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Old Air Field, PO-Rangreth, Srinagar 191132
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Dr. M. K. Verma,
Director, ICAR-CITH, Srinagar

Compiled & edited by:
M. K. Verma
O. C. Sharma
J. I. Mir
Geetika Malik
W.H. Raja
Arun Kishor
Mohd. Abas Shah
Sajad Un Nabi
Ronit Jaiswal

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ICAR-Central Institute of Temperate Horticulture,
Old Air Field, P.O.-Rangreth-191132, Srinagar (J&K), India.
Phone: 91-194-2305044, 2305045
E-mail: dircithsgr@icar.org.in
Website: cith.icar.gov.in

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Mobile: +91 9811622258

CONTENTS

1 EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

India has emerged as the world's second-largest producer of horticultural crops, largely due to its diverse agro-climatic conditions that support the cultivation of a wide variety of crops. In 2023–24, the country's horticultural output is estimated at 354.74 million tons, covering an area of 29.086 million hectares. The Himalayan states, with their favorable climate, are particularly well-suited for temperate horticulture, which plays a crucial role in sustaining rural livelihoods and the local economy. During this period, major temperate fruit crops were cultivated over significant areas, including apple (304 thousand ha), walnut (97 thousand ha), pear (35 thousand ha), plum (18 thousand ha), peach (17 thousand ha), almond (10 thousand ha), kiwifruit (4 thousand ha), and strawberry (3 thousand ha). To improve the productivity and quality of these crops, the ICAR–Central Institute of Temperate Horticulture (CITH), Srinagar, along with its regional stations at Mukteshwar (Uttarakhand) and Dirang (Arunachal Pradesh), has been actively engaged in developing region-specific technologies and improved varieties. Despite the region's potential, productivity levels remain lower than those in advanced countries. Since its establishment, the Institute has focused on crop improvement, production, protection, and post-harvest management, and has now evolved into a leading technological hub for temperate horticulture in India. A summary of its research and extension achievements during 2024 is outlined below.

Crop Improvement

ICAR-CITH, Srinagar, as the National Active Germplasm Site for temperate fruit crops, plays a key role in conserving and utilizing genetic diversity. Along with its regional stations at Mukteshwar and Dirang, the Institute is actively engaged in the collection, evaluation, characterization, and documentation of germplasm. In 2024, a total of 171 germplasm accessions of fruit, vegetable, and ornamental crops were collected and introduced in various forms such as plants, scion-wood, bulbs, runners, and seeds. Germplasm enrichment also continued at the regional stations, with efforts underway to establish mother orchards. Evaluation of different crops was carried out to identify elite genotypes for potential commercial cultivation.

A genome-wide association study (GWAS) in apple, using genotyping-by-sequencing (GBS) and SNP markers across 120 cultivars and wild relatives—including local types like Ambri and Shireen—revealed significant variability in fruit weight and total soluble solids (TSS). Evolutionary and population structure analyses identified eight clades and seven populations, with key SNP associations mapped to chromosomes 9, 10, 12, and 16. In pear, 15 Asian and European varieties were evaluated for quality traits. William Bartlett had the highest fruit weight (168g), Santya Braskaya the longest fruit (85.59 mm), and Max Red Bartlett the largest diameter (68.81 mm). Other notable cultivars included Packham (187.03g) and Abate Fetel (153.11g). In apricot, 41 genotypes were assessed, with CITH-Apricot 2 and Harcot producing the largest fruits. Twenty-four genotypes had sweet kernels, 13 produced double kernels, and kernel content ranged from 14.27% to 42.27%. Additionally, 10 apricot cultivars were studied for fruit color and biochemical properties, showing higher levels of TPC, TFC, and flavonols in the skin compared to pulp, with strong correlations among some biochemical traits.

A total of 29 peach cultivars/genotypes were evaluated, with nectarine types like Silverking,

Snow Queen, and Fantasia showing promising results and larger fruit size. Thirteen peach cultivars produced fruits weighing over 90g. Significant variation was observed in flesh color, stone adherence, and stone traits. Pulp percentage ranged from 78.14% to 96.13%, with most cultivars exceeding 90%. In addition to established varieties like Fantasia, Cresthaven, Red Globe, and Glohaven, newer cultivars such as Venture and F. Fury also showed promise. In plum and plumcot, 33 cultivars were assessed, with Santa Rosa producing the largest fruits (88.42g), followed by Mariposa, Angelino, and others. Maximum fruit length was recorded in Grand Duke (49.54 mm), and the highest diameter in Santa Rosa (53.7 mm). Pulp percentage ranged from 92.6% to 98.6%, and fruit color varied across green, yellow, red, and purplish shades. Red-fleshed types included Frontier, Auruburum, Durate, Mariposa, Au Cherry, and Au Rosa.

A total of 31 cherry varieties/genotypes were evaluated, with the heaviest fruits recorded in Van, followed by Sunburst, Makhamali, Glory, Bing, and Kordia. Fruit length and diameter ranged from 14.15–21.45 mm and 14.63–21.77 mm, respectively, while firmness varied between 35.97 and 66.63. In a cracking susceptibility test on nine cherry genotypes, Lambert showed the highest cracking rate (96.67%). In strawberry, 51 genotypes were assessed, with Winter Dawn showing the highest fruit weight, length, diameter, and yield per plant. Ofra had the maximum number of fruits per plant, and IC 340596 recorded the highest TSS (>10°Brix in 18 genotypes). In olive, 15 cultivars were evaluated, with fruit weight ranging from 2.15g (Tonda Iblea) to 4.82g (Leccino), and Leccino also showing the largest fruit size. High yields were recorded in Zaituna (26 kg/plant), Pendolino, Coratina, Cerignola, and others, with clear biennial bearing observed. In blackberry, 16 Rubus genotypes were tested for post-storage quality, showing anthocyanin content between 120.63–483.73 mg/100g. Local collections exhibited minimal color change and low fungal incidence, while genotypes 65/23 and 15/21 showed high color reversal (70–80%) with negligible fungal growth.

In almond, 10 cultivars were evaluated, with Makhdoom producing the heaviest nuts and highest kernel weight, while Non Pareil and Merced had the lightest nut and kernel weights, respectively. Shalimar showed the highest kernel percentage, and Non Pareil had the thinnest shell. In walnut, 219 genotypes were assessed, showing wide variability in nut (6.48–28.13 g) and kernel weight (2.52–12.52 g), shell thickness (0.34–3.20 mm), and kernel percentage (29.64–69.52%). Several promising genotypes such as CITH W-36, W-78A, W-102, BSP-1, KHS-1, and MB lines were selected for detailed evaluation. Two genotypes (CITH W-12 and CITH W-121) were identified for release. Some unique traits observed included papery/incomplete shells and dense branching. Initial signs of cluster bearing were also noted. In pistachio, CITH Pistachio-6 showed promise for commercial cultivation. Among eight hazelnut cultivars, Butler and Ennis were found suitable based on nut and kernel traits. In chestnut, CITH Chestnut-8 and Chestnut-10 were identified for further multiplication. In pecan, Selection-3 emerged as superior for nut and yield traits. Additionally, economic traits of persimmon, loquat, and Chinee ber genotypes were evaluated.

At ICAR-CITH, Regional Station, Mukteshwar, 58 germplasm accessions were added. In apple, among 20 cultivars evaluated, CITH Lodh Apple-1 recorded the highest fruit weight, while Mayan showed maximum TSS. Among seven newly evaluated cultivars, Mema Mester had the highest fruit weight (192.12 g), followed by Scarlet Spur-II (188.88 g), with Dark Baron Gala showing the highest TSS (11.13 °B). In peach, six cultivars were assessed, with Red June recording the highest fruit weight (128.48 g) and TSS (12.00 °B). Among eight plum cultivars, Santa Rosa had the highest fruit weight and Greengage recorded maximum TSS. In apricot, Chaubatia Madhu showed the highest fruit weight (73.94 g) among nine cultivars. In walnut, 10 cultivars were evaluated for growth traits, with CITH Walnut-9 showing the highest plant height (3.3 m). In kiwifruit, five cultivars were evaluated, with Hayward, Abbot, and Bruno identified as superior.

At ICAR-CITH, Regional Station Dirang, a field survey was conducted to identify wild edible temperate fruits, resulting in the documentation of species such as *Rubus ellipticus* (Golden Himalayan Raspberry), *Gaultheria fragrantissima* (Indian Wintergreen), *Rubus microphyllus, Elaeagnus* sp. (Autumn Olive), *Rubus niveus* (Ceylon Raspberry), wild strawberry, Diospyros lotus (Date Plum/Amlok), Stauntonia sp. (Stauntonia vine), and wild blueberries. Additionally, evaluation of strawberry varieties for high yield and quality under mid-hill conditions of Arunachal Pradesh is underway.

At ICAR-CITH, Srinagar, several vegetable genotypes outperformed existing checks in yield. In kale, HW-5, Pusa Sag-2, Pusa Sag-3, and NW Sag-23 recorded higher leaf yields than the best check, Hanz Haak. In turnip, PTWG Flat and White Flat yielded more than Pusa Chandrima, while in radish, CITH-White Round surpassed Pusa Himani. At the Mukteshwar station, 21 traditional bean types, 22 *Meetha karela (Cyclanthera pedata),* and other local vegetable germplasm were collected. Among 11 cherry tomato genotypes, CT-2 Red gave the highest yield (28.51 q/ha), while CITH SEL-6 and Selection-7 performed best in capsicum. In garlic, CITH-SEL-11 showed the highest yield (169.17 q/ha). At RS Dirang, indigenous cucumber germplasm was collected from the Northeastern and Northwestern regions of India. These temperate lines showed unique traits such as tolerance to low temperatures (5–10°C), better germination, early flowering, improved shelf life, high beta-carotene content, and resistance to downy and powdery mildew, making them distinct from traditional southern and northern varieties.

Under the project "Development of Superior Cultivars/Hybrids in Temperate Fruits through Conventional and Non-Conventional Methods," 13 hybrids from the cross *CITH-Ambri-1* × *Prima* were evaluated for morphological and biochemical traits, with several showing promising fruit weight (>150g), TSS (>13°B), firmness (>70 RI), attractive colour, and good antioxidant potential. Six identified apple hybrids were re-evaluated for trait stability. Scab resistance was confirmed in three hybrids—*Priame, Pride,* and *Pritor*—through Vf gene expression studies. Two hybrids, *Ammol* (Ambri × Mollies Delicious) and Ambrit (Ambri × Top Red), outperformed their parents in fruit quality. *Golden Snow* (Golden Delicious × Snow Drift) showed improved quality over both parents. Three hybrids—*CITH-Priame, CITH-Pride,* and CITH-Ammol—have been proposed for release through SVRC. Desirable physico-chemical and antioxidant traits were consistently observed. Ongoing molecular studies on various Ambri-based crosses aim to support QTL mapping and linkage map development. From the CITH-Ambri-1 × Redlane cross, two promising hybrids—*CITH-Amblane-1* and *CITH-Amblane-2*—were selected based on fruit colour, quality, and scab resistance.

S-allele typing, of identified apple hybrids which is an androit a reliable method for hybrid identification and pollination management, was successfully used to confirm the parentage of identified apple hybrids. The expected S-alleles matched those of the parent cultivars, and all hybrids produced predictive bands at the anticipated sizes, validating their pedigree. This marks the first report of hybrid identification using S-allele typing. Additionally, in the mutant population of CITH-Ambri-1, 13 fruit-bearing plants were evaluated for their physico-chemical characteristics and antioxidant potential.

Three pear hybrids—CITH Amber, CITH Gold, and CITH Blush—were assessed alongside their parents for key morphological and biochemical traits. Fruit weight ranged from 133.57 g to 233.54 g, with CITH Gold showing the highest weight and superior quality parameters including TSS (14.96°B), ascorbic acid (14.76 mg/100g FW), and antioxidant activity (92.36%). CITH Amber exhibited the highest firmness (61.65 RI) and juice content (60.84%), while CITH Blush had the highest total phenolics (2.87 mg/g). S-allele typing confirmed the genetic parentage of all hybrids, marking the first successful use of this method for hybrid identification in pear breeding.

Post-harvest studies were conducted on CITH Gold (Sept 3–Dec 18, 2024) and CITH Blush (Sept

4–Jan 1, 2025) under controlled conditions for 107 and 120 days, respectively, with evaluations at ten-day intervals. Sensory scores were 8.2/10 for both hybrids. Additionally, five more pear hybrids were evaluated. CITH-P-H-04 showed the highest fruit weight (304.37 g), while CITH-P-H-07 exhibited the highest TSS, juice content, and total phenolic content (3.48 mg/g), indicating strong antioxidant potential. In contrast, CITH-P-H-06 had the lowest TPC (1.88 mg/g). Stomatal studies in hybrids H-1 to H-5 showed H-5 had the highest chlorophyll a, b, and total chlorophyll content, while H-1 had the highest stomatal number. H-2 recorded the maximum stomatal length, width, and area.

During 2024, promising fruiting was observed in almond hybrid populations from earlier crosses. In the Non Pareil × Waris combination, 9 genotypes were evaluated, and Plant No. 3 was selected based on superior nut, kernel quality, and recovery. Similarly, in the CITH A-7 × Makhdoom cross, Plant No. 3 showed desirable traits and was selected for further evaluation. In apricot, two selections identified in 2023 were re-evaluated and found promising for traits like fruit size, yield, color, and sweet kernel. Additionally, hybridization efforts continued in walnut, apricot, peach, and cherry to develop elite genotypes.

A comprehensive transcriptomic analysis was conducted in almond cultivars 'Waris' and 'Ferralise' with contrasting flowering times to identify genes regulating flowering behavior. Whole-genome comparisons between early (Shalimar, Waris, Nonpareil) and late flowering (Tardy Nonpareil, Ferragnese, Ferralise) genotypes revealed differential expression of key genes. Late bloomers showed higher expression of flowering repressors, while early bloomers exhibited increased levels of flowering inducers. These findings provide valuable gene markers associated with late flowering and nut quality, supporting early-stage selection in almond breeding. Additionally, 184 EST-SSR primers were developed from the transcriptome data to target late flowering genes. Of these, about 60% successfully amplified the desired regions in 13 genotypes. While most primers showed monomorphic patterns, around 20 revealed polymorphic variations, indicating useful genetic diversity for further breeding applications.

In the breeding program for developing superior varieties/hybrids in solanaceous crops, significant variability was observed across brinjal, chilli, and capsicum genotypes. In brinjal, 53 genotypes were evaluated with fruit yield ranging from 361.92 to 1276.81 q/ha. Five accessions, including B-Sel-1/14 and Big Round, outperformed the best check, Local Round. In chilli, 83 genotypes were tested, with red ripe fruit yield ranging from 16.41 to 189.13 q/ha. The highest yield was recorded in check KL-1, followed by Arka Meghana and Sel-11/2018. In capsicum, among 41 genotypes evaluated, yields varied from 136.04 to 310.27 q/ha. Genotype CW x N-1 (F6) and others such as CITH-SP-2024 and Sel-12/11 performed at par or better than the check variety California Wonder.

In the rootstock breeding program for apple (*Malus* × *domestica*), hybrid populations from earlier crosses—CITH-A-RS-BP (M. baccata × M9-Pajam), CITH-A-RS-BB (M. baccata × B9), and CITH-A-RS-BM6 (*M. baccata* × MM-106)—were evaluated for rooting potential using air layering. Based on rooting ability, genotypes were grouped into five categories. Several genotypes, including BP-02, BB-03, BM9-02, and MMm-01, were identified as "Strong Rooting" types, making them promising for propagation. A few genotypes like CITH-A-RS-BP-87, BB-06, BM9-01, and MMm-07 were classified under the "Very Strong Rooting" category due to superior and consistent rooting performance. Additionally, tissue culture protocols for regenerating apple hybrid BM-9 were standardized. MS medium with 2 mg/L BAP yielded the best shoot multiplication (2.83 shoots/explant) and shoot length (3.51 cm), while the highest organogenesis (66.74%) was observed with 1.5 mg/L BAP. These findings support the efficient selection and propagation of elite rootstocks for enhanced orchard productivity.

Crop Production

During 2024–25, the institute distributed 17,378 plants of temperate fruit crops, 6,558

scion-wood, 1,306 ornamental plants, and 8,350 ornamental seedlings. Additionally, 8.803 kg of vegetable seeds, 20 kg of garlic seed, 10,530 vegetable seedlings, and 43.5 kg of onion seedlings were supplied to stakeholders, farmers, and research organizations. The institute generated a total revenue of ₹73.10 lakh, of which ₹54.59 lakh came from the sale of planting material, farm produce, training, technologies, and publications.

As part of a study on soil carbon dynamics and sequestration potential in temperate fruit crops of Arunachal Pradesh, 432 depth-wise soil samples were collected from apple, walnut, and kiwi orchards across three elevation zones. From these, 108 composite samples were prepared, and 216 samples were analyzed for parameters such as pH, organic carbon fractions, nutrients, microbial activity, and acidity indicators. Analysis of bulk density, texture, micro-nutrients, enzyme activities, SOC stock, and related parameters is ongoing. In a separate experiment on apple rootstocks, the combined application of phosphorus and silicon under varying soil moisture showed that MM-106 rootstock performed best under 60% field capacity, with improved root growth, nutrient and water use efficiency, and better soil health indicators. In integrated nutrient management trials for temperate vegetables, the treatment combining 50% inorganic fertilizers with 50% Trichoderma-enriched vermicompost (T6) resulted in superior performance across crops, notably in garlic, kale, and long-day onion. Natural farming treatments also performed well, particularly in kale and onion, but T6 consistently enhanced soil fertility and biological properties.

Under the project on developing techniques to enhance the multiplication rate of temperate fruits, four rootstocks (MM-106, CIVP-21, G-11, and G-202) were evaluated under polyhouse conditions using cocopeat as a rooting medium in air layering. MM-106 showed the highest plant height (85.48 cm) and maximum adventitious roots (5.20), indicating strong growth and rooting potential. In contrast, CIVP-21 showed the least growth and root development. Air layering in olive using growth regulators and soilless media showed initial success, though further refinement is needed. Additionally, among three quince rootstocks evaluated (Quince-A, Quince-C, and Quince BA-29C), Quince BA-29C demonstrated the most promising vegetative growth and rooting ability, suggesting its suitability for propagation under protected conditions.

In a study on propagation of apple rootstocks through cuttings, MM-106 showed the highest success rate (up to 95%, average 89.3%) with good plant height (77.26 cm) and root traits. MM-111 had a 90% success rate and produced the tallest plants (99.84 cm) but fewer roots. CIVP-21 had an 85% success rate and excelled in root development, showing the highest root length (13.42 cm), root diameter (40.50 mm), and number of adventitious roots (5.50), making it the best for root density. In olive, propagation through cuttings recorded the lowest success rate of 50%.

In greenhouse studies on quince cuttings, different concentrations of IBA (4000, 5000, and 6000 ppm) significantly affected growth parameters. IBA at 5000 ppm was optimal for root biomass and thickness, while 4000 ppm favored shoot growth. In pomegranate cv. Bhagwa, the combined application of IBA (200 ppm) + IAA (200 ppm) yielded the best rooting response (78%) and superior root traits. For almond, heading back in September during budding (August) showed better performance, with promising results also observed in apricot, peach, plum, cherry, and pear.

In canopy architectural engineering experiments in apple, six training systems were evaluated using two cultivars (Oregon Spur & Red Delicious) on four rootstocks. Maximum productivity was observed in Oregon Spur on MM 106 rootstock (62.69 t/ha), followed by the same variety on M9 (53.18 t/ha). In pear, among four varieties and two rootstocks across four training systems, William Bartlett on BA 29 C rootstock under the vertical axis system gave the highest yield (36.88 t/ha). At ICAR-CITH, RS Mukteshwar, the vertical axis system showed the highest yield in CITH Lodh Apple-1 and Red Delicious. In peach, Red June under the open center system yielded highest (35.5 kg), while Red

Nectarine recorded the lowest (22.5 kg) under the same system.

In the development of an almond-based intercropping system with saffron, different almond varieties with varying growth habits showed no significant influence on saffron flower traits. However, almond yield was highest in varieties with a spreading growth habit. Saffron yield equivalents were also higher under spreading types (1.262 kg/ha), followed by erect (0.875 kg/ha) and semi-spreading types (0.766 kg/ha). Biochemically, crocin content was highest under erect-type almonds, while picocrocin was greatest under semi-spreading types. Safranal content showed minor variation but remained higher than the control. In spacing trials, the highest fresh and dry saffron yields were obtained at 20×10 cm in raised beds, 15×10 cm in flat beds, and 50×5 cm in ridge-and-furrow systems. For quality traits (crocin, picocrocin, safranal), the 50×10 cm spacing in ridge-and-furrow planting was most beneficial. In cluster planting, 12 corms/cluster at 20×10 cm yielded the highest, while crocin was maximized with 9 corms, picocrocin with 6 corms, and safranal with 12 corms per cluster. Planting three corms per cluster in flat beds gave the highest crocin, while one corm per site resulted in higher picocrocin, with no significant difference in safranal.

Integrated nutrient management (INM) technology for cultivating vegetables as intercrops in apple orchards was demonstrated in the villages of Sunkiya and Gahena (Nainital) and Odlohar-Simsyari (Bageshwar) under the MGMG and SCSP schemes. The initiative aimed to promote crop diversification, optimize space and resource use, and enhance sustainable productivity without degrading soil health. For developing efficient organic production practices of persimmon (*Diospyros kaki L.*) in the North-Eastern Region, an experiment was conducted at ICAR-CITH, RS, Dirang, using one-year-old plants and 11 organic manure-based treatments in three replications. These included various combinations of sheep manure, farmyard manure (FYM), poultry manure, and vermicompost to evaluate their effects on plant performance under organic cultivation.

Under the project on *Disease and Pest Identification Models for Various Temperate Horticultural Crops using Deep Learning Techniques*, approximately 5,000 leaf images of apple exhibiting four key diseases—Alternaria, Apple Scab, Apple Mosaic Virus, and Powdery Mildew—were collected. A novel Multilayer Transformer-based Apple Disease Classification (MTADC) model using Vision Transformer (ViT) architecture was developed. This model outperformed conventional models such as CNN, ResNet, and VGG16, achieving a high overall accuracy of 96.32%, with class-wise accuracies between 92.84% and 99.58%. The model showed stable convergence within 30 training epochs, indicating efficient learning.

Kharif onion was validated as a new crop option for Kashmir through 3 years of on-station trials. In 2024, the technology was extended to farmers, with two farmers receiving 200 seedlings each for on-field demonstration. Additionally, the crop was cultivated at ICAR-CITH farm to further promote the practice.

Crop Protection

ICAR-CITH possesses a rich germplasm collection of various temperate fruit crops, which is continuously evaluated for important traits. In 2024, screening of apple germplasm led to the identification of 50 cultivars/genotypes resistant to powdery mildew, based on three years of data. Additionally, new diseases were recorded in the germplasm collection: Brown rot, rust, and little leaf in almond, and flat branch disorder in apple.

