IMPROVEMENT		
1.	National Innovations in Climate Resilient Agriculture (NICRA)	P.M. Singh	N. Rai, Anant Bahadur and Achuit Kumar Singh
2.	CRP on Hybrid Technology Project	N. Rai	Y. S. Reddy, Jagesh Kumar Tiwari and Manjunat Gowda T.
3.	CRP on Agro biodiversity	S.K. Tiwari	P. Karmakar, Vidya Sagar and Bhuvaneswari S.
4.	Agri Business Incubator (ABI)	P.M. Singh	SK Tiwari, Shubhdeep Roy and Neeraj Singh
5.	Zonal Technology Management Unit (ZTMU)	P.M. Singh	SK Tiwari, Shubhdeep Roy and Neeraj Singh
6.	ICAR-LBS award	J.K. Tiwari	-
7.	Discovery of novel genes and QTLs conferring resistance to ToLCNDV disease from indigenous sources, genome-wide transcriptional dynamics and allele mining of the candidate genes in Cucurbitaceous vegetables	Pradip Karmakar	T.K. Behera, Achuit Kumar Singh and Vidya Sagar
8.	Identification of suitable varieties/hybrids of cucurbitaceous crops and development of production protocol for better livelihood of river bed (diara land) farming community.	R.K. Dubey	K.K. Pandey and Rajneesh Srivastava
9.	Development and evaluation of annual moringa for food fodder and nutritional content in U.P.	Vidya Sagar	-
10.	Proteomics and metabolomics of stress-challenged tomato for functional metabolic clues of plant responses, crop quality and yield	D.P. Singh	Sudarshan Maurya and Y.S. Reddy
11.	Strengthening quality seed production of vegetable crops	Rajesh Kumar	P.M. Singh, T. Chaubey, Vikas Singh & Nakul Gupta
12.	DUS Testing in Pointed gourd	Pradip Karmakar	-
13.	DUS testing of Okra	Pradip Karmakar	Vidya Sagar
14.	DUS testing of Brinjal	S.K. Tiwari	Bhuvaneswari S.
15.	DUS testing of cucumber and pumpkin	Vidya Sagar	T. Chaubey
16.	DUS testing of Tomato	Y.S. Reddy	Jagesh Kumar Tiwari
17.	DUS testing of Bitter gourd and Bottle gourd	D.R. Bhardwaj	Nakul Gupta
18.	DUS testing of Vegetable pea and French bean	Jyoti Devi	R.K. Dubey
19.	DUS testing of Ash gourd, Snake gourd and Ivy gourd	Nakul Gupta	Vikas Singh
20.	FielD heat: adapting tomato germplasm to the dry and humid heat of the Indian monsoonal climate"	Y.S. Reddy	N Rai, Anant Bahadur, Rajeev Kumar
21.	Genome-wide SNP discovery for development of high-density genetic map and QTL mapping of multi-flowering and yield associated traits in vegetable pea (Pisum sativam L.)	Jyoti Devi	R.K. Dubey and Vidya Sagar
	DIVISION OF VEGETABLE PRODUCTION		
22.	Network Project on precision Agriculture (NePPA)	Anant Bahadur	Hare Krishna, Rajeev Kumar, S.K. Singh and Swati Sharma
23.	NASF-Sensor-based integrated vertical farming for horticultural crops and aquaponic system	Hare Krishna	Anant Bahadur and Swati Sharma
24.	Farmer FIRST Program on “Intervention of Improved Agricultural Technologies for Livelihood and Nutritional Security Adhering Local Resources and Working Knowledge of the Farmers	Neeraj Singh	Shubhadeep Roy, S.K. Singh and D.R. Bhardwaj
25.	Paid up trial for evaluation of the Nano-Urea on cabbage crop for one season (Rabi, 2023-24)	S.K. Singh	-

26.	Paid up trial on Kharif (Okra) for evaluation of the Nano Urea	S.K. Singh	-
27.	Paid-up trial on summer/kharif vegetables for evaluation of the Nano DAP	S.K. Singh	-
	DIVISION OF VEGETABLE PROTECTION		
28.	Establishment of biocontrol development center for production and promotion of bioagents to manage soil-borne diseases in vegetable crops	K.K. Pandey	Sudarshan Maurya, Nagendran K. (upto 22.12.2023) and Vijaya Rani (upto 08.12.2023)
29.	AICRP on Biological control of crop pests	J. Halder	A.N. Tripathi
30.	Strengthening and setting up of Nucleus Stock Development Centre in existing apiculture unit and development of Agri-Start-ups	Kuldeep Srivastava	Sudarshan Maurya, Jaydeep Halder, Shubhadeep Roy, Pratap A. Divekar and Sujan Majumdar
31.	Establishment of a referral laboratory for pesticide residue analysis in vegetable crops	Sujan Majumder	K.K. Pandey, Sudarshan Maurya, Nagendran K. (upto 22.12.2023) and Pratap Divekar
32.	Resistance monitoring studies in tomato early blight (*Alternaria solani*) for azoxystrobin fungicide	A.N. Tripathi	Sudarshan Maurya
33.	Baseline study of tomato powdery mildew pathogen against a fungicide molecule (Adepidyn)	A.N. Tripathi	Sujan Majumdar
34.	Resistance monitoring studies in tomato early blight (*Alternaria* spp.) against Pydiflumetofen	A.N. Tripathi	Jagesh Kumar Tiwari

Annexure IV

DISTINGUISHED VISITORS

Shri Narendra Singh Tomar Hon'ble Agriculture and Farmers Welfare Minister, Government of India	09 Januray, 2023
Shri. Surya Pratap Shahi Hon'ble Minister for Agriculture, Agricultural Education & Research, Govt. of U.P.	12 March 2023
Dr. Alok Srivastava Director, NBAIM, Mau	12 March 2023
Dr. K.G. Mandal Director, MGIFRI, Motihari,	12 March 2023
Dr. Aseem Rai MLA, Tamkuhiraj	12 March 2023
Dr. P.V. Vara Prasad Professor Kansas State University, USA	15 June, 2023
Dr. Prakash Jha Assit. Prof., Mississippi State University, USA & Youth 20 Representative & Advisor	15 June, 2023
Dr. Pramod Kumar Mishra Principal Secretary to the Hon'ble Prime Minister of India	28 September, 2023
Shri Devesh Chaturvedi Additional Chief Secretary of Uttar Pradesh	28 September, 2023
Dr. Tilak Raj Sharma Deputy Director General (Crop Science & Horticultural Science), ICAR, New Delhi	28 September, 2023
Shri Kaushal Raj Sharma PMO officials, Varanasi Divisional Commissioner	28 September, 2023
Shri S. Rajalingam District Magistrate	28 September, 2023
Dr. Sanjay Kumar Singh Director General, UPCAR Lucknow	28 September, 2023