Under the project on Diagnosis, Transmission, and Management of Virus/Virus-like Diseases of Temperate Fruit Crops, virome analysis using RNA sequencing was conducted in apple, quince, and plum. In apple, 8 viruses and 2 viroids were identified, including *CCGaV, ARWV-1 & 2, ApNMV, AMV, ASPV, ASGV, ACLSV, AHVd,* and *ASSVd*. In plum, 5 viruses and 1 viroid were detected, such as *PNRSV, APLPV, ACLSV, LChV-1, PBNSPaV,* and *HSVd*. In quince, only ApNMV was found. A RT-LAMP-based diagnostic was developed for rapid detection of ApNMV in apple. The viruses significantly impacted fruit

quality—causing reductions in fruit weight, size, firmness, and TSS/Titratable acidity ratios, while increasing titratable acidity and ascorbic acid content. Notably, Golden Delicious was the most sensitive cultivar, and Red Delicious the least. Anthocyanin levels and visual appeal (color and texture) were adversely affected, especially in infected Red Delicious apples.

In the study on "Elucidating the Diversity, Species Spectrum, and Management of Alternaria spp. Infecting Apple (*Malus* × *domestica Borkh*)," eleven fungicides—including propineb, ziram, captan, copper oxychloride, hexaconazole, myclobutanil, and several combination formulations—were evaluated in vitro for their efficacy in inhibiting fungal growth. Among these, hexaconazole and fluxapyroxad + pyraclostrobin emerged as the most effective, completely suppressing fungal growth at all tested concentrations. Based on in vitro performance, the top five fungicides were selected for field trials to develop and evaluate spray schedules. These included combination treatments comprising hexaconazole, ziram, fluxapyroxad + pyraclostrobin, myclobutanil, and hexaconazole + carbendazim. All treatments significantly reduced disease severity compared to untreated controls, with early application schedules showing the highest efficacy. Among the spray programs, Treatment T2—a sequential application of Ziram (3 g/L), Fluxapyroxad + Pyraclostrobin (0.2 ml/L), Myclobutanil (0.6 g/L), Hexaconazole + Carbendazim (0.5 ml/L), and Hexaconazole (0.5 ml/L)—proved to be the most effective, recording the lowest mean disease intensity (16.24%) and the highest disease inhibition (53.45%). In terms of application timing, the second week of May (Date 1) was the most effective, achieving a disease intensity of 10.67% and 50.29% inhibition, emphasizing the importance of timely intervention for effective disease control.

Under the project "Bioprospecting of Rhizo-cum-Endospheric Microbiota of Apple Rootstocks for Management of Soil-Borne Diseases of Temperate Fruit Crops," several promising microbial bioagents were identified for the control of root rot caused by *Dematophora necatrix*. Among fungi, *Trichoderma lentiforme, Trichoderma longibrachiatum,* and Aspergillus fumigatus showed strong antagonistic activity. Among bacteria, Bacillus subtilis and Pseudomonas spp. were effective in suppressing the pathogen. Volatile compounds such as Disulphide dimethyl, Isoprene, Methyl Alcohol, Acetonitrile, 1,3-Pentadiene, and Methanethiol were identified from these bioagents, indicating their potential role in biocontrol mechanisms. Based on compatibility assessments, six talc/kaolin-based bio-formulations (both individual and consortium-based) were developed and are currently under field evaluation for their effectiveness in managing soil-borne diseases.

A field study conducted at ICAR-CITH, Mukteshwar (2023–2024), assessed the efficacy of seven fungicides against Peach Leaf Curl (PLC) caused by *Taphrina deformans*. The combination fungicide Mitram 55% + Pyraclostrobin 5% WG (0.1%) showed the highest disease control (71.27%), followed by Carbendazim 12% + Mancozeb 63% WP (69.14%) and Carbendazim 50% WP (68%). The results indicate that a combination of systemic and contact fungicides provides superior control. Additionally, timely application at critical growth stages can reduce fungicide use, lower costs, and promote environmental sustainability.

In the study on Bionomics, Modelling, and Management of the Aphid-Pest Complex of temperate fruits, seasonal monitoring of green apple aphid (*Aphis pomi*) in medium and high-density apple orchards revealed that infestation begins in late March, peaking from mid-June to July before declining by late August. Aphid colonies appeared primarily in unsprayed zones, with winged forms emerging by mid-April. A two-year online survey involving 275 apple growers from 10 districts of Kashmir Valley assessed growers' perceptions. Most respondents reported recurring aphid infestations, with noticeable sooty mold development on leaves and fruits, impacting tree appearance. While 76% applied the recommended delayed dormancy horticultural mineral oil (HMO) spray, additional insecticide applications (ranging from 1–3

sprays) were often required. Growers commonly used insecticides such as chlorpyriphos 50% + cypermethrin 5% EC, followed by thiacloprid 240 SC, chlorpyriphos 20 EC, thiamethoxam 25 WG, and various combinations of neonicotinoids and pyrethroids for aphid management.

In the study on Biology, Ecology, and Management of Fruit Flies Infesting Temperate Fruits, five species of drosophilid fruit flies were identified from traps and infested fruits: *Drosophila suzukii, D. busckii, D. melanogaster, D. immigrans, D. repleta,* and *Zaprionus indianus.* Among these, Drosophila *suzukii* (spotted wing drosophila) was dominant. Seasonal monitoring revealed that peak activity of D. suzukii occurred during the last week of May to the second week of June, and again in late July, correlating with the availability of ripe fruits in the field. In a separate study on cherry infestation, laboratory analysis and larval rearing confirmed high infestation by *D. suzukii,* indicating its major role in fruit fly-related damage to temperate fruits like cherry.

Post-Harvest Management

To explore alternatives to petroleum-based packaging, a project was initiated on the synthesis of nanocellulose from horticultural waste and development of biodegradable packaging films. Waste from apple prunings, and onion and garlic leaves were collected for preliminary assessment. Initial findings showed notable cellulose content in onion (47.44%) and garlic (51.47%), making them promising sources for nanocellulose extraction. Additionally, a new research proposal titled "Upcycling of Temperate Fruit and Vegetable Derived Pomace into a Sustainable Carotenoid Avenue for Functional Food Product Development" was launched. As part of this, a study on Rosehip Seed Oil-Based Oleogels as a sustainable fat substitute in food was undertaken. Out of 85 collected rosehip samples, 11 accessions were selected based on color, appearance, and physical and engineering properties.

In the development of edible coatings enriched with antimicrobial bioactive compounds for stone fruits, gummosis samples were collected from cherry, apricot, peach, nectarine, and almond. These were extracted and purified using ultrasonication (60% amplitude for 30 minutes). Among the samples, cherry gum showed the least pigmentation and finest particle size, followed by apricot, making it most suitable for further use. Although most crops yielded a similar amount of purified gum, peach gum had higher pigmentation and lower yield. Based on these findings, cherry-derived gummosis was selected for further process standardization.

Value-added products developed included jaggery-based quince *tutti frutti* as a healthy alternative to sugar-based variants, persimmon pulp prepared using the hot pulping method for improved shelf life and quality, and green walnut pickle made from immature walnuts using traditional processing and regional spices. These products aim to enhance the commercial value and nutritional utilization of temperate fruits.

Extension and other activities

In 2024, ICAR-CITH, Srinagar and its Regional Stations actively engaged in extension and outreach activities to disseminate technologies among stakeholders. A total of 21 events, meetings, and workshops were organized, including major programs such as a Three-Day Training on Orchids, Brainstorming Session on Lettuce Business Modules, 15th Annual Group Meeting on Onion & Garlic, Workshop on Agri-food Systems in the Himalayan Region, Workshop on Genomic Advances in Disease Diagnostics, and a National Conference on Horticulture Development through Cooperatives. The institute conducted nine one-day training programs for officers, scientists, and personnel from organizations such as BSF, Dept. of Agriculture, CIPMC, and ISTM. Additionally, five one-day trainings on walnut propagation were held for forest department personnel at various nurseries in Uttarakhand. A total of 21 student visits/ training programs were organized at ICAR-CITH, Srinagar, and two programs at HNBGU, Uttarakhand, providing practical exposure to crops and research activities. For farmers, three programs were organized (one of three days and two of one day) for 68 progressive farmers from Himachal Pradesh.

During 2024, ICAR-CITH, Srinagar facilitated significant outreach through various farmer-centric programs. Seventeen farmer groups from J&K, sponsored by different agencies, visited the institute for one-day training and farm visits to learn about horticultural technologies. Additionally, 10 training programs on nursery production, pruning, fruit production, and plant protection were conducted under MIDH for Kashmiri farmers. The institute's regional stations were also active in capacity building. ICAR-CITH, RS Mukteshwar organized 14 training programs for officials, students, and farmers. In the NEH region, 20 programs benefitting 1,718 farmers were conducted. Under NGMG, two awareness programs, one diagnostic visit, and one demonstration were organized, benefitting over 38 farmers. As part of the SCSP initiative, two awareness and farm input distribution programs were held in Uttarakhand at Gahena and Odlohar-Simsyari villages, reaching 395 beneficiaries. Under TSP, ten programs were conducted across seven districts of J&K and Ladakh (Srinagar, Bandipora, Shopian, Poonch, Ganderbal, Leh, and Kargil), benefitting 435 tribal farmers.

In 2024, ICAR-CITH scientists made notable academic and outreach contributions, publishing 42 research papers, 8 review articles, 1 book, 23 book chapters, and 19 bulletins/popular articles/ pamphlets. The institute received 8 awards, 2 patents, and 1 varietal protection during the year. To translate research into practice, ICAR-CITH transferred key technologies on apple rootstock multiplication, apple feathering, and walnut propagation to the field by signing MoUs with 18 stakeholders, including farmers and nursery growers. Walnut varieties were also licensed through Agrinnovate India Ltd. For wider dissemination, scientists delivered 11 TV/radio talks and participated in 7 external exhibitions, along with organizing several in-house events. The institute witnessed a significant increase in outreach, with 9,226 farmers/visitors visiting ICAR-CITH, Srinagar—marking a 20.68% rise compared to 2023.

2 INTRODUCTION

Introduction

The horticultural scenario has witnessed a spectacular change in area and production in India and has become the second largest producer of horticultural crops in the world. It became possible due to varied agro climatic conditions suitable for growing of a large number of horticultural crops. Total horticultural production in the year 2023-24 is estimated to be 354.74 million tons on an area of 29.086 million ha with minor decrease of 0.19% compared to 2022-23. Although there is increase of about 2.28% in area during 2023-24 compared to 2022-23. As compared to 2022-23, increase in production was noticed in almost all the categories of horticultural crops except vegetables while decrease in area was recorded in vegetables (0.68%) and plantation crops (2.88%). As compared to 2022-23, there was 1.51% in fruit crops,11.22% increase in flower crops, 22.81% in medicinal & aromatic plants and 11.27 % in spices acreage during 2023-24. Similarly in production 2.51% in fruit crops, 14.14 % in flowers, 19.40 % in medicinal & aromatic plants, 2.81% in honey, 3.61% in plantation crops, and 5.52% in spices during 2023-24 as compared to 2022-23. The fruit production in India is about 112.97 million MT from an area of 7.13 million hectare with an average productivity of 15.64 t/ha during 2023-24. In vegetables, the production is about 207.21 million MT from an area of 11.23 million ha having productivity of 18.44 t/ha.

Indian Himalayan region offers vast opportunities for cultivation of temperate horticultural crops including fruits, vegetables, ornamental crops and medicinal & aromatic plants. The predominant fruit crops include apple, pear, peach, plum, apricot, cherry, almond and walnut. The Indian Himalayan belt lies starting from foot-hills in the south (*Siwalik's*) towards the region extends to Tibetan plateau in the north (trans-*Himalaya*) comprising about 95 districts of the country. Temperate fruits growing in India are spread over mainly in Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Ladakh, Sikkim and Arunachal Pradesh having major share in production of temperate fruit. With relative advantage in the region due to climate, a large number of temperate fruits are grown. There are several dozens of temperate fruit crops from pome, stone, nuts, berries and other groups. However, only 25-30 fruits/nuts are commercially grown around the world for fresh fruits as well as processed products. Due to less chilling requirements of some temperate fruit crops/ varieties makes them suitable for growing in other states also. Although there is increase in area and production after independence due to various R&D activities but it is not sufficient to feed the increasing population and there is sufficient scope for its expansion. During 2023-24, the area covered by apple is about 304 thousand ha, walnut (97 thousand ha), pear (35 thousand ha), plum (18 thousand ha), peach (17 thousand ha), almond (10 thousand ha), kiwifruit (4 thousand ha) and strawberry (3 thousand ha). Similarly, the production in apple was (2626 thousand MT) followed by walnut (318 thousand MT), pear (274 thousand MT), peach (109 thousand MT), plum (68 thousand MT), kiwifruit (17 thousand MT), strawberry (21 thousand MT) and almond (12 thousand MT).The maximum average productivity was recorded in apple (8.63 t/ha) followed by pear (7.82 t/ha), strawberry (7.0), peach (6.41 t/ha), kiwifruit (4.25 t/ha), plum (3.77 t/ha), walnut (3.27 t/ha) and almond (1.2 t/h) . Apricot is also another important fruit grown from mid hills to cold arid region and Ladakh is the major apricot producing region in the country.

Besides the major temperate fruit growing states like Jammu & Kashmir, Himachal Pradesh & Uttarakhand, there are many other states which are growing some temperate fruit crops depending upon the climatic conditions of the state. The apple is grown in Arunachal Pradesh, Ladakh, Kerala, Manipur, Nagaland, Rajasthan & Telangana. The temperate fruits which are grown in other states are as pear (Arunachal Pradesh, Chhattisgarh, Haryana, Kerala, Madhya Pradesh, Nagaland, Punjab, Sikkim, Ladakh & Tamil Nadu), plum (Arunachal Pradesh, Haryana, Madhya Pradesh, Maharashtra, Nagaland, Punjab, Ladakh & Tamil Nadu), peach (Arunachal Pradesh, Haryana, Kerala, Nagaland, Punjab, Sikkim, Ladakh & Tamil Nadu), Walnut (Arunachal Pradesh & Ladakh), kiwifruit (Arunachal Pradesh, Manipur, Meghalaya,Mizorm, Nagaland, Sikkim & West Bengal), strawberry (Andhra Pradesh, Chhattisgarh, Haryana, Jharkhand, Kerala, Madhya Pradesh, Maharasthra, Meghalaya, Mizoram, Nagaland, Tamil Naadu &West Bengal). In India, J&K has monopoly in area, production & productivity of apple (11.99 t/ha), almond (2.07 t/ha) and walnut (3.53 t/ha). In pear, maximum area is in J&K but production nd productivity (23.52t/h) is highest in Punjab while in case of peach, area is more in Uttarakhand but production and productivity (17.92 t/ha) is more in Punjab. In plum, area is more in Himachal Pradesh, production in J&K and productivity in Haryana (18.85 t/ha). In cse of strawberry, area and production is more in Maharashtra but productivity is more in Haryana (22.86 t/h). In kiwi fruit,area and production is more in Arunachal Pradesh but productivity is more in Manipur (15.5t/ha)

The productivity of quality produce of temperate horticultural crops is low as compared to advanced counties and there is a great scope to enhance the productivity through research & technological support. Keeping in view the importance of the temperate horticultural crops with respect to involvement of major population and their contribution towards national economy, a separate institution *i.e* ICAR- Central Institute of Temperate Horticulture, Srinagar with its two Regional Stations at Mukteshwar, (Uttarakhand) and Dirang, (Arunachal Pradesh) is playing a great role in designing and developing research programmes on crop improvement, production, protection and post-harvest management for achieving economic and nutritional security in the entire Himalayan region by enhancing the productivity of quality produce. Institute is mainly focussing on research and development in temperate fruits, nuts, vegetables, ornamentals, medicinal & aromatic plants and saffron. To overcome the production constraints and to improve quality of produce, the research on temperate horticultural crops is being carried out both at main campus Srinagar and at its Regional Stations with the following mandate and objectives:

Mandate

- To act as national repository of germplasm and scientific information on temperate horticultural crops.
- To undertake basic, strategic and applied research on temperate horticultural crops in collaboration with national and international agencies to enhance productivity and quality.
- To serve as centre of training for human resource development and transfer of technology.

Objectives

- Establishment of field gene bank and management of genetic resources and scientific data base of temperate horticultural crops.
- Genetic improvement of temperate horticultural crops for yield, maturity, quality, resistance to biotic and abiotic stresses through conventional breeding methods and biotechnological tools.
- Standardization of nursery management and high-tech propagation techniques of temperate horticultural crops.
- To device efficient and cost-effective production technologies and cropping systems for increasing productivity and improving quality of temperate horticultural crops.
- To develop eco-friendly integrated diseases/

pest management modules and diagnostics.

- Post-harvest value addition, product diversification and waste utilization for increasing availability and returns.
- To work out economics of production and impact assessment of technologies.
- Commercialization and transfer of technologies and skilled manpower development.

Staff Position (as on 31st December, 2024)

Category	Sanctioned	Filled (as on 31st December, 2024)	Vacant (as on 31st December, 2024)
Scientific	33+1RMP	19+1	13
Administrative	19	15	4
Technical	16	10	6
Supporting	11	11	0
Total	79+1RMP	55+1	23

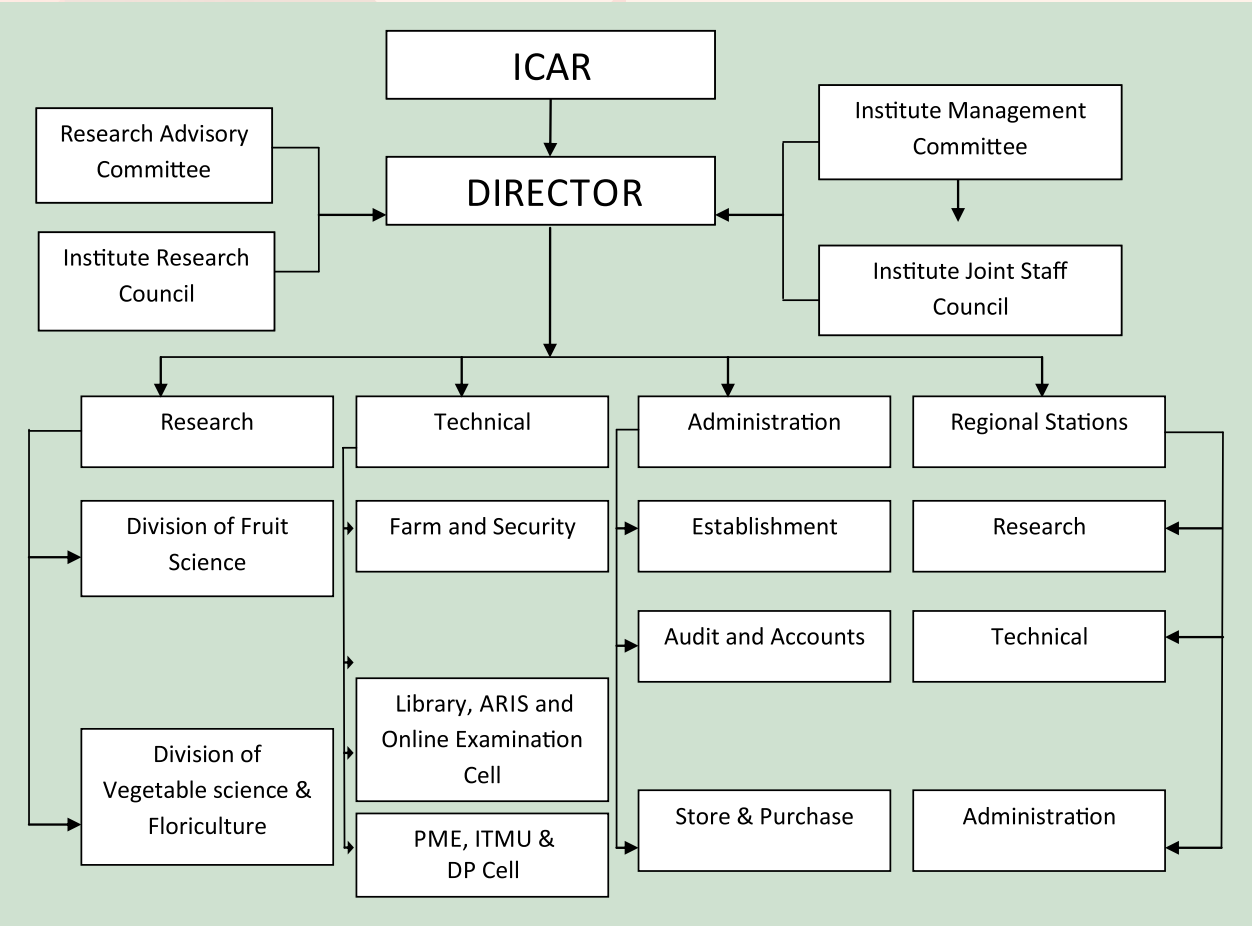
Financial Statement (2024-25)

S. No.	Head	Expenditure (Rs in Lakhs)
1	ONEH-Capital	114
2	ONEH-General	473
3	NEH -Capital	12.24
4	NEH - General	79.88
5	TSP-General	15.0
6	SCSP-General	35.0
7	Genome	107.95
8	Pension	27.83
9	Salary	799.22
Total		1664.12

Revenue Generated

Source	Rs in Lakh
Farm and sale of produce	51.82
Publications	0.40
Technology	0.77
Training	0.53
Institutional charges	1.07
Other sources	18.51
Total revenue from all sources	73.10

ORGANOGRAM OF CITH



3
RESEARCH ACHIEVEMENTS

I. Crop Improvements

Horticulture is one of the fastest-growing, high-return sectors in India, contributing significantly to economic and nutritional security. The country's diverse climate allows cultivation of a wide range of horticultural crops. In 2023–24, total horticulture production was estimated at 354.74 million tons from 29.086 million hectares, showing a slight production dip of 0.19% but a 2.28% increase in area over the previous year. Crop productivity and profitability heavily depend on the genetic potential of cultivars, making crop improvement through breeding crucial. In fruit crops, breeding is often challenging due to long juvenility periods. The Himalayan region is ideal for a variety of temperate horticultural crops, although apple and walnut dominate in area and production, with lesser contributions from pear, plum, peach, almond, and kiwi. However, productivity remains low compared to global standards, mainly due to a lack of superior cultivars. ICAR-CITH, Srinagar, along with its regional stations at Mukteshwar and Dirang, has been instrumental in developing and recommending high-performing, region-specific genotypes to enhance productivity and farmer income. The detailed research activities for 2024 are outlined project-wise below.