Shri PC Gaddigoudar Hon'ble Lok Sabha MP & Chairman of the Parliamentary Standing Committee on Agriculture, Animal Husbandry And Food Processing	24 June 2023
A. Ganesh Murthy Hon'ble MP, Lok Sabha	24 June 2023
Kanakamal Katara Hon'ble MP, Lok Sabha	24 June 2023
Devji Mansinghram Patel Hon'ble MP, Lok Sabha	24 June 2023
Sharda Anil Kumar Patel Hon'ble MP, Lok Sabha	24 June 2023
Bhimrao Baswantrao Patil Hon'ble MP, Lok Sabha	24 June 2023
Vinayak Bhaurao Raut Hon'ble MP, Lok Sabha	24 June 2023
Pocha Brahmananda Reddy Hon'ble MP, Lok Sabha	24 June 2023
Virendra Singh Hon'ble MP, Lok Sabha	24 June 2023
Ramilaben Becharbhai Bara Hon'ble MP, Rajya Sabha	24 June 2023
Mastan Rao Beeda Hon'ble MP, Rajya Sabha	24 June 2023
Anil Sukhdevrao Bonde Hon'ble MP, Rajya Sabha	24 June 2023
S. Kalyanasundaram Hon'ble MP, Rajya Sabha	24 June 2023
Ram Nath Thakur Hon'ble MP, Rajya Sabha	24 June 2023

PRINT MEDIA COVERAGE

कैंसर, शुगर, मोटापा कम करेगी 'काशी तृप्ति' मटर



80 दिन में ही तोड़ाई शुरू

प्रशिक्षु आइएएस पहुंचे आइआइवीआर

प्रशिक्षु आईएएस अधिकारियों का आईआईवीआर भ्रमण

भारत दर्शन कार्यक्रम

संस्थान की गतिविधियों से परिचित कराया गया

गंगा के दियारा में सब्जी उत्पादन पर किसानों को किया जागरूक

गंगा के कछार में कद्दूवर्गीय सब्जी उगाने पर जोर

आईआईवीआर ने कंपनियों को सहयोग का दिया भरोसा

बैठक भ्रमण

भारतीय सब्जी अनुसंधान संस्थान के सब्जी बीजों में निजी कंपनियों ने दिखाई रुचि

स्वछता जागरूकता कार्यक्रम आयोजित

वाराणसी। किसान इंटर कॉलेज, मिर्जामुराद के परिसर में विद्यार्थियों के बीच स्वच्छता जागरूकता कार्यक्रम का आयोजन भारतीय सब्जी अनुसंधान संस्थान, वाराणसी के द्वारा निदेशक डॉ तुषार कांति बेहेरा के दिशा निर्देशन पर किया गया। कृषि अपशिष्टों से समृद्धि की थीम पर आधारित स्वच्छता कार्यक्रम का प्रमुख उद्देश्य ग्रामीण परिवेश के विद्यार्थियों में गाँव देहात के खेत खलिहानों एवं घरों से निकलने वाले सब्जियों एवं अन्य फसलों के अपशिष्टों के समुचित प्रबंधन पर जानकारी देना था जिससे आगे चलकर यही बच्चे टेक्नोलॉजी-आधारित विकल्पों के माध्यम से गाँवों मे व्याप्त कृषि अपशिष्ट जैसे पराली आदि का प्रबंधन करके उसे मूल्यगत उत्पादों में बदल कर आर्थिक लाभ ले सकें। कार्यक्रम में वैज्ञानिकों का स्वागत करते हुए प्रधानाचार्य डॉ शिवराज मिश्र ने संस्थान के प्रयास की प्रशंसा करते हुए कहा कि ग्रामीण क्षेत्र के विद्यार्थियों के बीच में अपशिष्ट से समृद्धि विषयक कार्यक्रम उनके ज्ञानवर्धन के लिये उपयोगी होने के साथ ही उन्हें अपने घर के ही संसाधनों के सार्थक उपयोग के लिए प्रेरित करेगा।

सूक्ष्मजीव इनोकुलेंट स्वस्थ फसलों के लिए उपयोगी

जक्खिनी/वाराणसी। भारतीय सब्जी अनुसंधान संस्थान में निदेशक डॉ. तुषार कांति बेहेरा की निर्देशन में क्रियान्वित हो रही फार्मर्स फर्स्ट परियोजना के अंतर्गत बंगालीपुर गांव के प्रगतिशील किसानों को संस्थान ने मटर की उन्नत किस्म काशी उदय के बीज का वितरण किया। किसानों को संस्थान द्वारा विकसित किये जा रहे सूक्ष्मजीव इनोकुलेन्ट बीसी 6 जो मूलतः बैसिलस जीवाणुओं का कॉन्सोर्टिया है, के द्वारा बीज शोधन का सजीव प्रदर्शन प्रधान वैज्ञानिक डॉ. डीपी सिंह ने किया। फसल उन्नयन विभाग के विभागाध्यक्ष डॉ. नागेंद्र राय द्वारा किसानों को मटर की फसल के बीज शोधन के लिए पाउडर एवं तरल बीसी 6 कॉन्सोर्टिया भी वितरित किया गया। इस अवसर पर उपस्थित प्रधान वैज्ञानिक डॉ. नीरज सिंह ने परियोजना के तहत किसानों को दी जाने वाली सुविधाओं के बारे में चर्चा की। समन्वयक डॉ. सुभदीप रॉय रहे।

दियारा में सब्जी उत्पादन पर वैज्ञानिकों ने किसानों को किया जागरूक

शोध के लिए बीएचयू व आईसीएआर के बीच एमओयू

अच्छी उपज के लिए लें आईआईवीआर वैज्ञानिकों की मदद

कृषक पाठशाला

भारतीय सब्जी अनुसंधान संस्थान वाराणसी की ओर से अदलपुरा में कद्दूवर्गीय सब्जी विषयक जागरूकता एवं प्रशिक्षण कार्यक्रम

भोजन में सब्जियों का करें अधिक सेवन

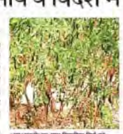
कार्यशाला

आईआईवीआर के राष्ट्रीय कृषि विज्ञान अकादमी वाराणसी चैप्टर का जागरूकता कार्यक्रम

हाईटेक नर्सरी से जुड़ेंगी स्वरोजगारी महिलाएं

शहंशाहपुर के आईआईवीआर में बन रहे जिला स्तरीय दो नर्सरियों का सीडीओ ने लिया जायजा

किसानों की आय व विदेश में धाक बढ़ाएगी 'काशी गरिमा'



अरुणाचल प्रदेश के किसानों को दिए सब्जी के बीज

वाराणसी। भारतीय सब्जी अनुसंधान संस्थान (आइआइवीआर) की ओर से अरुणाचल प्रदेश के किसानों को सब्जियों के बीज का मिनी किट वितरण किया गया। संस्थान के निदेशक डॉ. तुषार कांति बेहेरा ने बताया कि बीते 17 जून को केंद्रीय कृषि विश्वविद्यालय के उद्यान एवं वानिकी महाविद्यालय, पासीघाट, अरुणाचल प्रदेश में किसान सम्मेलन एवं कृषि इनपुट के वितरण का आयोजन किया गया। इसमें हिस्सा लेने वाले अरुणाचल प्रदेश राज्य के 120 किसानों को सब्जियों के बीज बांटे गए। चीन भारत के सीमावर्ती इलाकों के किसानों की सुविधा के लिए छिड़काव मशीन, फावड़ा आदि कृषि यंत्र बांटे गए।

सब्जी उत्पादन में तकनीकी सपोर्ट पर बल

वाराणसी। किसान दिवस के अवसर पर आज 23 दिसंबर,2023 को भा.कृ.अनु.प.-भारतीय सब्जी अनुसंधान संस्थान, वाराणसी द्वारा ग्राम शाहंशाहपुर में किसान दिवस व स्वच्छता पखवाड़ा (16 से 31 दिसम्बर) का आयोजन किया गया। संस्थान के निदेशक डॉ. तुषार कान्ति बेहरा द्वारा कार्यक्रम में उपस्थित 100 किसानों को सम्बोधित किया गया, जिसमें निदेशक ने युवा किसानों को कृषि क्षेत्र में उद्यमी बनने कि सलाह दी। यह मिर्च बेल्ट होने के कारण किसानों को हरी मिर्च का उचित मूल्य न मिलने कि स्थिति में एफ. पी. ओ. के माध्यम से हरी मिर्च पाउडर बनाने कि तकनीकी सपोर्ट देने पर बल दिया गया। संस्थान व एफ. पी. ओ. द्वारा किसानों को हाई-टेक नर्सरी में तैयार मिर्च के पौध उपल्ब्ध कराने और संस्थान की देख रेख में किसानों द्वारा सब्जी बीज उत्पादन करने हेतु किसानों को प्रोत्साहित किया गया। इसी क्रम में संस्थान के तीनों विभागाध्यक्ष डॉ नागेन्द्र राय (फसल सुधार), डॉ अनन्त बहादुर (फसल उत्पादन), डॉ अरविन्द नाथ सिंह (फसल सुरक्षा) ने किसानों को सब्जी उत्पादन कैसे बढ़ाए एवं रोग व किटो को कैसे नियन्त्रित किया जाए, इस विषय पर चर्चा की। इसी क्रम में संस्थान के वैज्ञानिक डॉ. शुभादीप रॉय ने भी संस्थान की उन्नतशील किस्मो से किसानों को अवगत कराया। इस कार्यक्रम में संस्थान के वैज्ञानिक वाई. एस. रेड्डी उपस्थित रहें। कार्यक्रम के अन्त में स्वच्छता पखवाड़ा के उपलक्ष्य में संस्थान के निदेशक, विभागाध्यक्ष, वैज्ञानिक व किसानों ने बढ़ चढ़ कर स्वच्छता कार्यक्रम में भाग लिया और प्रण किया की हम इसी प्रकार अपने गाँव व घर को स्वच्छ एवं साफ रखेगें।

भारतीय सब्जी अनुसंधान संस्थान की २८ किस्में विमोचित

डॉक्टर ए.के.सिंह(उप महानिदेशक बागवानी, भारतीय कृषि अनुसंधान परिषद, नई दिल्ली) की अध्यक्षता में बागवानी

फसलों की किस्मों का विमोचन एवं अधिसूचना, मानक की केंद्रीय उप समिति की ३० वीं बैठक में संपन्न हुई। बैठक में देशभर से किस्मों को अधिसूचित किया जाता है। भारतीय सब्जी अनुसंधान संस्थान, की ओर से विकसित विभिन्न फसलों में अधिसूचना के लिए प्रस्ताव दिया गया था। बैठक में समिति की ओर से सभी २८ किस्मों को अधिसूचित करने की अनुमति दी गयी जिसमें से १९, उत्तर प्रदेश सरकार और नौ अखिल भारतीय सब्जी परियोजना द्वारा रिलीज की गयी थी। इन किस्मों में जिन नयी प्रजातियों का विकास किया गया है, उसमें से चौराई चौराई में काशी चौराई, कलमी साग में काशी मनु, पंखिया सेम में काशी अन्नपूर्णा, मटर में काशी पूर्वी एवं काशी तृप्ति, भिंडी में काशी सहिष्णु, काशी प्राक्रम, काशी उत्कर्ष, बैंगन में काशी उत्सव, काशी मोदक एवं काशी उत्तम, मिर्च में गरिमा, बाकला में काशी संपदा, तरबूज में काशी मोहिनी, पालक में काशी बारहमासी, परवल में काशी परवल-१४१, टिंडा में काशी हरी, तोरई में काशी नन्दा, चिकनी तोरई में काशी वंदना, खीरा में काशी नूतन, सेम में काशी चौनी सेम १४, काशी चौनी सेम १८, ककड़ी में काशी विधि, मूली में काशी अनुराग, करेला में काशी प्रतिष्ठा, लौकी में काशी शुभ्रा एवं अधिक तापमान में उगने वाले टमाटर की दो किस्में काशी तपस एवं काशी अद्भुत, शामिल है। इस मौके पर संस्थान के निदेशक डॉक्टर तुषार कांति बेहरा ने सभी वैज्ञानिकों को इस सफलता के लिए बधाई दी और यह भी दिशा निर्देश दिया कि इन किस्मों को राजपत्र में अधिसूचित होने के बाद किसानों के बीच पहुँचाया जाय।

राज्य कर्मचारी संयुक्त परिष महामंत्री का कर्मचारियों ने f

राज्य कर्मचारी संयुक्त परिषद उ.प्र. के प्रांतीय महामंत्री अतुल मिश्र जी एवं उप महासचिव पूर्वांचल प्रभारी आनन्द मिश्र का शुक्रवार को काशी आगमन के अवसर पर श्री शिव प्रसाद गुप्त मंडलीय जिला चिकित्सालय कबीर चौरा में स्वागत एवं सम्मान संगोष्ठी का आयोजन सम्पन्न हुआ,जिसमें राज्यकर्मियों ने कर्मचारी नेतृत्व द्वय का फूल मालाओं से सम्मानित किया। इस अवसर पर राज्य कर्मचारी संयुक्त परिषद के जनपद अध्यक्ष शैलेंद्र कुमार सिंह, जनपद मंत्री राकेश कुमार सिंह, कर्मचारी शिक्षक संयुक्त मोर्चा के जनपद अध्यक्ष अरुण कुमार सिंह, फार्मेसिस्ट फेडरेशन उ.प्र. जनपद शाखा वाराणसी के अध्यक्ष जे.एस.उपाध्याय डिप्लोमा, फार्मेसिस्ट एसोसिएशन उ.प्र.जनपद शाखा मंत्री अरुण कुमार मौर्य, डिप्लोमा फार्मेसिस्ट राजपत्रित अधिकारी एसोसिएशन उ.प्र. के जनपद मंत्री जे.के. सिंह, नेत्र परीक्षण अधिकारी के प्रान्तीय महासचिव (उ.प्र. राजकीय आप्टोमेट्रिस्ट एसोसिएशन) अनुराग मिश्र, चेयरमैन संघर्ष समिति राज्य कर्मचारी संयुक्त परिषद उ.प्र. वाराणसी अखिलेश कुमार सिंह, लैब टेक्निशियन एसोसिएशन उ.प्र. के मंडलीय सचिव एन.बी. सिंह सहित अनेक