Survey, Collection, Evaluation, Characterization and Documentation of Temperate Horticultural Crops

Temperate horticulture serves as the backbone of livelihoods in the hill regions, and plant genetic resources are vital assets for meeting current and future needs. India's diverse climate supports a wide range of horticultural crops, with rich genetic diversity in many indigenous species. However, diversity in some exotic crops remains limited. ICAR-CITH, Srinagar, as the National Active Germplasm Site for temperate fruit crops, plays a key role in the conservation and utilization of this diversity. Along with its regional stations at Mukteshwar and Dirang, the institute continues to enrich its germplasm resources through collection, evaluation, and documentation. In 2024, a total of 171 germplasm accessions across fruits, vegetables, and ornamentals were added in various forms such as scionwood, bulbs, runners, and seeds. Germplasm banks at regional stations

Table 1. Germplasm status at ICAR-CITH, Srinagar (2024)

Sr No	Group	Germplasm Status (2023)	Added during 2024	Germplasm Status (2024)
1	Fruits	1415	58	1473
	Pome fruits	484	7	491
	Stone fruits	307	14	321
	Nuts	413	-	413
	Others	211	37	248
2	Vegetables	1172	34	1206
3	Ornamentals	355	79	434
4	Medicinal and aromatic plants	33	-	33
Total		**2975**	**171**	**3146**

were also strengthened, and evaluation revealed several promising entries for future use.

Fruit and Nut Crops

Apple

Genotyping-by-sequencing (GBS) was generated by single nucleotide polymorphism (SNP) markers coupled with phenotypic data from 120 apple cultivars/wild relatives including locally developed ones like Ambri, Shireen, Firdous, Hariman-99 and others, in a genome wide association study (GWAS) using a mixed linear model (MLM). Significant variability was recorded for both fruit weight and total soluble solids (TSS). Evolutionary analysis placed the panel into eight clades while population structure analysis revealed seven populations. The Q+K module revealed significant associations on chromosome numbers 12, 9 and 10 and others involving 15 SNPs while PCA+K model identified 17 significantly associated SNPs spread mostly over chromosomes 12, 16, 9 and others. Important SNPs for soluble solids included ones mapped to genes coding for Myosin family protein with Dil

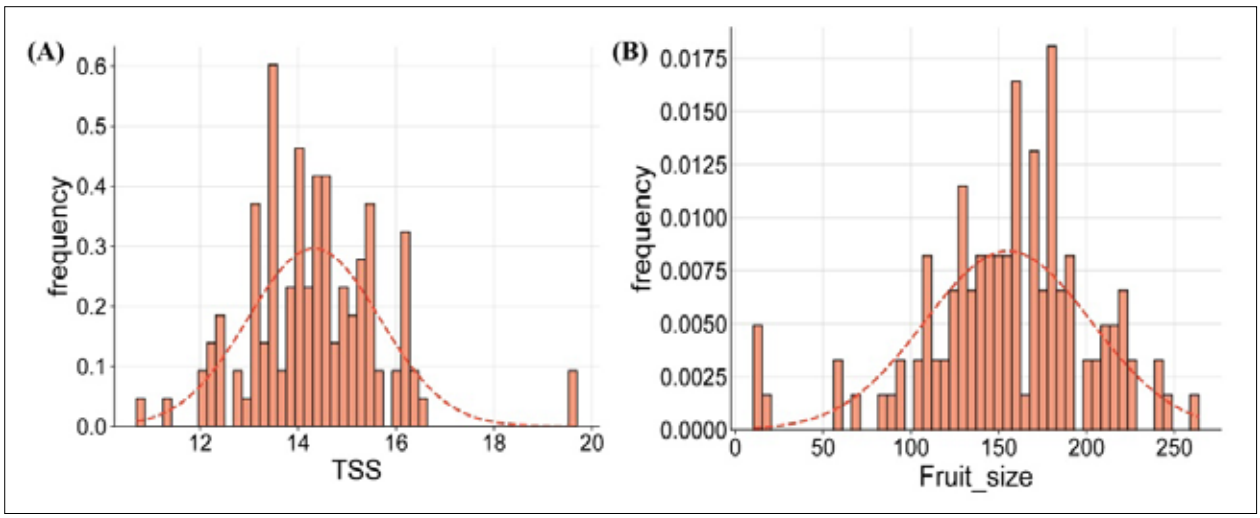


Figure 1. *Frequency distribution of phenotypic data for 120 apple accessions. (A) Histogram depicting distribution of total soluble solids (TSS) and (B) distribution of fruit size trait in apple accessions. The plots were generated using SRplots.*

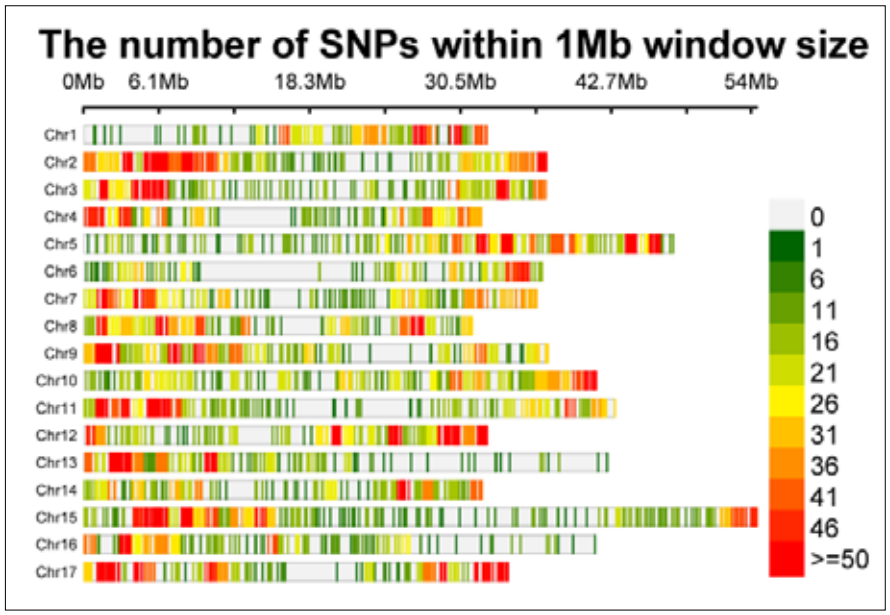


Figure 2. *SNP density plot across the 17 chromosomes of apple representing number of SNPs within 1 Mb window size. The horizontal axis represents the chromosome length in Mb while different colours correspond to SNP density. The plots were generated using SRplots*

domain, Flowering time control protein-related/ FCA gamma-related, Core-2/I-branching beta-1, Heavy metal atpase 5, mitogen-activated protein kinase, mechanosensitive ion channel protein, WRKY transcription factor, alpha-galactosidase 1 and exocyst component. Fruit size was in strong association with genes coding for Homeodomain-like superfamily protein, C-terminal domain phosphatase-like 1 and Tetratricopeptide repeat

(TPR)-like superfamily proteins. The candidate genes identified for soluble solids and fruit size have potential to contribute to an improved understanding of the genetic basis of apple fruit quality and facilitate marker-assisted selection (MAS) in this commercially important fruit crop (Fig 1& Fig 2).

Pear

In 2024, fifteen pear cultivars of Asian (*Pyrus pyrifolia*) and European (*Pyrus communis*) origin were evaluated for key quality parameters. Among them, 'William Bartlett' recorded the highest fruit weight (168 g), 'Santya Braskaya' had the longest fruit (85.59 mm), and 'Max Red Bartlett' showed the largest fruit diameter (68.81 mm). In contrast, 'Donne Burrah' exhibited the lowest fruit weight (51.29 g) and length (44.12 mm), while 'Vicker of Winfield' had the smallest diameter (44.07 mm). The longest pedicel (52.50 mm) was observed in 'Kashmiri Nakh' and the shortest (22.93 mm) in 'Kosui'. Fruit firmness ranged from 53.76 in 'Hayward' to 65.23 in 'Vicker of Winfield'. In terms of color attributes, 'Santya Braskaya' showed the highest L* and b* values, while 'Kosui' recorded the highest a*, chroma (45.13), and tint (87.16).

Table 2. Fruit characterstics of different pear cultivars.

S. No	Cultivars	Fruit weight (g)	Fruit length (mm)	Fruit diameter (mm)	Pedicel length (mm)	Firmness (RI)
1	Gent Drouard	151.247^{ab}	72.903^{de}	64.47^{abc}	26.583^{fg}	61.567^{bc}
2	Hayward	72.93^{def}	72.813^{de}	48.4^{hi}	31.35^{defg}	53.767^{f}
3	Max Red Bartlett	158.76^{ab}	73.103^{de}	68.81^{a}	37.31^{cde}	61.767^{bc}
4	Fertility	104.037^{c}	80.533^{bc}	54.113^{fg}	41.77^{bc}	59.433^{de}
5	Kashmiri Nakh	142.103^{b}	66.257^{ef}	66.573^{ab}	52.507^{a}	58.333^{de}
6	Kosui	98.113^{cd}	49.793^{ij}	58.637^{def}	22.93^{g}	58.933^{de}
7	Punjab Soft	88.457^{cde}	58.027^{gh}	54.627^{efg}	48.943^{ab}	58.433^{de}
8	Vicker of Winfield	54.707^{f}	63.617^{fg}	44.073^{i}	41.417^{bc}	65.233^{a}
09	Badshah Nakh	102.217^{c}	61.57^{fgh}	59.603^{cde}	27.643^{fg}	61.6^{bc}
10	Santya Braskaya	139.057^{b}	85.59^{ab}	62.553^{bcd}	39.6^{cd}	57.9^{e}
11	Punjab Beauty	77.65^{cdef}	55.297^{hi}	51.45^{gh}	29.51^{efg}	60.133^{cd}
12	Punjab Nectar	81.657^{cde}	58.523^{gh}	52.46^{gh}	29.45^{efg}	59.367^{de}
13	Donne Burrah	51.297^{f}	44.12^{j}	46.987^{hi}	30.847^{efg}	62.2^{b}
14	William Bartlett	168^{a}	78.123^{cd}	67.343^{ab}	26.153^{fg}	62.367^{b}
15	Chinese Sand Pear	63.147^{ef}	50.423^{ij}	48.693^{hi}	28.27^{fg}	64.733^{a}
	CD @5 %	*23.938*	*6.683*	*5.015*	*7.792*	*1.739*
	CV (%)	*13.548*	*6.037*	*5.282*	*13.608*	*1.717*

Fruits of some pear cultivars

The highest hue angle (84.32) was noted in 'Max Red Bartlett', whereas 'Hayward' exhibited the highest color index (10.62). Conversely, the lowest chroma (28.46) was found in 'Fertility', lowest hue angle (61.21) in 'Hayward', and lowest color index (1.13) in 'Santya Braskaya'. Additionally, 'Carmine', 'Packham', and 'Abate Fetel' were evaluated, with respective fruit weights of 114.95 g, 187.03 g, and 153.11 g. 'Carmine' recorded greater fruit length, while 'Packham' exhibited a larger fruit diameter.

Apricot

In apricot, 41 cultivars/genotypes were evaluated for fruit quality traits. The largest fruits were recorded in 'CITH-Apricot 2' (67.51 g), followed by 'Harcot' (66.0 g), 'CITH-Apricot 3' (64.59 g), 'CITH-Apricot 10' (62.34 g), and others including 'CITH A1', 'CITH A31', 'CITH A36', 'IC 558063', 'Packnovski', 'Selection 1/23', and 'Tokopopa' with fruit weights ranging between 50–60 g. Maximum fruit length was observed in 'Harcot' (54.79 mm), while the greatest diameter was noted in 'CITH-Apricot 2' (49.87 mm). Pulp percentage ranged from 84.21% in 'PAS-2' to 94.97% in 'Caisha'. Of the total genotypes, 24 had sweet kernels, 13 produced double kernels, and kernel percentage ranged from 14.27% to 42.27%. In another study, ten apricot cultivars were assessed for skin and pulp colour (a*) and biochemical traits such as total phenolic content (TPC), total flavonoid content (TFC), flavonols, and anthocyanins. 'Selection 1/23' and 'Selection 2/23' exhibited higher and more uniform redness (a* values). Cluster analysis revealed 'Selection 1/23', 'Selection 2/23', 'CITH-A-2', and 'Heartly' grouped closely, with 'Selection 2/23' being more similar to 'CITH-A-2' and significantly distinct from 'Selection 1/23'. TPC, TFC, and flavonol


CITH-Apricot-1


CITH-Apricot-2


CITH-Apricot-3


CITH-Apricot-10


CITH-Apricot-11


CITH-Apricot-31


CITH-Apricot-36


Caisha


Harcot


Early Maturing


Viva Gold


Safed Parachinar


Shakarpara


Apricot Selection 2/2023


Apricot Selection 1/2023

contents were significantly higher in skin than in pulp. Strong correlation was observed between TPC and TFC in both tissues, while flavonols showed lower correlation with the two. Principal component analysis showed that colour (a*) contributed most to PC1, while biochemical traits primarily influenced PC2, with all except TPC of skin contributing significantly to PC2.

Peach

In peach, a total of 29 cultivars/genotypes were evaluated for various fruit quality traits. Among


Venture


F Fury


Glenglo


Glowing Star


Loring


Blazing Star


Victoria


Cresthaven


Glohaven


Red Globe


Fantasia


Snow Queen

Fruits of some peach & nectarine cultivars

nectarines, 'Silver King', 'Snow Queen', and 'Fantasia' were found promising, each producing fruits weighing over 90 g. Similarly, 13 peach cultivars also recorded fruit weights exceeding 90 g. Significant variation was observed among cultivars in terms of flesh colour, stone adherence (clingstone or freestone), and stone characteristics. Pulp percentage ranged from 78.14% to 96.13%, with the majority of cultivars exhibiting more than 90% pulp content. In addition to established cultivars such as 'Fantasia', 'Cresthaven', 'Red Globe', and 'Glohaven', newly evaluated cultivars like 'Venture' and 'F. Fury' also showed promise for further utilization and development.

Plum

In plum and plumcot, 33 cultivars were evaluated for fruit characteristics. Among them, 'Santa Rosa' produced the largest fruits (88.42 g), followed by 'Mariposa' (76.5 g), 'Angelino' (70.54 g), 'Friar' (69.19 g), 'Au Rosa' (68.59 g), 'Auruburum' (66.91 g), 'Black Amber' (67.61 g), 'Grand Duke' (60.82 g), and others including 'Frontier', 'Red Beaut', 'Durate', 'Italian', 'Stanley', and 'Shiro'. The maximum fruit length was recorded in 'Grand Duke' (49.54 mm), while the highest fruit diameter was observed in 'Santa Rosa' (53.7 mm). Pulp percentage ranged from 92.6% in 'Kala Amritsari' to 98.6% in 'Black Amber'. Fruit colour varied widely across cultivars, including green, yellow, red, and purplish hues. Notably, red-fleshed cultivars included 'Frontier', 'Auruburum', 'Durate', 'Mariposa', 'Au Cherry', and 'Au Rosa', indicating significant diversity for potential utilization in breeding and commercial cultivation.


Frontier


Mariposa


Black Amber


Grand Duke


Santa Rosa


Red Beaut


Shiro


Durate


Angeleno


Plumcot-DPRU 0708

Sweet Cherry

In cherry, 31 varieties/genotypes were evaluated for various fruit traits. The heaviest fruits were recorded in 'Van', followed by 'Sunburst', 'Makhamali', 'Glory', 'Bing', and 'Kordia'. Fruit length ranged from 14.15 mm to 21.45 mm, and diameter from 14.63 mm to 21.77 mm. Fruit firmness varied between 35.97 and 66.63, while the fruit-to-seed weight ratio ranged from 5.77 to 14.01. The entire germplasm exhibited a narrow harvesting window, with maturity spanning from the third week of May to the first week of June. Late-maturing varieties included 'Regina', 'Merchant', 'Glory', 'Stella', 'Van', 'Makhamali', 'Misri', 'CITH-C-15A', and 'CITH-C-4', whereas 'DN II' was the earliest, ripening by the third week of May. Significant variability was also observed in other fruit, seed, and colour-related traits, offering potential for selection and improvement.

Additionally, nine cherry varieties/genotypes were evaluated under in-vitro conditions to assess their susceptibility to fruit cracking. Among these, 'Lambert' exhibited the highest susceptibility, with a cracking incidence of 96.67%. Various physical parameters—including fruit length, width, weight, shape, firmness, and total soluble solids (TSS)—were recorded to determine their correlation with cracking. 'Lambert' showed the highest TSS (14.86 °Brix) and firmness (66.93 kg/


Bing


Glory


Kordia


Regina


Benton


DN-II


Stella


Coral Champagne

cm²). The maximum fruit length (20.51 mm) and width (19.86 mm) were observed in 'Double', while the highest fruit weight (4.93 g) was recorded in 'Stella'. It was observed that heart-shaped fruits, higher TSS, and greater firmness contributed positively to cracking susceptibility, whereas fruit length and width showed no significant correlation with cracking.


In vitro induction of cracking in cherry cv. Lambert

Strawberry

In strawberry, 51 varieties/genotypes were evaluated for fruit and yield-related traits. Among these, 'Winter Dawn' recorded the highest fruit weight, length, and diameter. Out of the total genotypes, 18 produced fruits with TSS exceeding 10°Brix, with the highest TSS observed in IC 340596. The maximum number of fruits per plant was recorded in the cultivar 'Ofra', while the highest yield per plant was observed in 'Winter Dawn', followed closely by 'Sweet Charlie'. Among the evaluated traits, the highest coefficient of variation was recorded for fruit yield per plant, followed by the number of fruits per plant, fruit weight, fruit diameter, fruit length, and TSS.

Olive

In olive, 15 cultivars were evaluated for various fruit and stone characteristics. Fruit weight ranged from 2.15 g in 'Tonda Iblea' to 4.82 g in 'Leccino', with fruit length varying from 17.26 mm in 'Cerignola' to 24.59 mm in 'Leccino', and diameter from 13.66 mm ('Cerignola') to 18.11 mm ('Leccino'). TSS was lowest in 'Zaituna' and highest in 'Belice'. Stone weight ranged from 0.23 g ('Tonda Iblea') to 0.82 g ('Zaituna' and 'Coratina'), with stone length between 7.01 mm ('Toffhoio') and 19.31 mm ('Coratina'), and diameter from 6.34 mm ('Pendolino') to 9.14 mm ('Zaituna'). Pulp percentage (fresh weight basis) varied from 76.15% in 'Belice' to 98.23% in

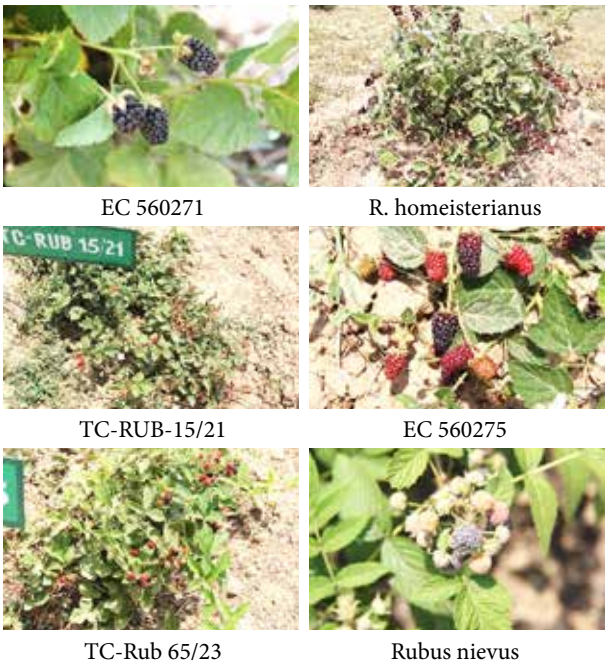

IC 340596, Sweet Charlie & Ofra

Cerignola Coratina Pendolino Messenese Zaituna

'Tonda Iblea'. Average yield per plant ranged from 0.2 kg ('Tonda Iblea') to 16.85 kg ('Zaituna'), with maximum recorded yields up to 26 kg in 'Zaituna', 17 kg in 'Pendolino', 15.3 kg in 'Coratina', 13.3 kg in 'Cerignola', 11.7 kg in 'Leccino', 10.3 kg in 'Messenese', and 7.8 kg in 'Picholine'. Notably, biennial bearing was prominently observed across cultivars.

Blackberry

In a study on blackberry, fruits from sixteen *Rubus* cultivars/collections obtained from ICAR-NBPGR, RS Srinagar were stored for 20 days and evaluated for colour reversal in relation to physical traits, biochemical composition, and fungal incidence. The average fruit weight ranged from 1.53 g (local collection) to 3.99 g (cultivar 15/21), while fruit length varied from 12.85 mm (local collection) to 27.36 mm (EC 560271). Anthocyanin content differed significantly across cultivars, ranging from 120.63 mg/100 g (cultivar 1/35) to 483.73 mg/100 g (cultivar 28/24). Minimal or no colour change was observed in 'Local Collection' and '66' after storage, with fungal incidence of 5% and 10%, respectively. Conversely, cultivars 65/23 and 15/21 showed the highest degree of colour reversal (70% and 80%), while maintaining low or negligible fungal infection. Cluster analysis grouped all the cultivars into three distinct clusters based on the evaluated parameters, indicating variability in post-harvest behaviour and storage potential.



EC 560271 R. homeisterianus
TC-RUB-15/21 EC 560275
TC-Rub 65/23 Rubus nievus

Fruiting in some Rubus genotypes

Almond

In almond, ten cultivars were evaluated for nut and kernel characteristics. The heaviest nuts were recorded in 'Makhdoom' (3.66 g), while the lightest were in 'Non Pareil' (2.05 g). Kernel weight was also highest in 'Makhdoom' (2.067 g) and lowest in 'Merced' (0.92 g). Kernel percentage was highest in 'Shalimar', followed closely by 'Pranyaj', 'Primorskij', 'Non Pareil', 'Darek', 'Makhdoom', 'Waris', 'Merced', 'IXL', and 'California Paper Shell'. Among all traits, the highest coefficient of variation was observed in shell thickness (19.69%), with the thinnest shells recorded in 'Non Pareil' (0.61 mm). Significant variation was also noted in other nut and kernel dimensions across the cultivars.

Walnut

In walnut, 219 genotypes were evaluated for nut and kernel traits. Nut weight ranged from

CITH W 12 CITH -W-121

MB 7/2 (Papery shell/ incomplete shell) MB 2/1 (More branching density and higher yield

Sporadic cluster bearing in some genotypes turning into male like flowers in later stages in walnut.

6.48 g to 28.13 g, while kernel weight varied between 2.52 g and 12.52 g. Shell thickness ranged from 0.34 mm to 3.20 mm, and kernel recovery percentage varied from 29.64% to 69.52%. Among the genotypes, 21 produced nuts weighing more than 18 g, and 38 exhibited kernel weights exceeding 8 g. Sixteen genotypes recorded kernel recovery above 55%, while 41 genotypes had shell thickness less than 1.5 mm, including 3 with shells thinner than 1 mm. Besides released varieties, several promising genotypes (CITH W-36, CITH W-78A, CITH W-102, BSP-1, KHS-1, MB 8/11, MB 2/1, MB 7/2) were shortlisted for further evaluation based on desirable traits. Two genotypes (CITH W-12 and CITH W-121) were recommended for release by the SVRC to the CVRC. Notably, one genotype produced nuts with papery/incomplete shells, and another exhibited higher branching density, contributing to increased yield. Sporadic or negligible cluster-bearing initiation was observed in a few genotypes, starting with female flowering and eventually producing catkin-like male structures on current-season growth.