सब्जियों के संकर बीज उत्पादन की दे रहे ट्रेनिंग

शुभारंभ

आईआईवीआर शहंशाहपुर में पांच दिनी प्रशिक्षण कार्यशाला में हिस्सा ले रहे दस प्रदेशों के वैज्ञानिक व अन्य

जनसंदेश न्यूज

वाराणसी। शहंशाहपुर स्थित भारतीय सब्जी अनुसंधान संस्थान यानि आईआईवीआर में सोमवार को पांच दिनी प्रशिक्षण कार्यशाला का शुभारंभ हुआ। 'बदलते जलवायु परिदृश्य में सब्जियों का संकर बीज उत्पादन' विषयक यह कार्यशाला सब्जियों में संकर बीज उत्पादन के महत्व को ध्यान में रखते हुए आयोजित किया गया है। कार्यक्रम में उत्तर प्रदेश समेत केरल, असम, छत्तीसगढ़, पश्चिम बंगाल, नागालैंड, महाराष्ट्र, नई दिल्ली, झारखंड, तमिलनाडु के संबंधित तकनीकी अधिकारी एवं वैज्ञानिक हिस्सा ले रहे हैं। कार्यशाला का उद्घाटन मुख्य अतिथि जनपद के अतिरिक्त पुलिस आयुक्त डॉ. एस. चिनप्पा ने किया। उन्होंने मानव जीवन में पोषण सुरक्षा एवं सब्जियों के महत्व पर प्रकाश डाला। आईआईवीआर के निदेशक डॉ. टीके बेहरा ने दस प्रदेशों से आये वैज्ञानिकों व अन्य संबंधित प्रतिनिधियों को संस्थान की गतिविधियों की जानकारी दी। साथ ही बदलते जलवायु परिदृश्य में सब्जियों के संकर बीज उत्पादन के महत्व के बारे में बताया।

इस अवसर पर संस्थान में सब्जियों के संकर बीज उत्पादन के क्षेत्र में किए जा रहे अनुसंधान कार्यों पर भी चर्चा हुई। वर्कशॉप में भारतीय कृषि अनुसंधान परिषद के विभिन्न संस्थानों, राज्य कृषि विश्वविद्यालयों एवं कृषि विज्ञान केंद्रों के प्रतिनिधियों ने कई बिंदुओं पर विशेषज्ञ वैज्ञानिकों के साथ विचार-विमर्श किया। डॉ. शुभादीप राय के संचालन में आईआईवीआर के विभिन्न अनुभागों के विभागाध्यक्ष, परियोजना समन्वयक, वैज्ञानिक, अफसर और कर्मचारियों की उपस्थिति रही। अंत में डॉ. राजीव कुमार ने आभार व्यक्त किया।

खेती में जैविक विकल्पों को बढ़ावा देने पर जोर

दिये गये टिप्स

सब्जी अनुसंधान केंद्र पर किसानों को दिया गया प्रशिक्षण

गोरखपुर। भारतीय सब्जी अनुसंधान संस्थान शाहंशाहपुर में किसानों को खेती में जैविक विकल्पों को बढ़ावा देने का मंगलवार को प्रशिक्षण दिया गया। ...

वाराणसी जागरण

अधिक तापमान में भी एक हेक्टेयर में 40 से 50 टन तक होगी उपज

गर्मी में पैदा होने वाली टमाटर की किस्में विकसित

भारतीय सब्जी अनुसंधान संस्थान की विकसित सब्जी की 28 किस्में जारी

बिहार के किसान सीखेंगे उन्नतशील सब्जी फसल उत्पादन टेक्नोलॉजी

बिहार के प्रशिक्षु किसानों के साथ आईआईवीआर के वैज्ञानिक

वाराणसी। भारतीय सब्जी अनुसंधान संस्थान, वाराणसी के निदेशक डॉ. तुषार कांति बेहरा के दिशा-निर्देश में "उन्नतशील सब्जी उत्पादन तकनीकों" विषय पर पांच दिवसीय प्रशिक्षण का मंगलवार को शुभारम्भ हुआ। इसमें गया-बिहार के किसान उन्नतशील सब्जी फसल उत्पादन टेक्नोलॉजी से अवगत होंगे।

यह प्रशिक्षण कार्यक्रम संस्थान की जोनल प्रौद्योगिकी प्रबंधन इकाई की तरफ से आयोजित किया गया है, जिसमें सब्जी उत्पादन की उन्नतशील तकनीकों के बारे में किसानों को

प्रशिक्षण शिविर

आईआईवीआर में पांच दिवसीय फसल गुणवत्ता प्रबंधन और जैविक समावेशन पर जोर

प्रशिक्षण दिया जा रहा है। इस प्रशिक्षण कार्यक्रम को बिहार सरकार के कृषि विभाग के आत्मा प्रकोष्ठ की तरफ से प्रायोजित किया गया है, जिसमें गया जिले के 25 किसान भाग ले रहे हैं। इस कार्यक्रम में संस्थान के वैज्ञानिकों द्वारा उन्नतशील प्रजातियां, फसल उत्पादन की आधुनिक तकनीक, फसल उत्पादन सुरक्षा, प्राकृतिक और जैविक खेती में सूक्ष्म जीवों की भूमिका, सब्जियों में ग्राफ्टिंग तकनीक एवं सब्जियों का संरक्षित वातावरण में खेती और पौधशाला प्रबंधन आदि विषयों पर प्रशिक्षण दिया जायेगा।

कृषि अपशिष्टों से समृद्धि व स्वच्छता पर किया जागरूक

कृषि अपशिष्टों के टेक्नोलॉजी आधारित प्रबंधन से मूल्यगत उत्पाद

...ताकि गंगा को कृषि रसायनों से बचा सकें

कवायद

भारतीय सब्जी अनुसंधान संस्थान गंगा के कछार में सब्जी की खेती करने वाले किसानों को कर रहे जागरूक

जनसंदेश न्यूज

खेतों में बढ़िया रिजल्ट दे रहीं सब्जियां

भारतीय सब्जी अनुसंधान संस्थान में 3 विभागाध्यक्ष

जनसंदेश न्यूज

गंगा के कछार में जैविक खेती का दिया प्रशिक्षण

- कहा, रसायन के प्रयोग से गंगा में भी बढ़ रहा प्रदूषण
- कद्दूवर्गीय और टमाटर की खेती के बताए तरीके

सब्जियां किसानों की आय बढ़ाने में सहायक

Impact of climate change on vegetable crops discussed

भारतीय सब्जी अनुसंधान संस्थान की 28 किस्में विमोचित

स्वरोजगारी महिलाएं सीख रहीं मशरूम प्रसंस्करण कार्य

रोहनिया। शहंशाहपुर स्थित भारतीय सब्जी अनुसंधान संस्थान यानि आईआईवीआर की ओर से जनपद के गांवों में संचालित महिला स्वरोजगार समूहों को मशरूम उत्पादन एवं उसके प्रसंस्कृत उत्पादों की ट्रेनिंग दी जा रही है। इस क्रम में धानापुर आदि गांवों में यह कार्यक्रम किया गया। जिसके तहत स्वरोजगारी महिलाओं को कृषि उद्यमिता विकास के लिए रोजगारपरक विधियां बतायी गईं। प्रधान वैज्ञानिक डॉ सुदर्शन मौर्य ने मशरूम स्पान उत्पादन के विभिन्न पहलुओं की जानकारी दी। उन्हें तकनीक, पैकिंग एवं विपणन, फ्रेश फ्रूट प्रोडक्ट समेत उसका सब्जियों के रूप में उपयोग आदि के बारे में बताया गया। कार्यशाला में डॉ. डीपी सिंह, अनुराग चौरसिया, गोविंद सिंह आदि की प्रमुख उपस्थिति रही।

प्रगतिशील किसानों को बांटे बीज

वाराणसी। भारतीय सब्जी अनुसंधान संस्थान की ओर से फार्मर्स फर्स्ट परियोजना के तहत गुरुवार को प्रगतिशील किसानों को मटर की उन्नत किस्म 'काशी उदय' बीज बांटा गया। इस मौके पर संस्थान द्वारा विकसित सूक्ष्मजीव इनोकुलेंट बीसी 6 के जरिये बीज शोधन का सजीव प्रदर्शन प्रधान वैज्ञानिक डॉ. डीपी सिंह ने किया। उन्होंने बताया कि माइक्रोबियल यानी सूक्ष्मजीव इनोकुलेंट के व्यापक उपयोग से किसान अपने खेतों में नाइट्रोजन, फॉस्फोरस, पोटाश एवं सूक्ष्मतत्वों जैसे जिंक आदि का जैविक एवं प्राकृतिक रूप से प्रबंधन कर सकते हैं। साथ ही इनके माध्यम से मिट्टी की उर्वरता बढ़ाने सहित रसायनों पर निर्भरता भी कम करना संभव है। कार्यक्रम में डॉ. नागेंद्र राय, डॉ. नीरज सिंह, डॉ. शुभदीप रॉय आदि ने भी कई जानकारी दी।

आइआइवीआर में एक हाईटेक नर्सरी तैयार

जागरण संवाददाता, वाराणसी : किसानों की आय दोगुनी करने के लिए नीति आयोग के निर्देश पर प्रदेश सरकार की ओर से जिले में तीन हाईटेक वेजिटेबल सीडलिंग उत्पादन इकाई यानी मिनी सेंटर आफ एक्सीलेंस फार वेजिटेबल स्थापित होनी है। इसके तहत भारतीय सब्जी अनुसंधान संस्थान (आइआइवीआर) में एक इकाई बनकर तैयार हो गई है जबकि दूसरी का 80 प्रतिशत तक कार्य पूरा हो चुका है। वहीं एक इकाई केवीके में भी प्रस्तावित है।

जिला उद्यान अधिकारी सुभाष कुमार ने बताया कि यह मनरेगा के तहत स्थापित की जा रही है। एक इकाई की लागत 1.29 करोड़ रुपये है। इस इकाई से आच्छादित शाक भाजी क्षेत्रफल के सापेक्ष 23.4 प्रतिशत से उत्पादन बढ़ाकर 34 प्रतिशत करने का लक्ष्य है। इसके माध्यम से हाई वैल्यू सब्जी उत्पादन होगा, जिससे किसानों की आय में वृद्धि होगी और रोजगार भी सृजन होगा। इन इकाइयों का संचालन उत्तर प्रदेश राज्य ग्रामीण आजीविका मिशन की ओर से होगा।

प्रत्येक इकाई से एक सीजन में 15 लाख पौधे का उत्पादन किया जाएगा, जो किसानों को लागत मूल्य के 10 प्रतिशत लाभांश पर सुलभ हो सकेगा। वर्तमान में यदि जनपद का कोई किसान स्वयं का उन्नतशील बीज जमाव के लिए इकाई को उपलब्ध कराता है तो उसे पौध तैयार कराने के लिए एक रुपये रुपये प्रति पौध शुल्क देना होगा। सुभाष कुमार ने बताया कि इकाई पर उत्पादित शाक भाजी पौध 2.24 रुपये की दर से उपलब्ध है, जिसमें बीज व उत्पादन लागत भी शामिल है। उन्होंने बताया कि संस्थान के साथ अन्य सारी प्रक्रियाएं पूरी कर ली गई हैं। जल्द ही समझौता पत्र हस्ताक्षरित के बाद बीज मुहैया कराया जाने लगेगा।

आइआइवीआर में तैयार हाईटेक वेजिटेबल सीडलिंग उत्पादन इकाई का निरीक्षण करते अधिकारी।

- किसानों की आय दोगुनी करने में मिलेगी मदद, उत्पादन लक्ष्य होगा 34 प्रतिशत
- प्रत्येक इकाई से एक सीजन में 15 लाख पौधों का उत्पादन किया जाएगा

अनुसंधान केंद्र पर किसानों को दिया गया प्रशिक्षण

सूक्ष्मजीव अनुकल्प रसायन-मुक्त खेती में सशक्त जैविक विकल्प

पायनियर समाचार सेवा। वाराणसी

भारतीय सब्जी अनुसंधान संस्थान, वाराणसी के वैज्ञानिकों द्वारा किसानों को खेती में जैविक विकल्पों को बढ़ावा देने के लिए आज वाराणसी एवं मिर्जापुर जनपद के ग्राम कादीचक एवं नक्कूपुर से आये 50 किसानों को एक दिवसीय प्रशिक्षण कार्यक्रम के माध्यम से प्रशिक्षण दिया गया। संस्थान के निदेशक डॉ तुषार कांति बेहेरा के निर्देशन में किसानों के बीच खेतों में जैविक संसाधनों को बढ़ावा देने हेतु कार्यक्रम नियमित रूप से चलाए जा रहे हैं। इसी क्रम में खेतों में आयोजित जैविक संसाधन संवर्धन कार्यक्रम का संचालन संस्थान के कार्यकारी निदेशक एवं फसल उन्नयन विभाग के अध्यक्ष डॉ. नागेन्द्र रॉय के दिशा निर्देश में किया गया।

सहारा www.rashtriyasahara.com

सब्जियों का कृषि विविधिकरण किसानों की आय दोगुनी करने में सहायक

भारतीय सब्जी अनुसंधान संस्थान का मनाया गया 33वां स्थापना दिवस समारोह

उच्च तापमान में सब्जी प्रबंधन की दी जानकारी

वाराणसी। भारतीय सब्जी अनुसंधान संस्थान ने खाद्य सुरक्षा के तहत बुधवार को 'यूथ-20' के सहयोग से सब्जियों में उच्च तापमान प्रबंधन पर वैश्विक युवा जागरुकता वार्ता का आयोजन हुआ। मुख्य अतिथि कंसास स्टेट यूनिवर्सिटी अमेरिका के डिस्टिंग्विश्ड प्रोफेसर डॉ. पीवी वरा प्रसाद थे। उन्होंने उच्च तापमान में सब्जी प्रबंधन की जानकारी दी। ग्लोबल वॉर्मिंग पर चर्चा करते हुए उच्च तापमान में सब्जी की फसलों में होने वाले विभिन्न प्रभावों की ओर ध्यान दिलाया। यूथ-20 के प्रतिनिधि एवं सलाहकार मिसिसिपी स्टेट यूनिवर्सिटी अमेरिका के डॉ. प्रकाश झा ने यूथ-20 के अंतर्गत होने वाली गतिविधियों के बारे में बताया। आरंभ में संस्थान के निदेशक डॉ. टीके बेहेरा ने संस्थान में सब्जियों पर हो रहे शोध के बारे में जानकारी दी। अंत में फसल सुधार संभाग अध्यक्ष डॉ. नागेंद्र राय ने आभार व्यक्त किया।