Pistachio

In pistachio, four genotypes were evaluated for nut and kernel characteristics. The heaviest nuts were recorded in 'CITH Pistachio-6' (1.092 g), followed by 'CITH Pistachio-4' (0.953 g), 'CITH Pistachio-2' (0.881 g), and 'CITH Pistachio-1' (0.812 g). Similarly, kernel weight was highest in 'CITH Pistachio-6' (0.623 g), followed by 'CITH Pistachio-4' (0.479 g), 'CITH Pistachio-2 '(0.444 g), and 'CITH Pistachio-1' (0.419 g). The highest kernel recovery was also observed in 'CITH Pistachio-6' (57.25%), followed by 'CITH Pistachio-1' (51.58%), 'CITH Pistachio-2' (50.49%), and 'CITH Pistachio-4' (50.19%). Based on superior nut and kernel traits, 'CITH Pistachio-6' appears most promising for commercial cultivation.

CITH-Pistachio-1 CITH-Pistachio-2 CITH-Pistachio-4 CITH-Pistachio-6

Hazelnut

In hazelnut, eight cultivars were evaluated for various nut and kernel traits. Nut weight ranged from 2.60 g in 'Morville' to 3.44 g in 'Ennis'. Kernel weight varied from 1.02 g in 'Tonda Romana' to 1.48 g in 'Butler'. Shell thickness was lowest in 'Butler' (1.22 mm) and highest in 'Tonda Giffoni' (1.76 mm). Kernel recovery ranged from 38.57% in 'Tonda Giffoni' to 48.18% in 'Butler'. Based on overall desirable nut and kernel characteristics, 'Butler' and 'Ennis' were identified as the most promising cultivars for commercial cultivation.

Tonda Giffoni *Tonda Romana*

Morville *Ennis*

Butler

Chestnut

In chestnut, seven selections were evaluated for various nut and kernel traits. The largest nuts were recorded in 'CITH Chestnut-8' (4.76 g), followed by 'CITH Chestnut-10' (4.33 g). These two selections also showed the highest kernel weights—3.58 g in 'CITH Chestnut-8' and 3.45 g in 'CITH Chestnut-10'—with corresponding kernel recovery rates of 81.50% and 79.26%, respectively. Based on these desirable traits, both selections appear promising for further multiplication and commercial cultivation. Additionally, in-vitro studies on pollen germination and viability were conducted using different staining techniques, including acetocarmine, methylene blue, inorganic acid, and a mixture of iodine and potassium iodide. Among these, acetocarmine stain yielded the highest pollen viability, making it the most effective method for viability assessment in chestnut.


CITH-Chestnut-1


CITH -Chestnut-2


CITH-Chestnut-3


CITH-Chestnut-7


CITH-Chestnut-8


CITH-Chestnut-9


CITH-Chestnut-10

Pecan

In pecan, two selections fruited during 2024, with Selection-3 demonstrating superior performance across several traits. Selection-2 produced nuts with a weight of 2.05 g, nut length of 20.58 mm, width of 15.61 mm, thickness of 16.78 mm, shell thickness of 0.57 mm, kernel weight of 0.91 g, kernel length of 14.44 mm, width of 13.07 mm, thickness of 10.25 mm, and a kernel recovery of 44.46%. In comparison, Selection-3 recorded higher values for most traits: nut weight of 2.13 g, length of 24.29 mm, width of 14.99 mm, thickness of 13.99 mm, shell thickness of 0.74 mm, kernel weight of 1.08 g, kernel length of 15.96 mm, width of 11.13 mm, thickness of 10.42 mm, and a kernel recovery of 50.45%. Moreover, Selection-3 also produced a greater number of nuts, indicating its better overall potential for further evaluation and multiplication.

Persimmon

Two persimmon cultivars, *Hachiya* and *Fuyu*, were evaluated for key fruit traits. *Hachiya* recorded higher values for fruit weight (237.96 g), fruit length (85.41 mm), and fruit diameter (70.73 mm) compared to *Fuyu*, which had corresponding values of 137.98 g, 70.26 mm, and 59.31 mm. However, *Fuyu* exhibited higher total soluble solids (TSS), indicating better sweetness. In addition to persimmon, germplasm collections of loquat and Chinese ber were maintained and assessed for fruit traits to identify elite types for future breeding and evaluation programs.


Pecan Selection-2


Pecan Selection-3

Fruiting and nuts of Pecan Selections


Persimmon- Hachiya


Persimmon- Fuyu


Loquat


Chinese ber

Fruits of Persimmon, loquat and Chinese ber

ICAR -CITH, Regional Station, Mukteshwar

During the last year, a total of 58 genotypes across various crops were collected in the form of plants, scion wood, and runners, and subsequently planted or propagated in the nursery. In addition, ongoing evaluation work was conducted on existing germplasm maintained at the station under mid-hill conditions of Uttarakhand across a range of crops including apple, peach, plum, apricot, walnut, and kiwifruit. The primary focus was on assessing physico-chemical traits.

Apple: Twenty cultivars representing the Delicious group, spur types, and color strains were evaluated for key qualitative and quantitative traits. The highest fruit weight (142.64 g) was recorded in 'CITH Lodh Apple-1', while 'Mayan' registered the highest TSS (11.13 °B). Among seven new cultivars tested, 'Mema Mester' showed the highest fruit weight (192.12 g), followed by 'Scarlet Spur-II' (188.88 g). The highest TSS was observed in 'Dark Baron Gala' (11.13 °B), followed by 'Mema Gala' (10.47 °B) and 'SchniCo Red Gala' (9.10 °B). In a separate density trial involving three cultivars, 'CITH Lodh Apple-1' recorded the highest fruit weight (166.69 g) at 2.0 m × 1.5 m spacing, followed by 'Golden Delicious' (123.06 g) at 0.75 m × 1.5 m spacing.

Peach: Six cultivars, including 'Red June', 'FLA-16-33', 'Flordasun', 'Flordaking', and 'Reliance', were evaluated in 2024. Red June showed the highest fruit weight (128.48 g) and TSS (12.00 °B), indicating its superior quality.

Plum: Among eight cultivars assessed, 'Santa Rosa' recorded the highest fruit weight (41.60 g), while 'Greengage' had the highest TSS (12.07 °B).

Apricot: Nine cultivars were evaluated, with 'Chaubatia Madhu' recording the highest fruit weight (73.94 g) and 'Gola Local' the highest TSS (14.13 °B).

Walnut: Ten cultivars were studied for growth-related traits. 'CITH Walnut-9' attained the tallest plant height (3.3 m), followed by 'CITH Walnut-10' (2.9 m) and 'CITH Walnut-8' (2.4 m). The maximum number of branches was observed in 'CITH Walnut-10' (5.7), followed by 'CITH Walnut-8' and 'CITH Walnut-9' (both 4.3). 'CITH Walnut-4' had the highest number of shoots (59.3), while 'CITH Walnut-8' exhibited the longest shoots (68.5 cm), followed by 'CITH Walnut-9' (66.8 cm) and 'CITH Walnut-10' (60.8 cm).

Kiwifruit: Five cultivars were evaluated for physico-chemical characteristics. 'Hayward' and 'Bruno' recorded the highest fruit weights (75.5 g and 65.5 g, respectively). The highest TSS was observed in 'Abbot' (15.10 °B), followed by 'Bruno' (14.5 °B), highlighting their superior sweetness and quality.

These evaluations are instrumental in identifying promising cultivars for future multiplication and commercial cultivation in the mid-hill regions of Uttarakhand

ICAR-CITH, Regional Station Dirang

ICAR-CITH, Regional Station Dirang, is actively engaged in research and development on temperate horticultural crops. The station is continuously enriching its germplasm resources and establishing mother orchards to facilitate detailed evaluation and support the future commercialization of promising crops and varieties.

Survey and exploration of indigenous germplasm

A field survey was conducted in West Kameng district of Arunachal Pradesh to identify wild edible temperate fruits, following detailed interviews with local inhabitants. Situated in the Eastern Himalayas, West Kameng is rich in biodiversity, particularly wild berries, which hold significant ecological and socio-economic importance for the local communities. The survey documented the diversity, distribution, and local relevance of these wild fruits. Some of the key species identified include *Rubus ellipticus* (Golden Himalayan Raspberry), *Gaultheria fragrantissima* (Indian Wintergreen), *Rubus microphyllus*, *Elaeagnus* sp. (Autumn Olive), *Rubus niveus* (Ceylon Raspberry), wild strawberry, *Diospyros lotus* (Date Plum/Amlok), *Stauntonia* sp. (Stauntonia vine), and wild blueberries.



Rubus spp.

Diospyros lotus

Variability in Rubus

Elaeagnus sp.

Gaultheria fragrantissima

Stauntonia sp.

Wild blueberries

Evaluation of strawberry varieties in the mid hills of Arunachal Pradesh

Five promising strawberry cultivars—'Elyana', 'Winter Dawn', 'Sweet Sensation', 'Festival', and 'Fortuna'—were recently procured and established at ICAR-CITH, Regional Station Dirang for systematic evaluation under high-altitude temperate conditions. These varieties are currently being assessed for their adaptability, growth behavior, flowering and fruiting characteristics, and performance in terms of fruit quality and yield potential in the unique agro-climatic conditions of Dirang. The evaluation aims to identify cultivars suitable for commercial cultivation in this region and to support the development of location-specific strawberry production technologies. The outcome of this trial will help in selecting elite cultivars that can boost strawberry cultivation and income generation in the temperate zones of Arunachal Pradesh and adjoining areas.

View of strawberry varieties planted in Naturally ventilated polyhouse and open field

Vegetable Crops

The germplasm of various vegetable crops, including kale, root vegetables (such as radish, carrot, and turnip), and a range of exotic vegetables (such as broccoli, lettuce, celery, parsley, and red cabbage), was systematically maintained and evaluated under open field conditions at the institute. The objective of the evaluation was to assess their adaptability, growth performance, yield potential, and quality attributes under the unique temperate agro-climatic conditions of the region. Each accession was grown using standard agronomic practices, and data were recorded on key parameters such as plant vigor, leaf and root morphology, harvest duration, marketable yield, and nutritional quality. The results revealed considerable variability among the genotypes, indicating the presence of promising lines suitable for introduction and promotion in the region

for commercial cultivation. This evaluation has provided valuable insights into the performance of traditional and non-traditional vegetable crops, which will aid in crop diversification, nutritional security, and the development of high-value vegetable production systems in temperate regions. The key findings from this evaluation are summarized below for further interpretation and recommendations.

Kale

The evaluated germplasm exhibited considerable variability in yield and associated traits (Table 3). Leaf yield across the genotypes ranged from 57.40 to 520.36 quintals per hectare. Notably, several genotypes outperformed the best-performing check variety, 'Hanz Haak' (329.05 q/ha). Among them, 'HW-5' recorded the highest yield (520.36 q/ha), followed by 'Pusa Sag-2' (489.67 q/ha), 'Pusa Sag-3' (460.30 q/ha), and 'NW Sag-23' (397.76 q/ha). These promising genotypes demonstrated superior productivity potential and may be considered for further evaluation, advancement, and possible release for cultivation in temperate regions.

Table 3. Evaluation of kale germplasm for yield and associated traits during 2024.

Sl. No.	Entries	Plant height (cm)	Plant spread (cm)	No. of leaves/ plant	Leaf length (cm)	Leaf diameter (cm)	Average wt of leaf (g)	Yield (q/ha)
1	CITH-KC-2	72.10	75.20	22	21.55	16.65	19.50	151.20
2	CITH-KC-3	52.20	71.55	21	23.10	15.25	23.20	179.33
3	CITH-KC-7	48.50	57.90	22	19.20	13.83	22.50	173.77
4	CITH-KC-9	54.10	66.65	24	20.70	17.15	18.50	149.86
5	CITH-KC-11	51.20	57.30	24	18.85	11.75	13.50	121.91
6	CITH-KC-12	50.10	73.90	18	19.40	16.40	15.25	61.92
7	CITH-KC-14	51.70	53.15	25	19.60	12.00	28.00	240.78
8	CITH-KC-16	53.20	67.80	25	21.50	15.95	14.00	131.21
9	CITH-KC-18	59.20	67.75	23	21.60	15.95	31.00	268.22
10	CITH-KC-20	59.20	71.95	31	22.55	14.75	21.00	226.52
11	CITH-KC-21	63.70	68.80	32	21.20	14.65	18.25	174.87
12	CITH-KC-24	54.10	59.15	18	21.60	15.85	28.50	183.45
13	CITH-KC-26	50.70	59.55	23	18.70	15.10	18.50	156.18
14	CITH-KC-30	60.80	68.35	22	20.10	15.10	14.25	103.69
15	CITH-KC-38	49.80	60.60	22	20.55	14.85	22.25	190.00
16	CITH-KC-40	56.30	65.97	24	20.25	15.55	26.25	220.53
17	CITH-KC-42	53.70	59.70	22	20.00	13.91	19.75	172.43
18	CITH-KC-44	51.30	61.15	27	19.40	12.62	20.25	191.52
19	CITH-KC-48	55.10	60.80	23	16.60	12.31	17.40	136.70
20	CITH-KC-53	53.70	62.10	30	18.70	13.03	10.75	108.61
21	CITH-KC-Sel-1	51.40	64.50	26	19.70	14.45	21.50	194.27
22	CITH-KC-Sel-5	51.60	59.55	15	20.80	14.80	28.55	172.51
23	CITH-KC-Sel-40	46.80	52.55	18	16.80	12.55	17.75	88.45
24	CITH-KC-1/17	46.10	56.30	13	20.70	13.30	17.25	77.93
25	CITH-KC-1/21	58.30	65.20	23	17.40	11.95	16.75	142.91
26	CITH-KC-3/21	49.00	61.65	32	19.80	13.60	23.75	268.89
27	CITH-KC-4/21	51.10	51.70	21	19.15	13.25	13.50	105.14

Sl. No.	Entries	Plant height (cm)	Plant spread (cm)	No. of leaves/ plant	Leaf length (cm)	Leaf diameter (cm)	Average wt of leaf (g)	Yield (q/ha)
28	CITH-KC-6/21	50.50	74.40	29	15.80	11.90	15.75	155.77
29	CITH-Sel-40 1/15	67.30	77.60	32	23.40	18.25	23.25	289.65
30	CITH-KC-26 (R)	61.90	74.20	27	22.00	16.20	21.50	227.88
31	CITH-KC-8 Khanyari type	62.30	61.65	23	23.70	18.55	22.25	170.86
32	NW-Sag-1	58.40	65.35	32	22.05	15.45	20.50	221.36
33	NW-Sag-2	57.80	73.30	23	20.40	16.45	19.50	167.77
34	NW-Sag-4	54.20	58.05	34	21.80	15.15	14.00	180.06
35	NW-Sag-15	50.60	64.70	24	19.10	13.87	18.25	170.11
36	NW-Sag-22	60.80	67.80	24	20.35	14.20	20.00	188.96
37	NW-Sag-23	53.00	58.95	33	18.90	14.30	30.50	397.76
38	NW-Sag-24	57.70	65.20	23	21.60	16.20	25.25	223.10
39	NW-Sag-27	51.50	57.10	25	19.90	14.85	20.50	178.07
40	NW-Sag-29	55.30	68.20	27	21.30	14.60	22.55	215.56
41	NW-Sag-30	55.20	63.75	38	18.70	13.10	13.50	174.03
42	NW-Sag-33	51.20	57.85	21	22.20	15.65	28.00	225.99
43	NW-Sag-36 (R)	58.80	57.15	27	20.80	15.00	23.00	217.28
44	NW-Sag-38	55.50	66.10	25	19.05	14.65	15.00	132.02
45	NW-Sag-39	56.80	69.40	25	22.10	15.95	17.75	161.80
46	NW-Sag-40	44.50	50.50	16	16.15	13.10	10.25	57.40
47	NW-Sag-41	61.70	59.90	24	21.10	15.05	23.00	204.32
48	NW-Sag-42	57.90	54.85	22	19.70	16.15	18.00	136.54
49	NW-Sag-44	48.30	63.85	23	18.19	13.60	15.00	122.93
50	NW-Sag-20 (R)	69.90	67.45	20	22.60	16.25	24.50	180.01
51	Pusa Sag-2	50.00	72.80	112	19.35	11.45	14.00	489.67
52	Pusa Sag-2 (Siberian type)	37.80	60.50	57	15.74	11.39	13.75	293.70
53	Pusa Sag-3	42.00	57.65	62	18.75	14.95	20.25	460.30
54	Pusa Sag-4	37.50	54.45	60	24.60	16.65	12.25	238.47
55	Tangmarg Kale -1	56.30	66.85	16	19.00	15.50	18.25	62.61
56	HW-1	48.00	55.70	21	20.40	14.75	22.00	181.37
57	HW-5	50.90	70.40	114	14.00	10.60	17.75	520.36
58	Khanyari (C)	66.00	56.55	23	19.60	16.00	26.50	199.82
59	Khanyari (Kohinoor)	48.70	54.35	18	19.70	13.95	25.25	171.88
60	Kawdari (C)	54.70	63.50	22	21.75	18.04	22.25	184.43
61	Hanz Haak (C)	56.80	58.10	87	20.30	14.55	13.75	329.05
62	SKUAST Sel-2	42.50	60.00	27	19.98	13.40	20.25	185.83
	CD (p≤0.05)	6.45	10.55	6.70	2.57	2.07	4.89	66.07
	CV (%)	5.99	8.37	10.74	6.43	7.07	12.36	16.14


Turnip Purple Round


Kale Siberian


Kale Khanyari

Turnip

The turnip germplasm exhibited significant variability in root yield (Table 4), with yields ranging from 380.75 to 1072.90 quintals per hectare. Among the evaluated genotypes, 'PTWG Flat 'recorded the highest root yield (1072.90 q/ha), followed closely by 'White Flat' (992.58 q/ha). Both genotypes outperformed the best check variety, 'Pusa Chandrima' (737.42 q/ha), indicating their strong potential for yield enhancement and suitability for cultivation under temperate conditions.

Table 4. Evaluation of turnip germplasm for yield and related traits during 2024.

Sl. No.	Entry	Plant height (cm)	Plant spread (cm)	No. of leaves/ plant	Root length (cm)	Root dia. (cm)	Average root wt. (kg)	Yield (q/ ha)
1	Nigeen-1 (C)	57.50	59.91	9.50	6.93	8.24	0.28	674.42
2	White Globe	51.15	50.88	9.00	7.15	8.90	0.36	603.75
3	Pink/Purple Globe	44.25	49.96	8.50	6.56	8.18	0.33	481.30
4	PS X PTWG	56.16	55.46	10.00	7.60	8.87	0.35	519.33
5	PSB	55.08	55.25	8.00	8.02	9.38	0.50	504.83
6	PTWG (Flat)	54.25	55.65	9.50	5.32	10.71	0.41	1072.90
7	PT X PC	52.35	56.30	10.00	7.42	9.50	0.48	799.03
8	Pink Flat	53.15	53.30	9.00	6.22	9.33	0.35	545.67
9	PS/ IARI	48.80	49.18	9.50	6.83	10.77	0.42	430.29
10	Green Top	39.75	38.04	11.00	8.37	9.58	0.48	757.07
11	Golden Ball W-4	44.55	43.53	10.50	6.69	9.09	0.40	866.22
12	White Flat	50.85	48.50	11.50	6.93	9.39	0.55	992.58
13	Purple Flat	50.50	47.28	11.15	6.37	8.35	0.39	806.82
14	Purple Type	49.15	47.65	12.70	8.02	10.09	0.45	871.92
15	Dark Green Top White Globe (Sel-1)	36.33	44.33	10.32	6.09	8.06	0.39	567.71
16	Purple Long	46.08	44.38	11.00	11.39	6.79	0.36	704.70
17	Pink Globe	51.67	50.92	9.92	8.06	9.53	0.41	797.42
18	Purple Flat	41.75	46.46	10.80	5.95	8.59	0.35	708.92
19	White Globe	51.66	46.79	10.00	7.16	8.78	0.41	847.25

Sl. No.	Entry	Plant height (cm)	Plant spread (cm)	No. of leaves/ plant	Root length (cm)	Root dia. (cm)	Average root wt. (kg)	Yield (q/ ha)
20	Purple Top Inner White (Sel-2)	51.16	44.58	8.75	6.56	7.00	0.26	560.75
21	CITH -T-2	40.88	41.58	9.16	6.18	7.18	0.21	380.75
22	Purple Top White Globe Flat (Sel-4)	50.83	52.29	11.05	7.02	8.44	0.31	641.50
23	Pusa Chandrima (C)	52.42	50.79	11.58	6.68	8.77	0.34	737.42
24	Purple Round	53.17	49.25	10.25	7.73	9.73	0.39	758.58
25	PTWG Flat	55.25	45.46	9.50	6.13	11.18	0.46	878.08
26	Purple White Sel-1	50.00	45.79	9.75	7.40	8.20	0.27	500.17
27	Pink White	51.41	51.54	9.75	8.30	10.25	0.46	846.67
28	Purple-Green Top White Flesh	49.58	47.37	8.00	8.37	9.34	0.38	677.25
29	Purple White Zebra	51.75	49.37	8.08	7.21	10.33	0.50	865.33
30	PTWG (C)	47.33	42.54	10.25	7.33	7.72	0.29	588.92
	CD (p≤0.05)	9.91	7.59	2.31	1.57	1.14	0.14	192.73
	CV (%)	9.65	7.47	11.33	10.66	6.18	17.83	13.31

Radish

The root yield of radish germplasm showed considerable variation, ranging from 50.67 to 397.97 quintals per hectare (Table 5). Among the evaluated genotypes, 'CITH-White Round' recorded the highest yield (397.97 q/ha), significantly outperforming the best check variety, 'Pusa Himani' (326.17 q/ ha), thus demonstrating its promise for high-yielding cultivation in temperate regions.

Table 5. Evaluation of radish germplasm for yield and related traits (2024).