Talk on food security

PIONEER NEWS SERVICE ■ VARANASI

The ICAR-IIVR (Indian Institute of Vegetable Research), Varanasi in association with Y20 (G20 Sub-theme) organised a Global Youth Awareness Talk on Food Security on the topic of Abiotic Stress Management in Vegetable Crops: High-Temperature Stress. Speaking in the event, Prof PV Vara Prasad, Director of the Feed the Future Sustainable Intensification Innovation Lab at Kansas State University, USA highlighted the impact of high temperature on crops and how this climate change will affect crop production in general and production of vegetable crops in particular.

He focused his lecture on two very important vegetable crops tomato and pepper, and the mechanism associated with heat stress tolerance in these crops and said that anthesis (flowering) is the most vulnerable stage to heat stress and it can be managed to a greater extent through different practices. Development of heat stress tolerant varieties is the best solution for getting higher production in the heat stress environment, he added. Dr Prakash Kumar Jha, Assistant Professor, Mississippi State University, USA highlighted the activity of Y20 in the country. He also spoke about the PhD and Post Doctoral opportunities in the USA. Dr TK Behera, Director ICAR-IIVR welcomed the speaker and briefly highlighted the on-going activities of the ICAR-IIVR, Varanasi. This Y20 programme was coordinated by Dr Vidya Sagar and Dr Nakul Gupta, and programme convenor was Dr Jyoti Devi, Scientist, ICAR-IIVR, Varanasi. This programme was attended by all the scientific staff, SRF, Young Professionals and students. At the end of the programme, Dr Nagendra Rai, Head, Division of Crop Improvement, ICAR-IIVR, Varanasi proposed the formal vote of thanks.

काशी मनु : एक बार बोआई और तीन साल तक होती रहेगी कटाई

मुकेश चंद्र श्रीवास्तव, वाराणसी

- भारतीय सब्जी अनुसंधान संस्थान ने कलमी या करमुआ साग की नई किस्म का बीज जारी किया
- पोखरों और जलाशयों के किनारे पाए जाने वाला यह साग किसानों की आय बढ़ाएगा, सेहत भी सुधारेगा

डा. तुषार कांति बेहेरा डा. आर के दुबे। फाइल

कलमी साग की नई किस्म। सौ. आइआइवीआर

100 ग्राम में पोषण का खजाना	
पोषक तत्व	मात्रा
कैल्शियम	141.92 मिग्रा
आयरन	59.67 मिग्रा
मैग्निशियम	462.22 मिग्रा
जिंक	1.59 मिग्रा
प्रोटीन	197.13 मिग्रा
फाइबर	2.19 ग्राम
विटामिन-ए	133 मिग्रा
कैलोरी	5.9

पोखरों, जलाशयों या पानी से डूबी जमीन पर स्वयं उगने वाला कलमी साग या करमुआ साग अब किसानों के खेतों तक पहुंचकर उनकी आय बढ़ाएगा, लोगों को पोषण भी देगा। वाराणसी स्थित भारतीय सब्जी अनुसंधान संस्थान (आइआइवीआर) ने करमुआ साग की नई किस्म 'काशी मनु' विकसित की है। प्रयोगशाला में सफल प्रयोग के बाद अब नई दिल्ली स्थित भारतीय कृषि अनुसंधान परिषद की केंद्रीय उपसमिति ने नई किस्म के बीज को किसानों के लिए जारी किया है।

भारतीय सब्जी अनुसंधान संस्थान अब इसके बीज किसानों को उपलब्ध करा रहा है, ताकि इसकी व्यावसायिक खेती कर सकें। किसानों द्वारा जो फसलें उगाई जाएंगी, संस्थान द्वारा उस पर भी निगरानी रखी जाएगी, जिससे यह पता लगाया जाएगा कि व्यवहारिक रूप से यह उपभोक्ताओं के लिए सेहतमंद और किसानों के लिए फायदेमंद साबित होगा। संस्थान के निदेशक डा. तुषार कांति बेहेरा ने बताया कि काशी मनु को खेत में एक बार लगाने के बाद साल में तीन से चार बार इसकी फसल काट सकते हैं। इसका पौधा दो से तीन साल तक चलता है। घर की छत पर, गमले या किचन गार्डन में उगाकर वर्ष भर इस साग की उपलब्धता सुनिश्चित की जा सकती है। काशी मनु का बीज विकसित करने वाले संस्थान के प्रधान विज्ञानी डा. राकेश कुमार दुबे ने बताया कि करमुआ साग की अभी तक कोई किस्म नहीं थी और यह खुद ही तालाबों, जलमग्न भू-भाग में उग जाता था। तालाब आदि में होने के कारण यह प्रदूषित होता था। संस्थान द्वारा विकसित काशी मनु को मिट्टी में उगाया जाता है। अन्य पत्तेदार सब्जियों के मुकाबले इसमें पोषक तत्वों जैसे जिंक, आयरन, एंटी आक्सीडेंट के साथ-साथ प्रोटीन की मात्रा काफी अधिक होती है। इसमें कैरोटीन और कई खनिज तत्व भी पाए जाते हैं। एक हेक्टेयर खेत में इसकी सालाना औसत उपज 900-1000 क्विंटल तक है और बाजार में 25-30 रुपये प्रति किलो तक बिकता है। इस तरह प्रति हेक्टेयर किसान को इससे तीन लाख रुपये तक आमदनी होती है। डा. राकेश ने बताया कि बीज व कलम भारतीय सब्जी अनुसंधान संस्थान में उपलब्ध है। कोई भी किसान संस्थान इसे ले सकता है।

गंगा के कछार में जैविक खेती का दिया प्रशिक्षण

- कहा, रसायन के प्रयोग से गंगा में भी बढ़ रहा प्रदूषण
- कद्दूवर्गीय और टमाटर की खेती के बताए तरीके

वाराणसी, प्रमुख संवाददाता। गंगा के कछार की बलुई मिट्टी में पोषक तत्वों की कमी दूर करने, पाला और कीटों के अत्यधिक प्रकोप से कद्दूवर्गीय सब्जियों को बचाने के लिए भारतीय सब्जी अनुसंधान संस्थान के वैज्ञानिकों ने शुक्रवार को अदलपुरा, मझवां व तराव में किसानों को प्रशिक्षण दिया।

वैज्ञानिकों ने किसानों को रासायनिक उर्वरकों और कीटनाशकों के खतरों से भी अवगत कराया। कहा कि इससे गंगा के जल में पेस्टिसाइड प्रदूषण बढ़ रहा है। इस समस्या से बचने के लिए किसानों को जैविक खेती के तौर तरीके बताए गए। कद्दूवर्गीय फसलों की खेती के साथ टमाटर और बैगन फसलों के जैव उत्पादन का भी प्रशिक्षण दिया। संस्थान के निदेशक डॉ. तुषार कांति बेहेरा के निर्देशन में प्रधान वैज्ञानिक डॉ. राकेश दुबे ने किसानों को सब्जियों के बीज एवं पौधे उपलब्ध कराए। मिट्टी की उर्वरता बढ़ाने एवं फसल सुरक्षा की लिए प्रधान वैज्ञानिक डॉ. डीपी सिंह एवं वैज्ञानिक डॉ. अनुराग चौरसिया ने जैव-प्रधान सूक्ष्मजीव उत्पादों को विकल्प के रूप में अपनाने की सलाह दी।

शिकायत के आधार पर चेकिंग कर उनका चालान किया गया है। संवाद

प्रस्ताव नई दिल्ली में हुई बैठक में आईआईवीआर के प्रजातियों को मिली अनुमति

किसान कर सकेंगे सब्जियों की 28 प्रजातियों की बोआई

संवाद न्यूज एजेंसी

वाराणसी। भारतीय कृषि अनुसंधान परिषद(भाकृअप) नई दिल्ली में बृहस्पतिवार को हुई बैठक में भारतीय सब्जी अनुसंधान संस्थान शहंशाहपुर की सब्जियों की 28 प्रजातियां दिखाई गईं। इन प्रजातियों की अनुमति मिलने से अब किसान इन सब्जियों की बोआई कर अच्छी कमाई कर सकते हैं।

भारतीय सब्जी अनुसंधान संस्थान द्वारा विकसित विभिन्न फसलों के प्रस्ताव दिए गए थे। कृषि अनुसंधान परिषद बागवानी के उप महानिदेशक डॉ. एके सिंह की अगुवाई में हुई

प्रजातियों को किसानों तक पहुंचाएं

भारतीय सब्जी अनुसंधान संस्थान ने वैज्ञानिकों को निर्देशित किया कि वे दिखाई गई प्रजातियों को किसानों के बीच पहुंचाएं, जिससे किसान अच्छी गुणवत्तायुक्त सब्जियों का पैदावार कर सकें।

बैठक में फसलों की प्रजातियों अधिसूचित करने की अनुमति दी गई। इसमें 19 उत्तर प्रदेश सरकार और नौ किस्मों को अखिल भारतीय सब्जी परियोजना ने रिलीज की है। इनमें काशी चौराई-1, कलमी साग में मनु, पंखिया सेम में काशी अन्नपूर्णा, मटर में काशी पूर्वी एवं तृप्ति, भिंडी में काशी सहिष्णु, प्राक्रम व उत्कर्ष, बैंगन में काशी उत्सव, मोदक एवं उत्तम, मिर्च में गरिमा, बाकला में काशी संपदा, तरबूज में काशी मोहिनी, पालक में काशी बारहमासी, परवल में काशी परवल-141, टिंडा में काशी हरी, तोरई में काशी नन्दा, चिकनी तोरई में काशी वंदना, खीरा में काशी नूतन, सेम में काशी बौनी सेम 14 एवं 18, ककड़ी में काशी विधि, मूली में काशी ऋतुराज, करेला में काशी प्रतिष्ठा, लौकी में काशी शुभ्रा एवं अधिक तापमान में उगने वाले टमाटर की दो प्रजातियां तपस एवं काशी अद्भुत शामिल हैं। संस्थान के निदेशक डॉ. तुषार कांति बेहरा ने वैज्ञानिकों को इस सफलता के लिए बधाई दी।

सब्जियों के उच्च तापमान प्रबंधन की तकनीक सीखी

वाराणसी। जी20 की तर्ज पर बुधवार को भारतीय सब्जी अनुसंधान संस्थान (आइआइवीआर) में यूथ20 (वाई-20) का आयोजन किया गया। इसमें युवाओं को सब्जियों में उच्च तापमान प्रबंधन की जानकारी दी गई। कार्यक्रम में संस्थान के निदेशक डॉ. टीके बेहेरा ने संस्थान में होने वाले सब्जियों पर शोध के बारे में जानकारी दी। इसमें अमेरिका विश्वविद्यालय के प्रो. डॉ. पीवी प्रसाद बतौर मुख्य अतिथि शामिल हुए। मिसिसिपी स्टेट यूनिवर्सिटी अमेरिका के सहायक प्राध्यापक और यूथ-20 के सलाहकार डॉ. प्रकाश झा ने वाई-20 के तहत होने वाली गतिविधियों के बारे में बताया। साथ ही विदेश में पढ़ाई के अवसर एवं चयन प्रणाली से भी रूबरू कराया। संवाद

Farmers told about cucurbit vegetable cultivation

TIMES NEWS NETWORK

Varanasi: The ICAR-Indian Vegetable Research Institute (IIVR), Varanasi, on Monday conducted an awareness cum training programme 'Krishak Pathshala' under the River bed cultivation project funded by the Uttar Pradesh Council of Agricultural Research (UPCAR) with an aim to generate awareness on modern advances in cultivation of cucurbit vegetables among the small and marginal farmers engaged in the [illegible] land cultivation on the banks of the Ganga basin.

More than [illegible] farmers took part in the program, [illegible] organised on the banks of the Ganga at [illegible] village in Mirzapur district. During the training, the farmers were appealed to reduce the use of insecticides/pesticides and [illegible] to keep the Ganga pure.

Presiding over the programme, the former vice-chancellor of the Mahatma Gandhi Gramodaya Vishwavidyalaya, Chitrakoot, Prof NC Gautam urged the farmers to cultivate high quality cucurbit varieties from IIVR and adopt scientific practices [illegible]. He praised the scientists working under the UPCAR project 'Identification of suitable variety/hybrids of cucurbitaceous crops and development of production protocol for better livelihood of riverbed farmers community'. [illegible]

4 **वाराणसी** वाराणसी। रविवार • 24 दिसम्बर • 2023 सहारा www.rashtriyasahara.com

प्रभु श्रीराम और माता सीता प्रेम, आस्था और विश्वास के शाश्वत प्रतिमान हैं। हमारे संस्कृति का प्रत्येक कण और समय का प्रत्येक क्षण उनकी कृपादृष्टि से ज्योतिर्मय है। आज अमरकंटक में राम-सीता मंदिर में जानकी मैया और प्रभु श्रीराम की लोकमंगलकारी छवि के पुण्य दर्शन कर संपूर्ण विश्व के कल्याण की कामना की। — शिवराज सिंह चौहान, पूर्व सीएम, म.प्र

संक्षिप्त खबरें

प्राथमिक विद्यालय में लगा बाल मेला

बाल मेला में प्रतिभाग करते छात्र।

[illegible]

विकसित भारत संकल्प यात्रा की लगी चौपाल

किसान सम्मान दिवस का हुआ आयोजन

किसानों के लिए जैविक खेती फायदेमंद

काशी विद्यापीठ/वाराणसी (एसएनबी)। [illegible]