Sl. No.	Entries	Plant height (cm)	Plant spread (cm)	Root length (cm)	Root dia (cm)	Average Root wt (kg)	Yield (q/ ha)
1	CITH White Round	50.10	61.31	7.51	8.26	0.30	397.97
2	CITH Red Round	57.05	64.53	8.00	7.97	0.31	385.58
3	Light Purple	46.69	57.50	21.81	5.49	0.44	233.34
4	Islamabadi Red	53.50	56.21	8.08	7.02	0.25	109.60
5	White Round (Pvt)	59.96	58.83	7.32	8.16	0.31	183.17
6	Scarlet Round	40.25	49.79	7.70	9.57	0.42	346.83
7	Pink Round White Flesh	42.08	50.71	8.23	7.23	0.30	294.00
8	Radish Red-1 (Pvt)	56.67	48.42	21.49	4.21	0.28	218.17
9	Sango (Pvt_)	41.32	52.08	10.49	5.68	0.24	135.83
10	Radish-2 Pink (Pvt)	49.50	41.88	24.17	5.15	0.19	226.67

Sl. No.	Entries	Plant height (cm)	Plant spread (cm)	Root length (cm)	Root dia (cm)	Average Root wt (kg)	Yield (q/ha)
11	Light Purple	46.92	43.30	7.93	7.30	0.40	336.17
12	Pink Radish-3	52.50	43.63	9.83	7.25	0.39	319.42
13	Pusa Himani (C)	51.50	41.63	25.08	4.80	0.42	326.17
14	Early Scarlet Globe	31.75	31.75	8.23	6.35	0.15	99.25
15	Mixed Colour	21.05	24.94	7.08	6.80	0.13	64.17
16	French Breakfast	41.25	29.12	18.75	4.37	0.12	68.17
17	Chinese Purple	39.50	45.88	7.99	5.57	0.20	50.67
18	Dark Purple-3	51.50	47.20	8.05	7.25	0.25	79.33
19	Dark Purple-4	46.95	46.18	8.40	6.78	0.32	197.83
20	Radish Pink-2	27.67	31.75	7.64	6.54	0.25	123.67
21	Medium Red Radish	48.75	48.42	8.50	6.46	0.34	213.58
22	Dark Purple	42.83	31.00	9.54	6.16	0.18	71.75
23	Dark Pink	48.75	39.00	20.00	6.04	0.34	65.75
24	Dark Purple-2	47.60	36.35	7.66	6.47	0.31	87.42
25	Pusa Mridula (C)	61.25	37.76	6.11	6.50	0.14	67.53
	CD ($p<0.05$)	6.76	9.52	2.38	0.90	0.12	66.02
	CV (%)	7.04	10.25	10.06	6.67	20.23	16.90

ICAR-CITH Regional Station, Mukteshwar

A comprehensive survey was conducted across various villages of Uttarakhand to collect germplasm of locally cultivated traditional vegetable crops. The survey resulted in the collection of 21 traditional bean types, 22 types of Meetha Karela (*Cyclanthera pedata*), two faba bean accessions, three types of Lai Patta (*Brassica juncea* var. rugosa L.), two garlic genotypes, and two capsicum lines. These collections will be evaluated at ICAR-CITH, Regional Station Mukteshwar for their suitability in future crop improvement and conservation efforts.

Cherry Tomato: A total of 11 germplasm lines of cherry tomato were evaluated for growth, yield, and yield-contributing traits. The highest yield was recorded in 'CT-2 Red' (28.51 q/ha), followed by 'CT-8' (26.57 q/ha), 'CT-1' (25.22 q/ha), and 'VLCT-1' (23.80 q/ha), indicating their promise for commercial cultivation in the region.

Capsicum (under protected cultivation): Six genotypes were evaluated under protected conditions. 'CITH SEL-6' recorded the highest number of fruits per plot (104.50), indicating good fruiting potential. In terms of yield, Selection-7 was superior with 100.80 q/ha, followed by 'CITH SEL-4' (93.41 q/ha), suggesting these lines are promising for high productivity in protected environments.

Garlic (Rabi Extended Summer 2023–2024): Seven garlic genotypes were evaluated for growth, yield, and quality traits. 'CITH-MG-1' exhibited

the highest TSS (38.27 °B), followed closely by 'CITH SEL-7' (38.00 °B) and 'CITH SEL-12' (37.03 °B), indicating high quality. In terms of yield, 'CITH SEL-11' recorded the maximum total weight per plot (3.38 kg) with a yield of 169.17 q/ha, followed by 'VLG-1' (3.12 kg/plot; 155.90 q/ha) and 'CITH-MG-1' (2.79 kg/plot; 139.32 q/ha).

These evaluations highlight the genetic variability and potential of local and introduced vegetable germplasm for improving crop productivity and quality under mid-hill conditions.

Cyclanthera pedate and capsicum (orange red and green) collected at CITH RS, Mukteshwar

Common bean cultivars and *Lai patta* seed collected at CITH, RS, Mukteshwar

ICAR-CITH, Regional Station Dirang

Exploration and collections of vegetable germplasm

During 2024, ICAR-CITH, Regional Station Dirang, Arunachal Pradesh, undertook extensive collection missions across various Northeastern states (Arunachal Pradesh, Nagaland, Assam, Mizoram, and Manipur) and Northwestern Himalayan states (Himachal Pradesh and Uttarakhand) to gather indigenous germplasm of diverse crops. Among these, cucumber (Cucumis sativus L.) germplasm stood out due to its unique traits, particularly when compared to the southern and northern varieties currently utilized in national breeding programs. Notably, these indigenous cucumber lines exhibited tolerance to extreme low temperatures (5–10 °C)—a rare trait in this thermosensitive crop, which typically requires 25–30 °C for optimal germination and flowering. Remarkably, the collected germplasm demonstrated successful germination and flowering at 5–10 °C during the winter season of 2024, qualifying them as potential temperate cucumber lines suitable for high-altitude and cooler regions. In addition to cold tolerance, the collected germplasm also exhibited superior shelf life, thicker flesh, richness in beta-carotenes, and resistance to key fungal diseases such as downy mildew and powdery mildew. These traits were found to be superior when compared with popular national checks such as Pusa Uday (IARI) and Arka Veera (IIHR). Following collection, the germplasm was self-pollinated to initiate the development of homozygous lines, and subsequently screened for agro-morphological traits. This led to the documentation and identification of elite lines with significant breeding potential, now earmarked for integration into the future cucumber improvement pipeline (Fig. 3). A summary of the germplasm collected and evaluated across various crops is provided in Table 6.

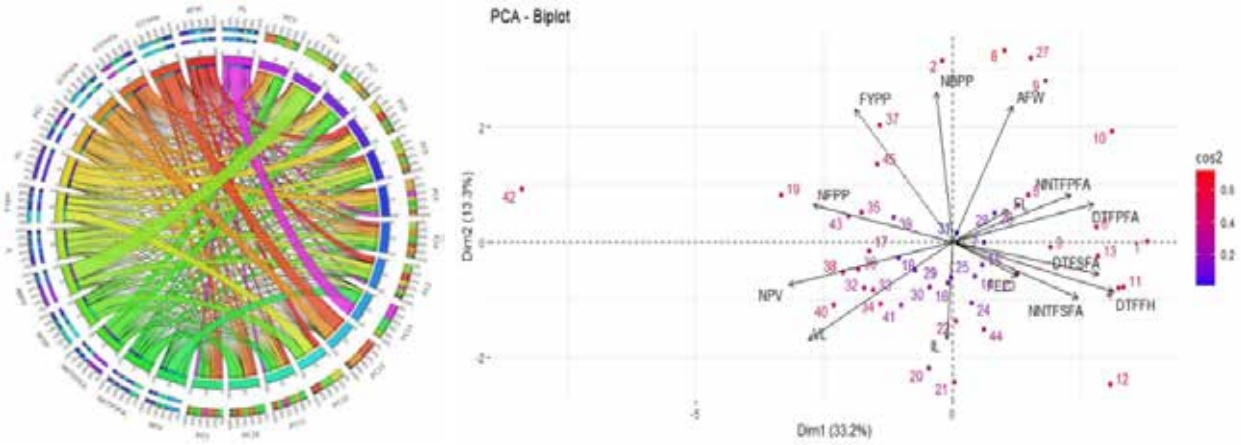


Figure 3. Circo's plot and PCA biplot for 14 agro-morphological traits correlation in cucumber (*Cucumis sativus* L.).

Table 6. List of different vegetable crops collected and maintaining at ICAR-CITH RS Dirang.

Sl. No	Germplasms	Special breeding traits
1.	Cucumber (*Cucumis sativus* L.)	Low temperature tolerance and adapted to giher altitudes (13,000 feet)
2.	Lai Patta (*Brassica juncea* var *rugosa* L.)	Better yielding and tolerance to low temperature
3.	Musk Melon (*Cucumis melo* L.)	Deep orange flesh
4.	Garden (*Pisum sativum* L.)	Tolerance to rust diseases, high yielding, variations in flower colour)
5.	Ground Apple (*Smallanthus sonchifolius* L.)	Medicinal usage and nutritionally rich root vegetable
6.	Radish (*Raphanus sativus* L.)	Locally grown and green Sholder with white tap root.
7.	Allium species (Chinese chive (*Allium tuberosum* L, *Allium hookeri)*,	Adapted to low temperature, higher altitude flower and nutritionally rich in micro nutrients.
8.	Brinjal (*Solanum muricatum* Ait,)	Adapted to higher altitudes and low temperatures with potential to many medicinal uses.

Indigenous collections of the different vegetable crops (Pepino, Local Garden pea, Lai Patta, cucumber) collected and maintaining ICAR-CITH RS Dirang, Arunachal Pradesh.

Development of Superior Cultivars/Hybrids in Temperate Fruits through Conventional and Non-Conventional Methods

Evaluation of breeding population (CITH-Ambri-1 × Prima) for morphological and biochemical characteristic

In an effort to mitigate the adverse effects of climate change on temperate fruit cultivation, a scab-resistant apple population ('CITH-Ambri-1' × 'Prima') is currently under evaluation for its physiological and biochemical traits. This population is being developed and assessed under open field conditions, targeting the inheritance of scab resistance from 'Prima', along with desirable quality traits—such as high total soluble solids (TSS), distinct aroma, and extended shelf life—from 'CITH-Ambri-1'. During the year 2024, 13 genotypes from this cross fruited and were thoroughly evaluated for key quality parameters, including fruit weight, TSS, firmness, skin colour, and biochemical properties such as antioxidant potential, total phenolic content, flavonoids, and flavanol levels. The initial results have been encouraging, with several genotypes exhibiting a fruit weight greater than 150 g, TSS above 13°B, and firmness exceeding 70 RI, along with attractive fruit coloration and high antioxidant potential. These findings indicate strong potential for the development of climate-resilient, high-quality apple cultivars. Detailed data are presented in Tables 7 and 8.

Table 7. Fruit Quality parameters of CITH-Ambri-1 x Prima population.

Genotype	Fruit weight	Fruit length	Fruit Diameter	TSS (°B)	Colour				pH	Firmness
	(g)	(mm)	(mm)		L	a	b	tint		(RI)
AP-6	145.33^{bc}	58.82^{de}	64.07^{bc}	13.7^{b}	43.54^{f}	24.52^{ab}	25.98^{b}	-97.87^{ab}	3.22^{d}	60.66^{de}
AP-7	121.0^{d}	57.62^{ef}	55.77^{d}	12.46^{ef}	58.40^{ab}	17.71^{de}	19.23^{ef}	-51.15^{e}	3.2^{d}	75.83^{ab}
AP-15	139.0^{cd}	52.35^{gh}	62.66^{c}	12.86^{de}	43.22^{f}	22.72^{bc}	11.94^{g}	-81.1^{ab}	3.52^{bc}	55.43^{fg}
AP-47	156^{ab}	65.68^{ab}	62.01^{c}	12.36^{f}	53.43^{bc}	20.18^{cd}	22.47^{bd}	-73.6^{cd}	3.66^{b}	68.53^{bc}
AP-53	155.66^{ab}	57.84^{de}	66.66^{bc}	14.33^{a}	48.40^{de}	19.83^{cd}	16.58^{ef}	-74.6^{bc}	3.49^{bc}	64.3^{cd}
AP-55	168.33^{ab}	57.91^{de}	66.84^{bc}	13.0^{de}	45.85^{ef}	23.95^{ab}	15.27^{fg}	-89.1^{ab}	3.16^{de}	79.36^{a}
AP-66	146^{bc}	60.66^{bc}	67.16^{ab}	12.5^{ef}	50.95^{cd}	29.77^{a}	18.97^{ef}	-102.5^{a}	3.16^{de}	74.13^{ab}
AP-69	118.33^{d}	68.23^{ab}	65.70^{bc}	12.46^{ef}	51.61^{cd}	26.01^{ab}	19.1^{ef}	-91.3^{ab}	3.14^{de}	69.13^{bc}
AP-70	139.33^{bc}	60.37^{cd}	70.48^{ab}	13.6^{bc}	56.52^{ab}	14.26^{ef}	28.60^{ab}	-59.1^{de}	2.06^{f}	59.26^{ef}
AP-98	182.33^{a}	66.77^{ab}	70.38^{ab}	12.43^{ef}	52.02^{cd}	22.94^{bc}	17.27^{ef}	-80.3^{ab}	3.56^{b}	67.46^{bc}
AP-117	147.33^{bc}	62.43^{ab}	73.56^{a}	12.41^{ef}	59.04^{ab}	19.86^{cd}	28.54^{ab}	-76.0^{bc}	3.46^{bc}	64.3^{cd}
AP-130	143.21^{bc}	68.98^{a}	65.79^{bc}	11.31^{g}	51.79^{cd}	27.79^{ab}	18.26^{ef}	-95.5^{ab}	2.97^{e}	68.26^{bc}
AP-181	142.58^{bc}	60.17^{cd}	70.85^{ab}	13.15^{cd}	47.37^{de}	25.03^{ab}	14.44^{fg}	-81.0^{ab}	2.26^{f}	54.5^{g}
Prima	119.69^{d}	50.79^{h}	51.78^{e}	12.33^{f}	48.04^{de}	12.47^{fg}	25.37^{bc}	-72.1^{cd}	3.30^{cd}	63.43^{cd}
Ambri	135.66^{cd}	54.17^{fg}	58.90^{de}	13.36^{bc}	60.27^{a}	10.14^{g}	32.47^{a}	-16.15^{f}	3.86^{a}	70.46^{bc}

**AP (Priame)*

AP-7 (Ambri x Prima)

AP-6 (Ambri x Prima)

AP-9 (Ambri x Prima)

AP-15 (Ambri x Prima)

AP-47 (Ambri x Prima)

AP-130 (Ambri x Prima)

AP-66 (Ambri x Prima)

AP-55 (Ambri x Prima)

AP-69 (Ambri x Prima)

AP-70 (Ambri x Prima)

Fruit of hybrid population (CITH-Ambri-1 x Prima) along with parents

Table 8. Antioxidative potential of 'CITH-Ambri-1' x 'Prima' population.

Genotype	% scavenging activity	Flavanoids mg QE/g fw)	Flavanols Mg QE/g fw)	Phenols mg GAE/g fw
AP-6	71.9^{ef}	0.62^{d}	0.026^{bc}	1.86^{i}
AP-7	72.6^{de}	0.69^{d}	0.029^{ab}	2.97^{d}
AP-15	74.7^{c}	0.63^{d}	0.026^{bc}	1.27^{k}
AP-47	55.8^{i}	0.86^{c}	0.036^{ab}	3.08^{c}
AP-53 52.12^{j}		1.14^{a}	0.048^{a}	2.88^{e}
AP-55	76.4^{b}	0.76^{cd}	0.032^{ab}	2.44^{g}
AP-66	83.0^{a}	0.42^{k}	0.017^{d}	2.11^{h}
AP-69	65.7^{g}	0.80^{e}	0.033^{ab}	2.86^{e}
AP-70	76.3^{b}	0.64^{d}	0.027^{bc}	2.62^{f}
AP-98	76.2^{b}	0.69^{d}	0.029^{ab}	4.90^{a}
AP-117	73.3^{d}	0.54^{e}	0.022^{cd}	1.50^{j}
AP-130	59.3^{h}	0.87^{c}	0.037^{ab}	3.75^{b}
AP-181	60.1^{h}	1.05^{b}	0.044^{b}	2.14^{h}
CITH-Ambri-1	76.5^{b}	0.14^{f}	0.028^{bc}	3.16^{c}
Prima	87.4^{a}	0.128^{f}	0.019^{c}	2.02^{h}

**AP (Priame)*

Evaluation of identified apple hybrids

Six apple hybrids identified by ICAR-CITH, Srinagar were re-evaluated during the year for various agronomic and fruit quality traits to assess the stability of expression across seasons. Among these, 'CITH Priame' ('Prima' × 'Ambri'), 'CITH-Pride' ('Prima' × 'Red Delicious'), and 'CITH Pritor' ('Prima' × 'Top Red') were confirmed to possess the scab resistance trait, validated through both presence and expression studies of the *Vf* gene. Two other hybrids, 'CITH Ammol' ('Ambri' × 'Mollie's Delicious') and 'CITH Ambrit' ('Ambri' × 'Top Red'), demonstrated superior fruit quality traits compared to both parents and showed promise as potential improvements over the indigenous cultivar 'Ambri' ('CITH-Ambri-1'). Additionally, the hybrid 'Golden Snow' ('Golden Delicious' × 'Snow Drift') exhibited enhanced fruit quality traits compared to both parents, making it a potential improvement over 'Golden Delicious'. In total, six elite apple hybrids have been developed by ICAR-CITH with notable improvements in scab resistance, fruit quality, and yield potential. These hybrids are currently under multi-location evaluation across different temperate regions of India, with the objective of identifying region-specific recommendations for commercial cultivation. Of these, three hybrids—'CITH Priame', 'CITH Pride', and 'CITHAmmol'—have been proposed for release through the State Variety Release Committee (SVRC). These hybrids have also shown desirable physico-chemical attributes and high antioxidant potential, as detailed in Tables 9 and 10.

Table 9. Physico-chemical parameters of apple hybrids.

Genotypes	Weight (g)	Length (mm)	Breadth (mm)	TSS (^{0}B)	Firmness (RI)	Colour				pH
						L	a	b	tint	
CITH Priame	187.03^{bc}	62.49^{c}	66.81^{cd}	12.9^{d}	70.6^{b}	57.82^{bc}	26.95^{b}	25.21^{c}	-98.67^{i}	3.7^{b}
CITH Pride	154.66^{ef}	61.03^{c}	68.22^{c}	13.1^{d}	60.0^{de}	32.65^{f}	31.35^{a}	13.4^{f}	-142.71^{k}	3.9^{ab}
CITH Golden Snow	249.66^{a}	72.61^{a}	75.7^{a}	13.8^{bc}	64.7^{d}	68.94^{a}	-7.84	32.19^{b}	-4.86^{b}	2.8^{d}
CITH Ammol	207.0^{b}	72.18^{a}	75.24^{a}	14.1^{b}	58.4^{e}	44.78^{e}	28.09^{ab}	16.25^{e}	-105.96^{j}	3.9^{ab}
CITH Pritor	168.0^{de}	60.37^{c}	72.14^{ab}	15.9^{a}	68.2^{c}	49.77^{de}	18.47^{d}	9.13^{g}	-60.65^{f}	4.2^{a}
CITH Ambrit	162.0^{de}	67.18^{b}	57.43^{e}	13.8^{bc}	68.9^{c}	54.99^{c}	25.34^{b}	24.16^{c}	-89.83^{h}	3.9^{ab}
Prima	119.76^{fg}	53.45^{d}	62.13^{d}	12.33^{e}	63.43^{d}	48.04^{de}	12.47^{cd}	25.37^{c}	-72.16^{g}	3.2^{c}
CITH Ambri-1	135.6^{ef}	57.23^{cd}	54.58^{ef}	13.36^{c}	70.46^{b}	60.27^{b}	10.14^{d}	32.47^{b}	-16.15^{d}	3.7^{b}
Red Delicious	180.5^{cd}	69.56^{a}	71.23^{b}	14.02^{b}	60.82^{de}	51.3^{d}	22.1^{bc}	15.03^{e}	-33.3^{e}	3.7^{b}
Golden Delicious	149.7^{e}	52.15^{d}	55.28^{ef}	14.1^{b}	69.02c	63.08^{b}	8.95^{e}	31.62^{b}	-12.55^{c}	4.0^{a}
Snowdrift	48.0^{h}	40.81^{e}	48.71	14^{b}	66.68^{cd}	62.72^{b}	1.04^{f}	36.64^{a}	13.01^{a}	2.7^{d}
Mollies Delicious	202.3^{b}	69.51^{a}	65.14^{cd}	13.5^{c}	58.2^{e}	58.52^{bc}	19.01^{c}	25.14^{c}	-94.81^{i}	4.0^{a}
Top Red	98.9^{g}	57.52^{cd}	52.58^{f}	14.2^{b}	73.9^{a}	48.7^{de}	8.46^{e}	20.69^{d}	-40.08^{g}	3.7^{b}

Table 10. Anti-oxidative potential, phenol and flavonoid content of apple hybrids.

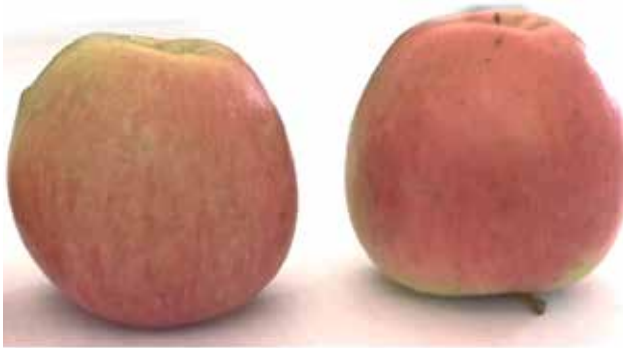
Genotype	% scavenging activity	Flavanoids mgQE/ gfw)	Flavanols mgQE/gfw)	Phenols mgGAE/ Gfw
CITH-Pride	87.3^{ab}	0.153^{a}	0.039^{d}	2.94^{d}
CITH-Priame	81.9^{ef}	0.121^{de}	0.016^{g}	2.93^{d}
CITH-Pritor	81.1^{fg}	0.142^{b}	0.080^{a}	3.59^{b}
CITH-Ammol	79.6^{g}	0.109^{f}	0.058^{b}	2.34^{f}
CITH-Ambrit	82.9^{ef}	0.122^{de}	0.028^{e}	4.33^{a}
CITH-Golden Snow	87.9^{ab}	0.132^{c}	0.038^{d}	3.05^{c}
Prima	89.7^{a}	0.115^{e}	0.014^{g}	1.76^{i}
Red Delicious	83.7^{de}	0.180^{f}	0.019^{fg}	2.58^{e}
CITH-Ambri-1	87.4^{ab}	0.148^{ac}	0.049^{c}	2.02^{g}
Mollies Delicious	85.7^{bc}	0.102^{f}	0.078^{a}	2.39^{f}
Golden Delicious	89.0^{ab}	0.128^{cd}	0.045^{c}	1.97^{h}
Snowdrift	84.9^{cd}	0.082^{g}	0.023^{f}	2.10^{g}
Top Red	91.02^{a}	0.048^{h}	0.024^{ef}	2.12^{g}

CITH Pride

CITH Priame

CITH Ammol

CITH Golden Snow



CITH Ambrit

Prima

Apple hybrids ready for release and commercialization

Hybridization for introgression of columnar growth habit & scab resistance in CITH Ambri-1

Breeding populations developed from various crosses involving 'CITH-Ambri-1'—including 'CITH-Ambri-1' × 'Prima, CITH-Ambri-1' × 'Oregon Spur', 'CITH Ambri-1' × 'Redlane', and 'CITH-Ambri-1' × *Malus floribunda*—are currently under evaluation using molecular tools for QTL (Quantitative Trait Loci) analysis and linkage map development. These efforts aim to identify key genomic regions associated with important traits such as scab resistance, fruit quality, and colour. During the evaluation of the 'CITH-Ambri-1' × 'Redlane' breeding population, two promising hybrids—'CITH Amblane-1' and 'CITH Amblane-2'—were selected based on their attractive fruit colour, superior quality attributes, and potential resistance to apple scab. These selections hold promise for further advancement in the breeding pipeline and possible future release for commercial cultivation.