जनपद स्तर पर 24 किसान हुए सम्मानित

[illegible]

भारतीय सब्जी अनुसंधान में मनाया गया किसान दिवस

जक्खिनी/वाराणसी (एसएनबी)। [illegible]

आईआईवीआर निदेशक ने शहंशाहपुर में लगायी झाड़ू

[illegible]

पोषण से भरपूर पंखिया सेम 'काशी अन्नपूर्णा' को लगे पंख

मुकेश चंद्र श्रीवास्तव • वाराणसी

भारतीय सब्जी अनुसंधान संस्थान (आइआइवीआर) द्वारा विकसित पंखिया सेम 'काशी अन्नपूर्णा' को पंख लग गए हैं। इसी माह नई दिल्ली में आयोजित भारतीय कृषि अनुसंधान परिषद से संबद्ध विमोचन एवं अधिसूचना मानक की केंद्रीय उप समिति की बैठक में इसका विमोचन किया जा चुका है।

यह एक अल्पदोहित दलहनी सब्जी है, जिसे अपने गुणों के कारण 'वंडर वेजिटेबल' भी कहते हैं। इसमें प्रचुर मात्रा में आवश्यक सभी पोषक तत्व पाए गए हैं। इसमें मौजूद रेशे का अच्छा स्रोत शरीर में कोलेस्ट्रॉल के स्तर को कम करता है। शाकाहारी व्यक्तियों के लिए पंखिया सेम सस्ते प्रोटीन का एक अच्छा विकल्प भी है। पंखिया सेम न केवल स्वादिष्ट होती है बल्कि इनमें बहुत से औषधीय गुण भी पाए जाते हैं। इसकी फलियों के अलावा इसकी हरी पत्तियां, फूल एवं कंदिल जड़ें भी खाई जा सकती हैं।

पंखिया सेम की फसल • जागरण

- विमोचन एवं अधिसूचना मानक की केंद्रीय उपसमिति कर चुकी है विमोचित
- पंखिया सेम में है रेशे की अच्छी स्रोत, कम करती है शरीर में कोलेस्ट्रॉल का स्तर
- यह अल्पदोहित दलहनी सब्जी अपने गुणों के कारण कहलाती है वंडर वेजिटेबल

पंखिया सेम से न केवल खाद्य पदार्थों में विविधता लाकर पोषण सुरक्षा होगी बल्की बहुत अधिक आर्थिक लाभ भी होगा। फलियां खनिज एवं विटामिन्स की भी अच्छी स्रोत है। इसमें प्रचुर मात्रा में फेनोल, फ्लवोनोइडस एवं एंटी आक्सीडेंट भी पाया जाता है। फलियां चार किनारों वाली है और किनारे पर पंख होने के कारण इसे पंखिया सेम कहते है। इसकी हरी फलियों में प्रोटीन की मात्रा लगभग 2.4 ग्राम प्रति 100 ग्राम खाने योग्य भाग में होती है।

– डा. तुषार कांति बेहेरा, निदेशक, भारतीय सब्जी अनुसंधान संस्थान, वाराणसी

पूर्वांचल समेत उत्तर भारत के किसानों के लिए इस प्रजाति का बीज उपलब्ध कराया जा रहा है। इस प्रजाति में जलवायु परिवर्तन के प्रति भी काफी अनुकूलन क्षमता देखी गई है। भविष्य में पंखिया सेम के निर्यात की भी प्रबल संभावना है। यह प्रजाति उत्तर प्रदेश के लिए अनुमोदित पंखिया सेम की पहली प्रजाति है जो कि देश के एक मात्र संस्थान आइआइवीआर द्वारा विकसित की गई है।

– डा. राकेश कुमार दुबे, प्रधान वैज्ञानिक, भारतीय सब्जी अनुसंधान संस्थान, वाराणसी

15–20	सेमी लंबी व हरे रंग की होती हैं काशी अन्नपूर्णा की फलियां	90	सेमी के अंतराल पर बनी पंक्तियों में करें बुआई
12–15	बीज पाया जाता है प्रत्येक फली में	55–60	दिनों में फूल आने लगते हैं
10–12	दिन बाद बीज में अंकुरण प्रारंभ	10–12	दिन बाद फलियां तुड़ाई के लिए तैयार
25–30	किग्रा बीज की आवश्यकता एक हेक्टेयर की बुआई में	350–400	क्विंटल प्रति हेक्टेयर है हरी फलियों की उपज

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Make vegetable farming employable, says Mishra

PIONEER NEWS SERVICE ■ VARANASI

PS to PM Dr PK Mishra addressing Foundation Day function at IIVR in Varanasi on Thursday

Principal Secretary to the Prime Minister (PM) Dr Pramod Kumar Mishra called upon the agricultural scientists to make vegetable farming employable and research on important topics like climate change, artificial intelligence, higher product value and processing is the need of the hour. He was speaking as the chief guest at the 33rd Foundation Day function of Indian Council of Agricultural Research (ICAR)-Indian Vegetable Research Institute (IIVR) here on Thursday.

Dr Mishra praised the research work of the ICAR-IIVR (Varanasi) and said that the IIVR has played an important role in the vegetable production scenario of India. "The farmers can increase and double their income by diversifying agriculture through vegetables," he said, expressing hope that planting material will be easily available to the farmers through hi-tech vegetable nurseries which will benefit lakhs of farmers of Uttar Pradesh.

Speaking as a special guest Additional Chief Secretary of Uttar Pradesh government Dr Devesh Chaturvedi said in his address that UP is a leading state in vegetable production and farmers of Purvanchal (eastern UP) are now earning more income by exporting vegetables abroad. Deputy Director General (Crop Science and Horticulture Science), ICAR, New Delhi, Dr Tilak Raj Sharma said that India is setting new dimensions every day in vegetable production and last year vegetables worth more than Rs 7,000 crore were exported.

The programme started with the inauguration of hi-tech vegetable nursery and plantation of trees in the institute campus. In his welcome address, IIVR Director Dr Tushar Kanti Behera highlighted the achievements of the institute so far and gave details of the action plan to double vegetable production by 2047.

On the occasion, various publications of the institute were released and for the best work after the year, Pradeep Karmakar in the scientific category, Sudhir Kumar in the technical category and Dr Manoj Kumar Pandey in the Agricultural Science Centre were given citations. The awards were also distributed to the school students. An agricultural exhibition was also organised on this occasion. In this ceremony, PMO officials, Divisional Commissioner (DC) Kaushal Raj Sharma, District Magistrate (DM) S Rajalingam, Director General, Uttar Pradesh Agricultural Research Council, Lucknow, Dr Sanjay Kumar Singh, officers of agriculture and horticulture departments of the state, the scientists, technical and administrative officers, support staff, research students, and senior officers of the institute apart from a large number of farmers and school students were also present.

The programme was conducted by Dr Dhananjay Pratap Singh, while the vote of thanks was proposed by Dr Sudhakar Pandey, Assistant Director General (Horticulture), ICAR.

NOTES

NOTES

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