S-Allele typing of identified apple hybrids

S-allele typing, an androit method was employed as a reliable and efficient method for the identification of apple hybrids and to support informed pollination management. The analysis confirmed the presence of expected S-alleles in all hybrids by comparing them with their respective parental combinations (Table 11). The S-allele profiles of the parental lines were consistent with previously reported findings, validating the accuracy of the method. Each hybrid produced predictive PCR bands corresponding to the expected sizes of their inherited S-alleles, thereby confirming their parentage and genetic integrity. This represents the first documented report of apple hybrid identification using S-allele typing. In addition to pedigree confirmation, the findings provide critical insights for effective pollination planning in future orchard establishment by ensuring compatibility among genotypes.

Differential quantity of major bioactive compounds and their antioxidative potential in some important apple genotypes

The present study aimed to investigate the variation in the content of key bioactive compounds and the antioxidant potential of thirteen apple genotypes, while also exploring correlations that may offer insights into their therapeutic value. High-Performance Liquid Chromatography (HPLC) was used to quantify major bioactive constituents, while antioxidant capacity was assessed using the DPPH radical scavenging assay. HPLC analysis revealed considerable variation in the concentration of bioactive compounds across genotypes. Catechins, quercetin, and rutin were identified as the dominant bioactives, with catechins exhibiting the highest relative concentration (Table 12 & Fig. 4). Among the genotypes, 'CITH Ambrit' recorded the maximum concentration of bioactive compounds. Total phenolic content (TPC) and total flavonoid content (TFC) were determined using the Folin-Ciocalteu reagent and the aluminum chloride colorimetric method, respectively. The same extracts were further evaluated for antioxidant activity through the DPPH assay. Notably, 'CITH Pride' exhibited the highest TPC (376.23 ± 0.88 mg GAE/100 g fresh weight), while 'CITH Ambri-1' recorded the highest levels of TFC (15.50 ± 0.17 mg QE/100 g FW) and flavanols (4.53 ± 0.04 mg QE/100 g FW). Principal Component Analysis (PCA) revealed a strong positive correlation between TPC and antioxidant activity, particularly with DPPH radical scavenging efficiency. These findings suggest that phenolic compounds are the primary contributors to antioxidant efficacy in the studied apple genotypes. In conclusion, the study highlights significant genotypic variation in bioactive content and antioxidant potential, underscoring the therapeutic promise of specific apple genotypes such as 'CITH Ambrit' and 'CITH Pride' for future nutraceutical or functional food applications

Table 11. S-alleles in apple parents and hybrids under study.

Parent1	S-allele	Parent 2	S-allele	Hybrid	S-allele
Prima	S2S10	Ambri	S9 S20	Priame	S10S20
Golden Delicious	S2S3	Snow Drift	S25 S45	Golden Snow	S3 S25
Ambri	S9S20	Mollies Delicious	S3 S7	Ammol	S9 S7
Ambri	S9S20	Top red	S9 S28	Ambrit	S9 S20
Prima	S2S10	Top Red	S9 S28	Pritor	S9 S10
Prima	S2S10	Red Delicious	S9 S28	Pride	S2 S9

Table 12. Variability in concentration (mg/g) of various analyzed bioactive compounds of different apple genotypes.

Genotypes	Quercetin	Rutin	Catechin	Epicatechin	Ferulic acid	Chlorogenic acid	Sinapic acid
CITH Ambri-1	0.457± 0.017^{bcd}	0.143 ± 0.047^{e}	1.352 ± 0.567^{e}	0.109 ± 0.038^{a}	0.059 ± 0.071^{b}	0.095 ± 0.032^{cde}	0.148 ± 0.341^{a}
Golden Delicious	0.142 ± 0.032^{de}	0.282 ± 0.046^{e}	0.632 ± 0.082^{ef}	0.162 ± 0.117^{a}	0.112 ± 0.069^{ab}	0.078 ± 0.0453^{de}	0.315 ± 0.251^{a}
Mollies Delicious	0.286 ± 0.02^{bcde}	0.101 ± 0.053^{e}	0.686 ± 0.226^{ef}	0.176 ± 0.116^{a}	0.065 ± 0.025^{b}	0.071 ± 0.081^{de}	0.107 ± 0.021^{a}
Prima	0.459 ± 0.065^{bcd}	0.175 ± 0.117^{e}	3.176 ± 0.178^{d}	0.736 ± 0.687^{a}	0.067 ± 0.0232^{b}	0.015 ± 0.043^{e}	0.144 ± 0.066^{a}
Red Delicious	0.276 ± 0.024^{cde}	0.252 ± 0.049^{e}	0.278 ± 0.174^{f}	0.116 ± 0.058^{a}	0.258 ± 0.166^{ab}	0.128 ± 0.103^{bcd}	0.122 ± 0.032^{a}
Snow Drift	0.046 ± 0.061^{e}	0.724 ± 0.044^{d}	0.632 ± 0.184^{ef}	0.166 ± 0.109^{a}	0.253 ± 0.214^{ab}	0.068 ± 0.021^{de}	0.112 ± 0.072^{a}
Top Red	0.477 ± 0.103^{bcd}	0.234 ± 0.048^{e}	0.252 ± 0.102^{f}	0.086 ± 0.067^{a}	0.059 ± 0.025^{b}	0.058 ± 0.032^{de}	0.193 ± 0.041^{a}
CITH Ambrit	2.188 ± 0.087^{a}	0.924 ± 0.146^{c}	5.591 ± 0.991^{a}	1.552 ± 1.496^{a}	0.079 ± 0.0331^{ab}	0.162 ± 0.051^{abc}	0.267 ± 0.129^{a}
CITH Ammol	0.623 ± 0.155^{b}	1.056 ± 1.225^{bc}	4.816 ± 0.322^{c}	1.062 ± 0.926^{a}	0.140 ± 0.062^{ab}	0.172 ± 0.023^{abc}	0.469 ± 0.0543^{a}
CITH Golden Snow	0.561 ± 0.071^{bc}	1.210 ± 0.058^{b}	3.784 ± 0.134^{d}	0.811 ± 0.668^{a}	0.121 ± 0.054^{ab}	0.175 ± 0.032^{abc}	0.531 ± 0.035^{a}
CITH Priame	0.582 ± 0.035^{bc}	0.622 ± 0.157^{d}	6.072 ± 0.211^{b}	1.244 ± 1.112^{a}	0.185 ± 0.051^{ab}	0.215 ± 0.025^{a}	0.377 ± 0.032^{a}
CITH Priator	0.396 ± 0.284^{bcd}	1.614 ± 0.131^{a}	5.062 ± 0.096^{c}	1.102 ± 0.942^{a}	0.16 ± 0.093^{ab}	0.118 ± 0.07^{bcd}	0.461 ± 0.064^{a}
CITH Pride	2.078 ± 0.212^{a}	0.747 ± 0.126^{d}	4.778 ± 0.212^{c}	1.129 ± 0.975^{a}	0.341 ± 0.068^{a}	0.192 ± 0.061^{ab}	0.381 ± 0.038^{a}

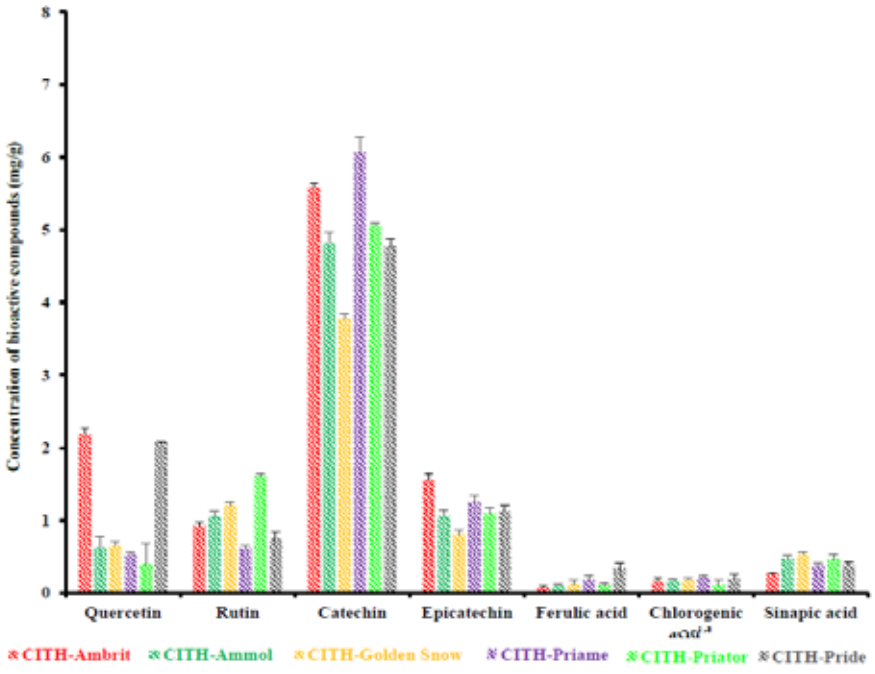


Figure 4. *Comparison of marked build-up of bioactive compounds among the potential apple genotypes from the study.*

Screening of mutant population (CITH-Ambri-1) for qualitative traits

The indigenous apple variety 'CITH-Ambri-1' is widely appreciated for its excellent aroma, taste, and shelf life. However, it lacks visual appeal due to its less attractive red coloration, which limits its marketability. To overcome this limitation, gamma radiation-induced mutagenesis (at doses of 30 and 40 Gy) was employed as a strategy for improving fruit colour. As a result, thirteen mutant plants produced fruits during the evaluation period. These were assessed for their physico-chemical properties and antioxidant potential (Table 13). Preliminary findings indicate promising variability, which could lead to the development of improved selections with enhanced red colour while retaining the superior quality attributes of the parent variety.

Table 13. Anti-oxidative and free radical scavenging potential of mutant population.

Genotype	Fruit weight (g)	% scavenging activity	Flavanoids mgQE/gfw)	Flavanols mgQE/gfw)	Phenols mgGAE/gfw	Colour		
						L	a	b
AM-15	125 ^{a}	78.92^{c}	0.039^{bc}	0.027^{bc}	1.924^{d}	62.3 ^{a}	13.9 ^{c}	27.0 ^{a}
AM-26	106.6^{a}	83.52^{ab}	0.069^{a}	0.042^{ab}	2.871^{b}	62.2 ^{a}	10.5 ^{d}	23.8 ^{b}
AM-94	80.66 ^{b}	67.11^{d}	0.051^{ab}	0.040^{ab}	1.333^{gh}	53.3 ^{b}	23.5 ^{b}	14.9 ^{c}
AM-96	103.00 ^{a}	83.68^{ab}	0.031^{cd}	0.019^{d}	3.480^{a}	54.1 ^{b}	24.8 ^{b}	20.5 ^{b}
AM-137	61.33 ^{c}	60.19^{e}	0.06^{ab}	0.048^{a}	1.354^{g}	63.0 ^{a}	13.2 ^{b}	30.3 ^{a}
AM-235	82.26 ^{b}	86.73^{a}	0.022^{d}	0.017^{d}	2.243^{c}	51.1 ^{b}	25.0 ^{b}	17.5 ^{c}
AM-242	113.06 ^{a}	80.90^{bc}	0.022^{d}	0.015^{d}	1.299^{gh}	52 ^{b}	32.5 ^{a}	17.0 ^{c}
AM-289	94.62 ^{b}	41.73^{g}	0.046^{bc}	0.029^{bc}	1.297^{h}	50.4 ^{b}	29.4 ^{b}	23.7 ^{b}
AM-341	109.3 ^{a}	62.88^{e}	0.038^{bc}	0.023^{cd}	1.472^{f}	54.1 ^{b}	25.0 ^{b}	18.3 ^{c}
AM-394	102.00 ^{a}	71.34^{d}	0.052^{ab}	0.016^{d}	1.639^{e}	55.1 ^{b}	23.9 ^{b}	15.7 ^{c}
AM-397	122.33^{a}	85.61^{a}	0.031^{cd}	0.034^{ab}	1.628^{e}	50.6 ^{b}	25.2 ^{b}	17.7 ^{c}
AM-400	130.0 ^{a}	54.80^{f}	0.030^{cd}	0.021^{d}	1.197^{i}	54.7 ^{b}	25.9 ^{b}	21.6 ^{b}
AMB-11	91.00 ^{b}	87.05^{a}	0.015^{c}	0.007^{b}	1.286^{b}	56.2 ^{b}	20.6 ^{c}	20.1 ^{b}
AMB-26	101.66 ^{a}	84.34^{a}	0.058^{a}	0.034^{a}	1.433^{b}	53.2 ^{b}	23.7 ^{b}	16.4^{c}
AMB-39	109.00 ^{a}	85.66^{a}	0.057^{a}	0.035^{a}	1.958^{a}	62.2 ^{a}	12.1 ^{c}	23.1 ^{b}
AMB-90	93.66 ^{b}	83.79^{a}	0.028^{bc}	0.016^{ab}	1.166^{b}	59.1 ^{b}	19.1^{b}	20.1 ^{b}
AMB-224		85.70^{a}	0.029^{bc}	0.018^{ab}	1.206^{b}	59.1 ^{b}	19.2 ^{b}	20.2 ^{b}
AMB-368	72.33 ^{c}	61.26^{b}	0.046^{ab}	0.030^{a}	1.209^{b}	48.8 ^{c}	27.6 ^{b}	21.9 ^{b}
CITH-Ambri-1	109.7 ^{a}	76.5^{b}	0.14^{f}	0.028^{bc}	3.16^{c}	60.5 ^{a}	16.0 ^{b}	30.7 ^{a}

Fruit characteristics of mutants in comparison to parent "CITH-Ambri-1"

Pear

Physico-chemical and quality evaluation of pear hybrids

Three pear hybrids—'CITH Amber', 'CITH Gold', and 'CITH Blush' along with their respective parental lines were evaluated for fruit physico-chemical and biochemical characteristics. The fruit weight of the hybrids ranged from 133.57 g to 233.54 g, with 'CITH-Gold' exhibiting the highest average weight (233.54 g). The fruit length ranged between 62.33 mm and 83.15 mm, and fruit breadth between 60.32 mm and 75.82 mm. 'CITH Amber' recorded a fruit weight of 146.03 g, with dimensions of 62.33 mm × 65.80 mm, while 'CITH Blush' weighed 133.57 g with the largest fruit length (83.15 mm) and breadth of 60.32 mm (Table 14). The total soluble solids (TSS) content among the hybrids varied from 12.88 to 14.96 °Brix, with the highest TSS observed in 'CITH Gold' (14.96 °Brix). 'CITH Amber' and 'CITH Blush' also exhibited comparable TSS values ranging from 12.88 to 14.59 °Brix. Titratable acidity ranged from 0.33% to 0.44%, while ascorbic acid content spanned 13.63 to 14.76 mg/100 g fresh weight (FW), with 'CITH Gold' again showing the highest value (14.76 mg/100 g FW), followed by 'CITH Blush' (14.15 mg/100 g FW) and 'CITH Amber' (13.63 mg/100 g FW). Colorimetric analysis indicated L^* (lightness) values between 53.01 and 58.76, a^* (red-green axis) values from 3.27 to 13.25, and b^* (yellow-blue axis) values ranging from 32.94 to 36.75 (Table 15). Fruit firmness was recorded

in the range of 59.72 to 61.65 RI, with 'CITH Amber' showing the highest firmness (61.65 RI), closely followed by 'CITH Gold' (61.59 RI) and 'CITH Blush' (59.72 RI). Pedicel length ranged from 35.26 mm to 36.53 mm, with the longest pedicel observed in 'CITH Blush' (36.53 mm). Juice content varied from 53.55% to 60.84%, with 'CITH Amber' yielding the highest juice content (60.84%), followed by 'CITH Gold' (56.97%) and 'CITH Blush' (53.55%). In terms of biochemical properties, total phenolic content (TPC) was highest in 'CITH Blush' (2.87 mg/g), followed by 'CITH Amber' and 'CITH Gold'. TPC, expressed in mg gallic acid equivalents (GAE)/100 g FW, ranged from 158 to 325 mg GAE/100 g FW (Fig. 5). Antioxidant activity, assessed via DPPH free radical scavenging assay, ranged from 88.05% to 92.36%, with 'CITH Gold' demonstrating the highest inhibition (92.36%). For comparison, the cultivar 'Kosui' exhibited the highest radical scavenging activity among all tested genotypes (92.59%). The TPC was further quantified using Folin-Ciocalteu's reagent, and the results confirmed considerable variability among the hybrids, suggesting potential for functional food and nutraceutical applications (Fig. 6).

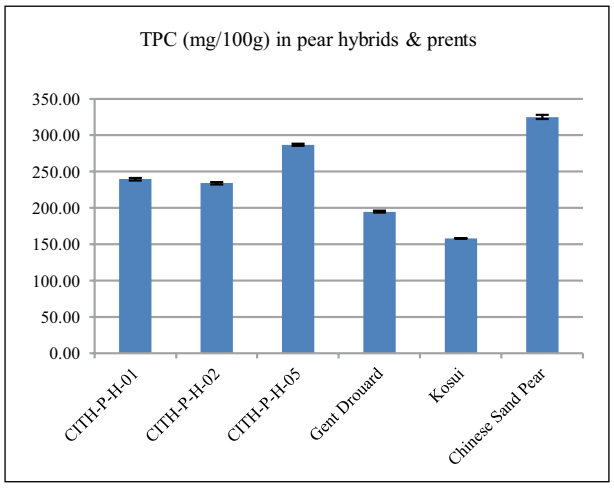


Figure 5. TPC (mg/100 g) in pear hybrids & parents

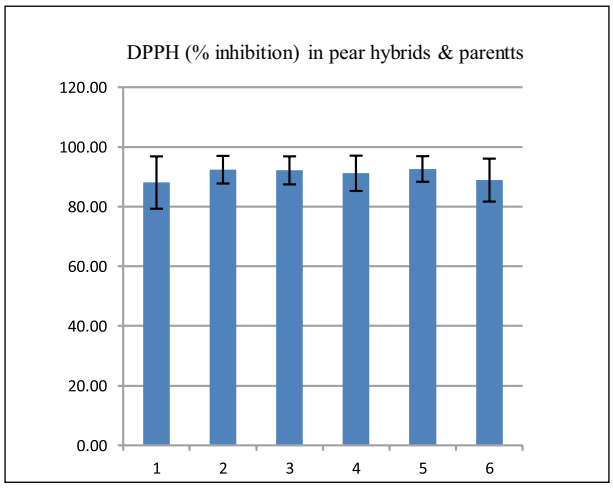


Figure 6. TPC (mg/100 g) in pear hybrids & parents TPC **(mg/100g) in pear hybrids & parents**

Table 14. Physico-chemical characteristics of CITH-Pear hybrids.

Genotype	Fruit Weight (g)	Fruit length (mm)	Fruit Dia (mm)	Fruit Thick-ness (mm)	Fruit Shape Index	Pedicle length (mm)	Firm-ness (RI)	TSS (°B)	Acid-ity (%)	Juice (%)	Ascor-bic Acid (mg/ 100g)	TPC (mg/g)	DPPH (% inhi-bition)
CITH Amber	146.035^{bc}	62.335^{bcd}	65.805^{abc}	63.44^{bc}	0.95^{cd}	35.445^{a}	61.65^{ab}	12.885^{bc}	0.405^{ab}	60.845^{a}	13.63^{b}	239.5^{abc}	88.05^{b}
CITH Gold	233.54^{a}	66.565^{bc}	75.82^{a}	71.965^{a}	0.875^{de}	35.265^{a}	61.595^{ab}	14.965^{a}	0.445^{ab}	56.975^{ab}	14.765^{ab}	234.00^{abc}	92.36^{a}
CITH Blush	133.57^{bcd}	83.155^{a}	60.325^{bc}	57.225^{cd}	1.375^{a}	36.535^{a}	59.725^{ab}	14.59^{ab}	0.335^{ab}	53.55^{bc}	14.155^{ab}	287.00^{ab}	92.125^{a}
Gent Drouard	164.18^{b}	73.005^{ab}	67.575^{ab}	64.495^{b}	1.085^{b}	24.9^{b}	62.725^{ab}	11.945^{c}	0.295^{b}	40.555^{d}	13.655^{b}	195.00^{bc}	91.15^{a}
Kosui	104.555^{cd}	49.475^{d}	62.65^{bc}	52.9^{d}	0.795^{e}	21.765^{b}	57.63^{b}	11.52^{c}	0.36^{ab}	61.16^{a}	15.665^{ab}	158.00^{c}	92.595^{a}
Chinese Sand Pear	97.36^{d}	55.68^{cd}	56.555^{c}	53.795^{d}	0.995^{bc}	24.885^{b}	65.225^{a}	12.045^{c}	0.485^{a}	47.925^{c}	16.185^{a}	325.00^{a}	88.87b

Table 15. Colorimetric evaluation (L*, a*, b*) of CITH pear hybrids.

Genotypes	L*	a*	b*	Tint	Chroma	Hue angle	color Index
CITH Amber	58.76^{a}	3.275^{b}	36.575^{ab}	13.035^{b}	36.86^{ab}	83.645^{a}	2.095^{b}
CITH Gold	53.01^{bc}	13.325^{ab}	36.75^{ab}	64.41^{a}	39.24^{ab}	71.52^{ab}	6.355^{ab}
CITH Blush	56.145^{ab}	3.335^{b}	32.945^{bc}	14.87^{b}	33.195^{ab}	83.93^{a}	1.935^{b}
Gent Drouard	49.515^{c}	2.485^{b}	25.755^{c}	7.865^{b}	25.895^{b}	84.555^{a}	1.92^{b}
Kosui	53.27^{bc}	17.31^{a}	43.385^{a}	86.715^{a}	44.31^{a}	66.195^{b}	8.675^{a}
Chinese Sand Pear	52.01^{bc}	2.975^{b}	31.77^{bc}	13.775^{b}	31.92^{ab}	84.675^{a}	1.785^{b}

Pedigree Confirmation in CITH pear hybrids using S-Allele typing

S-allele typing in the hybrid population successfully revealed the presence of expected S-alleles when compared with their respective parental lines (Table 16). The S-allele profiles of the parents were consistent with previously reported data, validating their authenticity. All hybrids exhibited predictive amplification bands corresponding to the anticipated sizes of the S-alleles, thereby confirming their genetic pedigree. Notably, this represents the first report of hybrid verification through S-allele typing in these genotypes, marking a significant advancement in hybrid identification and parental validation (Fig. 7).

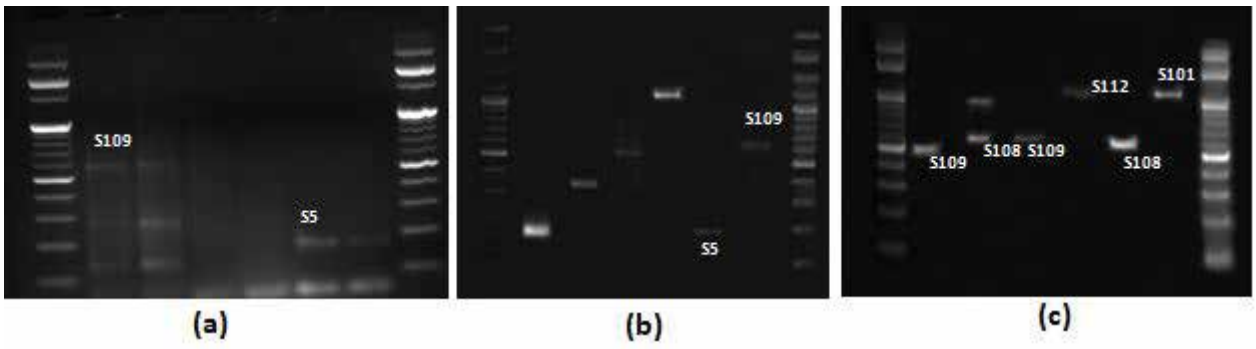


Figure 7. Pedigree confirmation in CITH pear hybrids using *S*-Allele typing (a) *S*-allele typing for 'CITH Amber' ('Kosui' x 'Chinese Sand pear') (b) 'CITH Gold' ('Kosui' x 'Chinese Sand pear') (c) 'CITH Blush' ('Gent Drouard' x 'Chinese Sand pear')

Table 16. *S*-alleles in pear hybrids and parents.

Parent-1	S-allele	Parent -2	S-allele	Hybrid	S-allele
Kosui	S^4 S^5	Chinese Sand pear	S_{109} S_{112}	CITH Amber	S^5 S_{109}
Kosui	S^4 S^5	Chinese Sand pear	S_{109} S_{112}	CITH Gold	S^5 S_{109}
Gent Drouard	S_{101} S_{108}	Chinese Sand pear	S_{109} S_{112}	CITH Blush	S_{108} S_{109}

**The allelic configuration of cv. Chinese Sand pear and Gent Drouard is being reported for the first time in the present study*

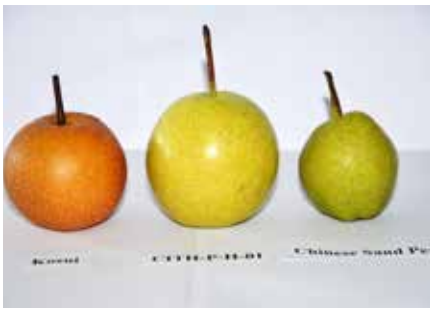

Kosui


Chinese Sand pear


Gent Drouard

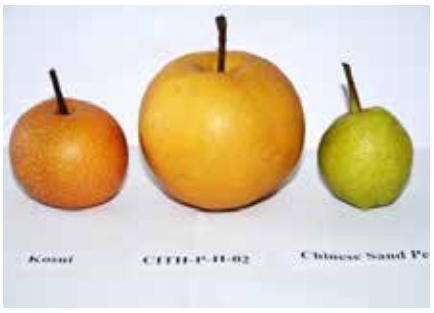

CITH Amber

CITH-P-H-01


Kosui CITH-P-H-01 Chinese Sand Pear


CITH Gold


CITH-P-H-02


Kosui CITH-P-H-02 Chinese Sand Pear


CITH Blush

CITH-P-H-02


Gent Drouard CITH-P-H-05 Chinese Sand Pear

Post-harvest quality of 'CITH Gold' and 'CITH Blush' during cold storage

Post-harvest studies were undertaken to assess the physiological and biochemical changes influencing the storage quality of two pear hybrids, CITH-Gold and CITH-Blush. The evaluation was conducted under controlled environmental conditions from 3rd September to 18th December 2024 for CITH-Gold, and from 4th September 2024 to 1st January 2025 for CITH-Blush. The fruits were monitored at ten-day intervals over storage durations of 107 days and 120 days, respectively.

Physiological Losses

During the storage period, both hybrids exhibited a progressive decline in fruit weight, primarily due to moisture loss associated with respiration and transpiration. In 'CITH Gold', the average fruit weight decreased from 280 g to 248.25 g, amounting to an 11.34% loss. Similarly,

'CITH Blush' recorded a reduction from 145 g to 134.18 g, corresponding to a 7.46% loss. These reductions reflect the metabolic activity and water loss inherent during extended storage. A gradual yet significant decline in fruit firmness was also observed, indicative of physiological ripening and textural softening. In 'CITH Gold', firmness decreased from 61.50 RI to 58.60 RI (a 4.00% decline), while in 'CITH Blush', it reduced from 62.90 RI to 59.70 RI (5.00% decline). These changes are consistent with the natural progression of post-harvest ripening under controlled storage conditions.

Biochemical changes

Total Soluble Solids (TSS) content demonstrated a consistent increasing trend throughout the storage period, indicating enhanced sugar concentration resulting from moisture loss and metabolic transformations. In 'CITH Gold', TSS increased from 15.60°Brix to 16.73°Brix, reflecting a 7.24% increase, while in CITH-Blush, it rose from 13.80°Brix to 14.20°Brix, corresponding to a 2.90% increase. In contrast, titratable acidity showed a significant decline during storage, likely due to the utilization of organic acids in respiration. 'CITH Gold' exhibited a 20.00% reduction in acidity, while 'CITH Blush' showed an 11.00% decrease. After 120 days of storage, internal browning symptoms developed in fruits of 'CITH Gold', rendering them unsuitable for consumption, despite their externally firm appearance. This warrants further investigation to determine the physiological basis and potential mitigation strategies. Storage Conditions: Daily monitoring of environmental parameters revealed an average temperature of 2.94°C and relative humidity of 88.61%, both of which significantly influenced the physiological and biochemical responses observed during storage.

CITH Gold

CITH Gold after 120days storage

CITH Blush

CITH Blush after 134

Sensory Evaluation of Pear Hybrids

CITH Gold: Hybrid Tasting Feedback

'CITH-Gold' is currently in the advanced stages of evaluation under the ongoing cultivar development program. This hybrid pear genotype has demonstrated strong potential as a commercially viable variety, owing to its consistently superior performance in multi-parameter sensory evaluations. It has been particularly distinguished for its excellent flavour profile, appealing skin coloration, and extended post-harvest shelf life. During the recent seasonal assessment, 'CITH Gold' received an overall sensory score of 8.2 out of 10. Specific trait-wise ratings included 8.0 for appearance, 9.0 for skin colour, and 8.0 for flavour, texture, and overall eating quality, underscoring its suitability for both consumer preference and market acceptability.

CITH Gold demonstrates several traits of agronomic and commercial interest:

- *Taste and Organoleptic Quality*: Sensory evaluation panels consistently rated the fruit highly for its sweetness, juiciness, and crisp texture, indicating strong potential for consumer acceptance and market preference.
- *Aesthetic Appeal*: The fruit displays a uniform and attractive skin coloration, a key determinant of marketability and visual appeal in commercial fruit grading.
- *Storage and Shelf Life*: Preliminary post-harvest assessments suggest excellent storage potential, with minimal quality deterioration over extended periods. This makes the hybrid suitable for long-distance transportation and extended market availability.

CITH Blush: Hybrid Tasting Feedback

'CITH Blush' is currently undergoing advanced-stage evaluation as part of ongoing

Sensory Evaluation – Appearance, Texture, Flavor Profile testing of hybrid samples

cultivar development and performance trials. This interspecific hybrid pear has emerged as a highly promising candidate, consistently receiving superior ratings in sensory assessments. It is particularly noted for its exceptional flavour profile, vibrant and uniform skin coloration, and impressive post-harvest storage stability. In seasonal organoleptic evaluations, the hybrid received an overall score of 8.2/10. It was rated 9/10 for skin colour and appearance, and 8/10 for flavour, texture, and overall eating quality, underscoring its potential for commercial cultivation and consumer acceptance.

CITH Blush demonstrates several traits of agronomic and commercial interest:

- *Taste and Organoleptic Quality*: Sensory evaluation panels have consistently rated the fruit highly for its sweetness, juiciness, and texture, indicating strong potential for consumer preference and market acceptance.
- *Aesthetic Appeal*: The fruit displays a uniform and visually striking skin coloration with an attractive red blush—an essential trait contributing to its commercial appeal.
- *Storage and Shelf Life*: Preliminary post-harvest assessments reveal extended storage longevity with minimal quality degradation, making the hybrid well-suited for long-distance transportation and flexible market distribution.

Physiochemical traits of other pear hybrids

In addition to the previously discussed hybrids, five more pear hybrids fruited and were evaluated for their physico-chemical and biochemical characteristics (Table 17). Among them, 'CITH-P-H-04' exhibited the highest fruit weight (304.37 g), significantly surpassing all other genotypes, while 'CITH-P-H-06' had the lowest fruit weight (84.27 g). Correspondingly, 'CITH-P-H-04' also recorded the largest fruit dimensions, including fruit length (75.37 mm), diameter (85.81 mm), and thickness (83.39 mm), indicating its potential for producing large-sized fruits. Pedicel length was longest in 'CITH-P-H-04' (36.20 mm) and shortest in 'CITH-P-H-07' (24.40 mm). Regarding fruit texture, 'CITH-P-H-04' again led with the highest firmness (67.84 RI), suggesting superior shelf life and transport resilience. In contrast, 'CITH-P-H-08' recorded the lowest firmness (56.72 RI). In terms of biochemical traits, 'CITH-P-H-07' stood out with the highest Total Soluble Solids (TSS) at 18.80°Brix, while 'CITH-P-H-06' had the lowest (12.06°Brix). 'CITH-P-H-07' also recorded the highest juice content (64.11%), compared to 'CITH-P-H-06', which exhibited the lowest (41.29%). Total

phenolic content (TPC), indicative of antioxidant potential, was also highest in 'CITH-P-H-07' (3.48 mg/g), while the lowest was noted in 'CITH-P-H-06' (1.88 mg/g), reflecting its relatively poor phytochemical profile. Colorimetric analysis (Table 18) showed substantial variation across genotypes. The lightness (L*) value was highest in 'CITH-P-H-08' (64.32), indicating a lighter skin tone, and lowest in 'CITH-P-H-06' (52.21), indicating darker fruit. The a* value, representing red coloration, was highest in 'CITH-P-H-07' (9.14) and lowest in 'CITH-P-H-03' (1.32). The b* value, indicating yellow pigmentation, peaked in 'CITH-P-H-03' (43.71) and was lowest in 'CITH-P-H-07' (34.89). Hue angle, which indicates the dominant perceived color, ranged from a high of 88.21° in 'CITH-P-H-03' (suggesting a yellowish hue) to a low of 75.22° in 'CITH-P-H-07' (indicating a redder hue). Tint and chroma values, reflecting hue and color intensity respectively, were also highest in 'CITH-P-H-07' (49.89) and 'CITH-P-H-03' (43.74). The lowest tint and chroma were recorded in 'CITH-P-H-04' (22.02 and 35.03, respectively). Finally, the color index—a composite indicator of pigmentation—was highest in 'CITH-P-H-07' (5.00), indicating a deep and vibrant coloration, while 'CITH-P-H-03' had the lowest (0.50), reflecting a relatively pale skin tone.

CITH-P-H-03 (Kosui × Sand Pear

CITH-P-H-04 (W. Bartlett × Sand pear)

CITH-P-H-06 (Kosui × Kashmir Nakh)

CITH-P-H-07 (Kosui × Kashmir Nakh)

CITH-P-H-08
Kosui × Kashmir Nakh)

Table 17. Physico chemical traits of some pear hybrids.

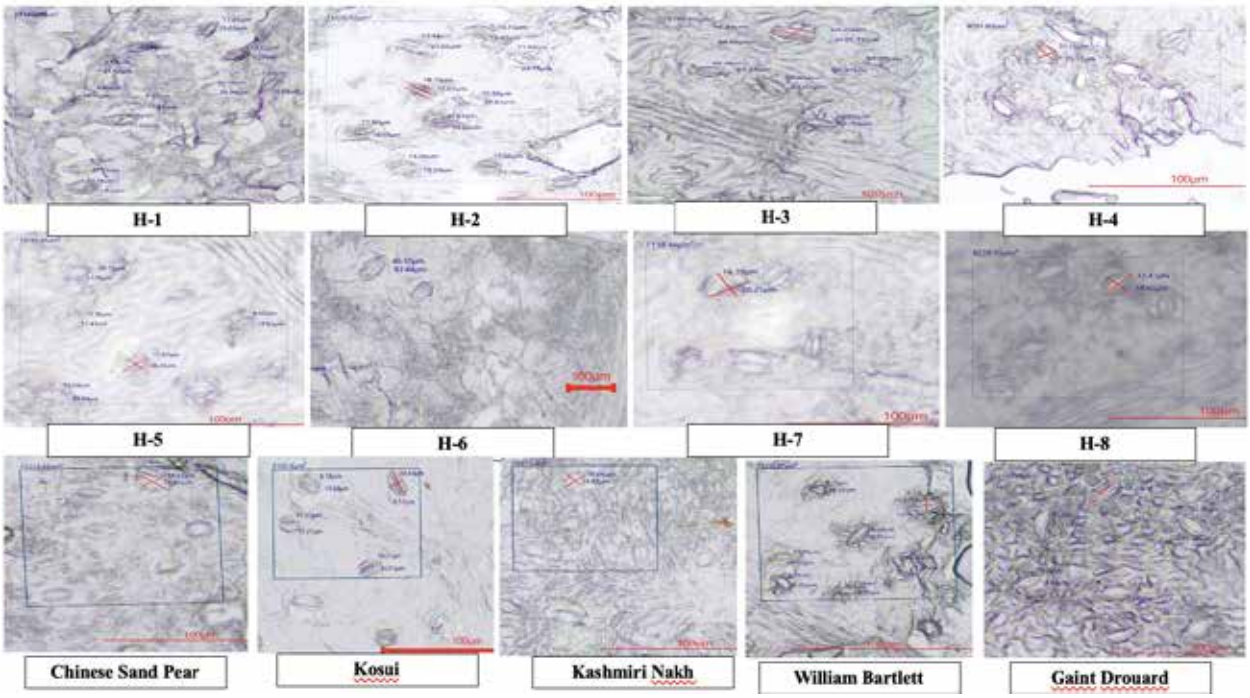
Genotype	Fruit Weight (g)	Fruit length (mm)	Fruit Dia(mm)	Fruit Thickness (mm)	Pedicle length (mm)	Firmness (RI)	TSS (°B)	Juice (%)	TPC (mg/g)
CITH-P-H-03	126.38^{cd}	60.112^{c}	59.822^{d}	58.75^{d}	32.85^{ab}	61.76^{b}	12.88^{b}	58.91^{bc}	2.45^{c}
CITH-P-H-04	304.37^{a}	75.37^{a}	85.812^{a}	83.39^{a}	36.202^{a}	67.84^{a}	13.16^{b}	54.147^{c}	3.09^{b}
CITH-P-H-06	84.274^{d}	47.826^{d}	57.606^{d}	53.85^{d}	34.404^{ab}	63.04^{b}	12.06^{b}	41.287^{d}	1.88^{de}
CITH-P-H-07	236.758^{b}	68.712^{b}	76.168^{b}	73.62^{b}	24.404^{b}	66.48^{a}	18.8^{a}	64.11^{a}	3.48^{a}
CITH-P-H-08	149.104^{c}	63.29^{bc}	66.168^{c}	64.99^{c}	30.512^{ab}	56.72^{c}	13.7^{b}	60.577^{ab}	1.99^{d}
CD@5%	45.513	5.574	5.212	5.45	N/A	1.825	1.823	5.656	0.002
SE(m)	15.051	1.843	1.724	1.802	3.511	0.603	0.603	1.708	0.001
SE(d)	21.286	2.607	2.438	2.549	4.966	0.853	0.853	2.415	0.001
C.V. (%)	18.679	6.537	5.577	6.023	24.787	2.136	9.548	5.3	0.05

Tble.18: Colorimetric parameters (L*, a*, b*) of pear hybrids.

Genotype	L*	a*	b*	Tint	Chroma	Hue angle	color Index
CITH-P-H-03	62.584^{a}	1.322^{c}	43.708^{a}	23.954^{bc}	43.738^{a}	88.206^{a}	0.496^{c}
CITH-P-H-04	57.708^{b}	1.432^{c}	34.994^{b}	22.02^{c}	35.034^{c}	87.504^{a}	0.782^{c}
CITH-P-H-06	52.21^{c}	5.482^{b}	35.944^{b}	33.226^{b}	36.36^{bc}	81.324^{b}	2.924^{b}
CITH-P-H-07	53.748^{bc}	9.142^{a}	34.888^{b}	49.894^{a}	36.186^{bc}	75.222^{c}	5.002^{a}
CITH-P-H-08	64.318^{a}	8.622^{a}	40.294^{ab}	44.856^{a}	41.34^{ab}	77.654^{bc}	3.52^{ab}
Cd@5%	4.808	2.928	5.725	10.123	5.471	4.947	1.765
SE(m)	1.59	0.968	1.893	3.348	1.809	1.636	0.584
SE(d)	2.249	1.369	2.678	4.734	2.559	2.314	0.825
C.V.	6.118	41.641	11.151	21.517	10.499	4.463	51.279

Studies on stomatal density of some pear hybrids

Pear hybrids (H-1 to H-5) and their parental cultivars ('Chinese Sand Pear', 'Kosui', 'William Bartlett', 'Kashmiri Nakh', and 'Giant Drouard') were evaluated for stomatal traits and chlorophyll content in their leaves. Among the hybrids, H-5 exhibited superior physiological performance, with the highest levels of chlorophyll a (0.047 mg g^{-1} fw), chlorophyll b (0.117 mg g^{-1} fw), and total chlorophyll (2.707 mg g^{-1} fw). The highest chlorophyll a/b ratio (0.518) was observed in 'H-1', indicating balanced pigment synthesis. In contrast, 'H-2' recorded the lowest pigment concentrations—chlorophyll a (0.018 mg g^{-1} fw), chlorophyll b (0.049 mg g^{-1} fw), and total chlorophyll (1.139 mg g^{-1} fw)—while the lowest a/b ratio (0.141) was found in the 'Chinese Sand Pear'. Regarding stomatal parameters, 'H-1' had the highest stomatal density (11.33), followed by 'H-5' (9.67), whereas the lowest stomatal counts (5.33) were recorded in 'H-2', 'Chinese Sand Pear', and 'Giant Drouard'. 'H-2' showed the



Stomatal parameters study in pear hybrids and their respective parents

largest stomatal dimensions, including maximum length (92.89 µm), width (46.64 µm), and area (307,641.21 µm²), while 'Kosui', 'H-1', and 'Chinese Sand Pear' exhibited the smallest values for stomatal length (17.77 µm), width (10.55 µm), and area (9,229.53 µm²), respectively. These findings indicate significant variability in stomatal and chlorophyll traits among hybrids and their parents, highlighting 'H-5' as a physiologically promising genotype.

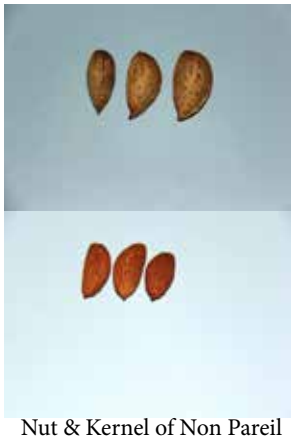
Almond

During 2024, adequate fruiting was observed in the almond hybrid populations developed from previous years' crosses, allowing for comprehensive evaluation of nut and kernel characteristics. In the cross combination' Non Pareil' × 'Waris', nine genotypes were assessed. Among them, 'Plant No. 1' recorded the highest nut weight (5.023 g) and kernel weight (1.447 g), although the nuts were bitter in taste. Based on overall performance in terms of nut and kernel traits, including kernel recovery, 'Plant No. 3' was identified as the most promising and selected for further evaluation. In the 'CITH A10' × 'Pranyaj' cross, six plants were evaluated alongside the parents. Although Plant Nos. 1, 3, 5, and 6 produced higher nut weights than the 'Pranyaj' parent, none of the progeny surpassed it in kernel weight or kernel recovery percentage. Nonetheless, Plant Nos. 1 and 9 were retained for further observation due to their promising traits. In the 'CITH A-7' × 'Makhdoom' cross, four plants were evaluated, with two genotypes exhibiting nut weights superior to Makhdoom. Based on a combination of desirable characteristics, Plant No. 3 from this group was selected for further evaluation.

Nut & Kernel of CITH A-7 X Makhdoom

Bearing plant of CITH A-7 X Makhdoom

Nut & Kernels of CITH A-7, CITH A-7X Makhdoom and Makhdoom



Nut & Kernel of Non Pareil X Waris

Bearing plant of Non Pareil x Waris

Nut and kernels of Non Pareil, Non Pareil x Waris & Waris

In apricot, two selections identified in 2023 were further evaluated and found promising based on desirable traits such as large fruit size, high yield potential, attractive fruit colour, and sweet kernel. In addition to this, hybridization efforts were undertaken in walnut, apricot, peach, and cherry to develop elite genotypes with improved horticultural and quality attributes.

Bearing and fruits of Selection 1/23

Bearing and fruits of Selection 2/23

Characterization and Diversity Analysis of Flowering Related Gene/ Genes in Almond

As part of the characterization and diversity analysis of flowering-related gene(s) in almond, transcriptomic profiling was conducted for cultivars 'Waris' and 'Ferralise,' which exhibit contrasting flowering times. Almond, a nutritionally rich nut crop, was studied using whole-genome transcriptome analysis across early-flowering cultivars ('Shalimar', 'Waris', 'Nonpareil') and late-flowering cultivars ('Tardy Nonpareil', 'Ferragnese', 'Ferralise'). The objective was to identify genes and regulatory pathways differentially expressed between early- and late-flowering genotypes. Validation through qPCR revealed distinct expression patterns during floral development. Notably, late-blooming cultivars exhibited elevated expression of flowering time repressor genes, while early-blooming types showed higher expression of flowering induction genes. These transcriptomic insights have identified specific genes and molecular markers associated with late flowering and superior nut quality. The identified markers hold significant potential for use in marker-assisted selection, enabling early-stage identification of desirable hybrids and thereby accelerating almond breeding programs aimed at improving flowering time and kernel traits.

Development and validation of primers for late flowering genes in almond

In this study, a total of 184 EST-SSR primers were developed from the whole-genome transcriptome data of almond cultivars. These primers were initially validated across 13 almond genotypes, where approximately 60% (100 primers) successfully amplified the target regions, confirming their specificity and amplification efficiency. Most of the primers exhibited monomorphic banding patterns, indicating conserved genetic sequences among the genotypes tested. However, around 20 primers revealed polymorphic variations, reflecting underlying genetic diversity within the existing germplasm. In the subsequent phase, these primers will be screened across a broader almond population to evaluate their polymorphic potential more comprehensively. This will facilitate their effective use in genetic diversity studies, marker-assisted selection, and breeding programs focused on improving traits such as late flowering in almond.

Breeding for Development of Superior Varieties/ Hybrids in Solanaceous Vegetable Crops

In the ongoing evaluation of vegetable germplasm, a comprehensive assessment was conducted on 53 brinjal, 83 chilli, and 41 capsicum genotypes to identify promising lines for key horticultural traits. The objective was to characterize the accessions for their morphological, physiological, and yield-contributing attributes to support breeding efforts aimed at improving productivity, quality, and stress tolerance. In brinjal, traits such as plant vigour, fruit shape, size, yield potential, and pest resistance were analyzed. Chilli genotypes were assessed for traits including fruit length, pungency (Scoville Heat Units), yield per plant, and resistance to viral and fungal diseases. Capsicum entries were evaluated for fruit colour, shape, wall thickness, and shelf life,

alongside yield and disease resistance. The data generated from these trials have been carefully compiled and are summarized crop-wise in the following sections and detailed in the respective tables. These evaluations will serve as a valuable resource for selecting superior lines for future hybridization programs and for strengthening genetic improvement initiatives in solanaceous vegetables.

Brinjal

The evaluation of brinjal germplasm revealed a wide range of variability in fruit yield, with values spanning from 361.92 to 1276.81 quintals per hectare (Table 19). This variation underscores the genetic diversity present within the tested accessions, offering valuable potential for crop improvement. Among the evaluated genotypes, five accessions demonstrated superior performance compared to the best-performing check variety, 'Local Round', which recorded a yield of 719.10 q/ha. These top-performing accessions included 'B-Sel-1/14' (1276.81 q/ha), 'Big Round' (1185.12 q/ha), 'B-4-8' (1118.72 q/ha), 'B-Sel-3' (963.51 q/ha), and 'B-SB-19-3' (940.98 q/ha). The significantly higher yields recorded in these lines highlight their promise as potential donors for high-yielding traits and their suitability for further breeding and selection programs. Their performance also indicates strong adaptability and productivity under the prevailing agro-climatic conditions, making them valuable candidates for varietal development and commercial cultivation.

Table 19. Yield and yield related traits in brinjal during 2024.

S. No.	Entry	Fruit Width (cm)	Fruit Length (cm)	Average Fruit Weight (g)	Yield (q/ha)	S. No.	Entry	Fruit Width (cm)	Fruit Length (cm)	Average Fruit Weight (g)	Yield (q/ha)
1	Local Long (C)	2.12 18.00		69.05	677.32	28	B-SB-4/14	2.98	8.58	45.90	576.04
2	White Cluster	3.36	11.75	48.43	504.37	29	Sel-1/18	4.82	5.82	45.71	499.26
3	Round Cluster	6.40	11.10	48.64	557.70	30	B-4-11-Sel-1 Cluster	3.01	6.15	42.91	472.71
4	White Brinjal	2.92	18.21	63.76	785.99	31	PPC x Sel-7 (F2)	4.93	6.40	41.40	466.37
5	Gulabo-1	5.18	13.56	54.76	672.30	32	B-4-5	2.79	12.04	53.31	613.36
6	Gulabo	4.56	14.91	47.61	549.14	33	B-9-9/18	3.28	12.39	50.52	632.54
7	Local Round (C)	5.49	7.52	56.41	719.10	34	B-1/16	2.75	11.77	42.82	552.08
8	B-4-1-SEL-1	3.56	14.02	43.06	529.64	35	B-SB-19	5.74	6.26	50.06	612.07
9	CITH-BSB-2	3.02	15.84	33.41	374.79	36	B-4-19	3.65	11.19	53.43	686.86
10	IARI selection (PUSA)	3.05	20.55	35.61	385.50	37	SEL-9/18	2.61	10.45	57.42	748.78
11	Sel-16/18	4.55	17.32	38.09	400.60	38	SEL-2/18	2.93	8.80	58.98	715.59
12	B-SEL-1	3.41	19.95	37.76	395.82	39	Dirang Collection	2.83	10.78	64.81	792.53

S. No.	Entry	Fruit Width (cm)	Fruit Length (cm)	Average Fruit Weight (g)	Yield (q/ha)	S. No.	Entry	Fruit Width (cm)	Fruit Length (cm)	Average Fruit Weight (g)	Yield (q/ha)
13	B-SB-19-1	3.93	9.30	33.80	405.93	40	Big Round	2.50	8.83	91.79	1185.12
14	B-4-16	4.69	5.40	36.09	361.92	41	Sel-10/18	2.93	10.15	80.39	934.36
15	B-SB-6-Sel-1/18	3.66	10.23	48.75	514.74	42	B-Sel-1/14	2.69	9.38	103.70	1276.81
16	B-4-2-Sel-1	2.65	9.87	51.55	544.18	43	B-SB-9-SEL-1	3.03	9.32	78.80	929.57
17	B-4-7	2.46	13.38	42.24	423.15	44	Sel-8/18	2.68	8.75	48.84	551.44
18	Sel-1 Cluster	2.51	11.67	44.99	470.94	45	B-SB-7	2.95	11.10	62.65	726.73
19	BSB-1	3.45	11.40	42.30	459.20	46	B-4-3-SEL1/14	3.09	11.01	80.25	923.48
20	B-4-16 Sel-1/14	3.30	7.37	38.80	422.95	47	Sel-11/18	3.33	11.65	59.98	711.66
21	B-4-9 PC Cluster	2.26	7.53	35.99	407.33	48	Kokila	2.64	10.11	80.31	892.81
22	B-SB-3	3.48	7.49	47.36	502.76	49	B-4-9-SEL-2	3.58	10.90	48.64	543.88
23	B-SB-2 Sel -1/14	3.47	13.10	43.96	477.22	50	B-Sel-3	3.25	11.74	81.16	963.51
24	B-SB-19-2	3.77	8.50	40.45	444.99	51	B-SB-19-3	2.57	10.15	78.55	940.98
25	Pusa Purple Cluster (C)	3.07	11.33	49.36	548.66	52	B-4-8	2.82	11.87	94.98	1118.72
26	Pusa Anupam (C)	1.78	10.31	48.36	585.77	53	CITH-BSB-2	3.04	11.65	65.46	769.21
27	B-4-6-1	3.49	11.57	58.30	725.96		CD (p≤0.05)	0.86	2.15	14.91	221.35
							CV (%)	12.64	9.63	13.54	17.31

Chilli

The evaluation of chilli germplasm for red ripe fruit yield revealed considerable variation, with yields ranging from 16.41 to 189.13 quintals per hectare (Table 20), reflecting the diverse genetic potential of the accessions under study. Among the genotypes, the check variety 'KL-1' ('Kashmir Long-1') recorded the highest yield at 189.13 q/ha, closely followed by the commercial F1 hybrid check 'Arka Meghana' (180.74 q/ha) and the advanced selection 'Sel-11/2018' (168.36 q/ha). These three entries performed statistically at par with each other, yet significantly outperformed the rest of the germplasm evaluated. Their superior productivity suggests a combination of favorable agronomic traits such as fruit setting efficiency, plant vigor, and adaptability to local growing conditions. The promising performance of 'Sel-11/2018', in particular, highlights its potential for further evaluation and possible release as a high-yielding variety. Overall, these high-yielding entries offer excellent genetic material for future breeding programs aimed at improving chilli productivity and enhancing income potential for farmers in the region.

Table 20. Evaluation of yield and related traits in chilli during 2024.

Sr No	Entry	Fruit length (cm)	Fruit width (cm)	Red Ripe fruit yield (q/ha)	Sr No	Entry	Fruit length (cm)	Fruit width (cm)	Red ripe fruit yield (q/ha)
1	Arka Lohit (C)	8.32	0.63	112.09	45	Sel-12/18	8.41	0.88	119.47
2	Arka Meghna (C)	10.57	0.83	180.74	46	CITH-HP-6/13	8.52	0.77	87.09
3	KL-1 (C)	9.74	1.12	189.13	47	Sel-136-1-2	7.91	1.06	125.30
4	AL-2	11.85	0.53	105.42	48	Sel-3/15	7.74	1.11	103.55
5	AL-3/5	12.33	0.76	121.62	49	Sel-1	7.72	1.03	112.09
6	CITH-HP-1-2	9.04	0.75	103.84	50	Sel-5/18	8.91	0.98	116.21
7	ARC-HP-228	11.17	0.79	108.63	51	Sel-1014/11	7.94	1.16	105.84
8	CITH-HP-45/13	10.86	1.06	119.82	52	Sel-101	7.27	0.81	119.55
9	Dirang - 4	8.43	1.09	140.13	53	Sel-836-1-2	9.62	1.00	98.62
10	KA-2-Sel-1	7.74	0.76	90.83	54	Sel-1014/11	6.81	0.97	108.33
11	AL-5-2	9.85	0.91	112.26	55	Sel-88-1	8.09	1.05	127.46
12	AL-4	10.13	0.99	112.05	56	Sel-1064/11	5.08	0.82	118.00
13	KA-2-Sel-2	8.30	0.92	127.13	57	Sel-1050-1/11	6.81	1.36	132.86
14	CITH-HP-1154	9.62	1.14	95.84	58	Sel-2018/2	6.70	1.52	112.14
15	CITH-HP-111-2	10.22	1.02	126.57	59	Sel-89	7.67	0.90	117.93
16	CITH-HP-111-4	11.24	0.91	129.37	60	Sel-878-1	10.88	1.05	120.68
17	AL-5-2	10.16	0.68	115.49	61	Sel-20/18	10.40	0.87	151.04
18	CITH-HP-42/13	11.38	0.73	118.13	62	Sel-839	7.87	0.77	134.06
19	CITH-HP-19/13	8.63	0.62	109.48	63	Sel-12/18	6.57	0.81	160.63
20	CITH-HP-49/13	11.25	0.94	114.41	64	Sel-8/2018	8.09	1.02	102.16
21	CITH-HP 39/13	9.96	0.67	115.73	65	Sel-9/18	6.62	0.86	70.90
22	CITH-HP-1154	10.73	0.91	116.82	66	Solan Collection	5.56	2.57	39.47
23	CITH-HP-85/13	5.60	1.26	128.42	67	Sel-1065	9.29	0.63	44.69
24	CITH-HP-1154-1	7.15	0.90	98.70	68	Sel-876-1	8.97	0.64	16.41
25	CITH-HP-1154/13	9.89	0.82	107.12	69	Kashi Anmol (C)	7.07	0.69	55.31
26	CITH-HP-32/13	12.77	0.83	128.98	70	Sel-4	8.60	1.00	62.33
27	CITH-HP-111	10.40	0.57	99.02	71	Sel-1154-3	8.87	1.33	41.75
28	CITH-HP-62/13	9.91	0.75	124.50	72	Sel-1052/11	9.33	1.01	53.48
29	CITH-HP-15/13	11.17	1.29	111.04	73	Sel-2/2021	10.49	0.67	79.62
30	AL-1-1/15	11.07	0.68	101.70	74	Sel-1050/11	9.17	0.45	32.59
31	CITH-HP-91/13	9.28	0.92	103.23	75	Sel-19/18	7.35	0.82	35.83
32	Sel-89	9.39	0.77	98.36	76	Sel-7/18	8.48	1.36	28.72
33	CITH-HP 1154-3-1	9.80	0.82	96.18	77	HPH-29-Chilli (F1)	11.25	0.89	77.82
34	Sel-15/18	10.13	1.12	105.83	78	Sel-102-2	9.12	0.53	51.85
35	CITH-HP-61/13	10.44	1.00	150.05	79	HPH-263	11.89	0.98	44.30

Sr No	Entry	Fruit length (cm)	Fruit width (cm)	Red Ripe fruit yield (q/ha)	Sr No	Entry	Fruit length (cm)	Fruit width (cm)	Red ripe fruit yield (q/ha)
36	CITH-HP-111/13	9.30	0.91	82.64	80	Sel-10/18	6.74	0.97	63.62
37	CITH-HP-114/13	6.35	1.00	97.05	81	Sel-3/2021	7.08	1.42	68.23
38	CITH-HP-8/13	7.53	0.61	87.83	82	Sel-13/18	11.13	0.72	20.07
39	Sel-11/2018	3.86	1.75	168.36	83	Sel-1 (2022)	8.88	0.89	20.71
40	Sel-7/2018	7.85	0.84	97.15		CD (p<0.05)	1.17	0.27	27.51
41	CITH-HP-111-1/17	7.68	0.83	118.68		SE (d)	0.59	0.14	13.81
42	CITH-HP-71/13	6.38	0.97	129.63		SE (m)	0.41	0.09	9.77
43	CITH-HP-2024	7.11	0.83	120.24		CV (%)	6.53	14.51	13.83
44	Sel-1011(E)	6.82	0.80	109.04					

Capsicum

In the evaluation of capsicum germplasm, significant variability was observed in marketable fruit yield, which ranged from 136.04 to 310.27 quintals per hectare (Table 21). Among the genotypes, 'CW x N-1' (F6) recorded the highest yield at 310.27 q/ha, followed closely by 'CITH-SP-2024' (305.29 q/ha), Sel-12/11 (296.42 q/ha), and 'Nishat-1' x 'SP-461' (287.69 q/ha). These genotypes performed on par with the best check variety, 'California Wonder', which yielded 295.73 q/ha, indicating their strong yield potential under the given agro-climatic conditions. The superior performance of these advanced lines suggests a favorable combination of traits such as fruit size, shape uniformity, plant architecture, and disease tolerance. Their high marketable yield, comparable to a widely cultivated standard, highlights their promise for commercial cultivation and suitability for further advancement in capsicum breeding programs aimed at yield improvement and stability.

Table 21. Evaluation of yield and related traits in capsicum during 2024

Sr No	Entry	Fruit polar diameter (cm)	Fruit equatorial diameter (cm)	Yield (q/ha)	Sr No	Entry	Fruit polar diameter (cm)	Fruit equatorial diameter (cm)	Yield (q/ha)
1	California Wonder (C)	6.97	6.35	295.73	23	CITH-SP-4-Sel	5.60	4.95	291.34
2	California Wonder-1	4.58	4.94	266.73	24	CITH-SP-2024	6.37	5.06	305.29
3	California Sel-3	3.79	3.67	222.72	25	Sel-21/11	4.07	3.64	223.95
4	Gold-Sel-1	5.92	6.75	239.19	26	CITH-SP-706	4.10	4.31	213.38
5	CITH-SP-603-1-1	6.30	5.39	203.43	27	Sel-12/11	4.98	4.57	296.42
6	Nishat-1-Sel-2	4.74	3.24	136.04	28	BSS-554-1	6.04	4.45	230.54
7	Nishat-284-1/15	5.42	5.36	239.37	29	Sel-10/11	3.63	3.47	227.28
8	Piemento x CITH-SP-4	5.04	3.43	252.57	30	Nishat-1 x SP-461	8.90	5.08	287.69
9	Sel-19/11	5.50	5.43	272.98	31	Piemento-1	7.64	3.36	255.93
10	Nishat-4-2	4.70	5.06	275.77	32	MLJ-2	4.14	3.80	207.10

Sr No	Entry	Fruit polar diameter (cm)	Fruit equatorial diameter (cm)	Yield (q/ha)	Sr No	Entry	Fruit polar diameter (cm)	Fruit equatorial diameter (cm)	Yield (q/ha)
11	Bombay (C)	4.45	5.10	267.03	33	Sel-3/11	4.37	3.61	210.19
12	N-1-Sel-4	4.25	5.02	276.93	34	Piemento x CITH-SP-603	3.81	3.38	252.03
13	Nishat-1 (C)	5.92	4.89	276.99	35	Gold-1-Sel-1	4.96	3.92	207.27
14	Sel-20/11	2.69	3.70	245.83	36	Sel-5/11	5.37	3.94	233.52
15	Sel-4/11	4.70	4.49	236.83	37	Solan Collection	3.23	3.27	249.86
16	Piemento X Bombay	4.67	3.79	243.38	38	Pusa Deepti (F3)	5.39	4.73	255.37
17	N-7-Sel-1	4.58	4.71	200.89	39	CW x N-1 (F6)	5.43	5.07	310.27
18	Sel-1/4	4.75	4.00	202.79	40	Solan Bharpur (C)	4.76	4.22	222.94
19	CITH-SP-3-1	4.81	3.93	188.92	41	Nishat-7	4.50	4.50	188.40
20	Orobell (C)	2.97	3.52	202.13		CD ($p<0.05$)	1.17	0.89	27.96
21	N-4-1-1	5.56	4.55	228.61		CV (%)	11.84	9.98	5.77
22	Sel-15/11	2.25	1.70	189.23					

Rootstock Breeding in Apple (*Malus* × *domestica*)

During the year 2024, the crossing populations developed in previous years were evaluated for their suitability in vegetative propagation through air layering, with the objective of streamlining multiplication and reducing the time required for field evaluation. The trials were conducted using pot-based air layering techniques to simulate controlled propagation environments. Rooting performance served as the primary criterion for classification, given its crucial role in propagation success, subsequent plant establishment, and overall vigor. The diverse rootstock population was systematically categorized based on their rooting efficiency into five distinct classes: *very weak, weak, medium, strong,* and *very strong*, in accordance with the Distinctness, Uniformity, and Stability (DUS) guidelines. These classifications were based on parameters such as root initiation percentage, root length, number of roots per layer, and survivability post-detachment. This structured evaluation enabled early-stage identification of genotypes with superior propagation potential, thereby facilitating the selection of elite rootstocks for further breeding, orchard development, and standardization of propagation protocols. The base genetic material used in this study comprised a diverse gene pool drawn from previous hybridization efforts and elite selections, ensuring both genetic variability and adaptability across different horticultural traits.

- CITH-A-RS-BP: Cross between *Malus baccata* & M 9-Pajam
- CITH-A-RS-BB: Cross between *Malus baccata* & B9
- CITH-A-RS-BM6: Cross between *Malus baccata* & MM-106

The rootstocks evaluated for their rooting potential through air layering were categorized into five distinct classes—Very Weak, Weak, Medium, Strong, and Very Strong—based on root development parameters, in accordance with DUS guidelines. These categories reflect the rootstocks' suitability for vegetative propagation, particularly for mass multiplication and orchard establishment.

***Very Weak Rooting*:** This group comprises genotypes exhibiting minimal root initiation and poor root system development, making them

unsuitable for efficient propagation. Genotypes such as *CITH-A-RS-BP-11, BP-24, BP-33, BP-38, BP-40, BP-61, BP-85(1), BP-91,* and *BP-92* consistently demonstrated inadequate rooting performance under air layering conditions.

***Weak Rooting*:** These rootstocks showed slightly improved rooting over the "very weak" category but still fell short of acceptable propagation standards. This category includes *CITH-A-RS-BP-01, BP-05, BP-07, BP-08, BP-12, BP-17, BP-20, BP-58, BP-59, BP-73, BP-77, BP-81, BP-81(1), BP-88,* and *BP-120*. From the *CITH-A-RS-BB* series, genotypes such as *BB-01, BB-10, BB-29* were included, along with several MMm genotypes like *MMm-05, MMm-23, MMm-30,* and *MMm-36.*

***Medium Rooting*:** Genotypes in this class displayed moderate rooting capability and may perform better under optimized propagation environments. Included are *CITH-A-RS-BP-03, BP-06, BP-15, BP-19, BP-32, BP-34, BP-36, BP-53, BP-62, BP-63, BP-64(10), BP-65, BP-70, BP-78, BP-84, BP-93, BP-97, BP-105, BP-107, BP-109, BP-111*, and *BB-07, BB-09, BB-13, BB-23, BB-25(b)* from the *CITH-A-RS-BB* group. The BM9 series includes *BM9-08, BM9-09,* and *BM9-10*, while *BM-106-03* and MMm genotypes such as *MMm-08, MMm-11, MMm-12, MMm-13, MMm-24, MMm-25, MMm-26, MMm-28, MMm-29, MMm-35,* and *MMm-40* also fall under this category.

***Strong Rooting*:** This category represents genotypes with reliable and high rooting capacity, making them suitable for large-scale propagation and field planting. Strongly rooting genotypes from the *CITH-A-RS-BP* (*M. baccata* × M9-Pajam) series include *BP-02, BP-21, BP-25, BP-26, BP-29, BP-39, BP-43, BP-44, BP-49, BP-50, BP-51, BP-75, BP-80, BP-83, BP-85, BP-99, BP-100, BP-101, BP-102, BP-106, BP-108, BP-110, BP-112, BP-116, BP-117, BP-119, BP-121,* and *BP-122*. From the *CITH-A-RS-BB (M. baccata* **× B9) group,** *BB-03, BB-04, BB-05(1), BB-06(1), BB-15, BB-20, BB-22,* and *BB-25* are included. BM9 genotypes *BM9-02, BM9-03,* and *BM9-04*, along with *BM-106-01, BM-106-02*, and MMP types *MMP-01, MMP-03, MMP-04, MMP-05* showed consistent rooting. A number of MMm genotypes—*MMm-01, MMm-03, MMm-04, MMm-06, MMm-09, MMm-14, MMm-17, MMm-22, MMm-27, MMm-32, MMm-33, MMm-39, MMm-41,* and *MMm-43*—were also placed in this group, along with MMmm lines *MMmm-05, MMmm-06,* and *MMmm-07.*

***Very Strong Rooting*:** Rootstocks in this elite group demonstrated exceptional rooting performance, with uniform and vigorous root formation, making them ideal for commercial-scale propagation and as breeding material for developing high-performance clones. These include *CITH-A-RS-BP-87, CITH-A-RS-BB-02, BB-06,* and *BB-27* from the *M. baccata* × *B9* lineage. BM9 series genotypes *BM9-01, BM9-07,* and *BM9-11* also fall in this class. Among MMm and MMmm genotypes, the top performers were *MMm-02, MMm-07, MMm-10, MMm-16, MMm-18, MMm-19, MMm-20, MMm-21, MMm-31, MMm-34, MMm-38, MMm-46*, and *MMmm-01*. Their high rooting efficiency ensures rapid multiplication, better transplant success, and improved orchard productivity.

Very Weak

CITH-A-RS-BP-33 CITH-A-RS-BP-40 CITH-A-RS-BP-38

Categorization of hybrid apple rootstock population (as per DUS guidelines) for rooting ability through air layering technique

Establishment media for the regeneration and multiplication of apple hybrid BM-9 (M. baccata × M-9)

Establishment media for the regeneration and multiplication of apple hybrid BM-9 (*M. baccata* × M9-) was standardized. MS medium supplemented with BAP (2 mg L^{-1}) performed best in No. of micro-shoots/explants (2.83), length of micro-shoot (3.51 cm) with least duration taken for organogenesis (12.34 days) while the highest shoot organogenesis (66.74%) recorded in MS medium supplemented with BAP (1.5 mg L^{-1}).

II. Crop Production

The use of improved production technologies to mitigate the problem of low productivity of quality produce in temperate fruit crop plays a vital role in fruit industry. The factors responsible to the low productivity are quality planting material supply coupled with non adoption of advanced production technologies like training, pruning, nutrient & water management, pollination, post harvesting handling, diseases and pest management which ultimately decides the benefit to farmer. ICAR- CITH, Srinagar and its Regional Stations are continuously propagating planting material of elite varieties of temperate fruits, nuts, vegetables and ornamentals to supply quality planting material to farmers, line department and research organizations. The demand for institute planting material along with production technology is increasing year after year. During 2024-25, institute has supplied about 17378 plants of different temperate fruit crops besides the supply of 6558 scionwood; 1306 plants & 8350 seedlings of ornamentals; about 8.803 kg vegetable seeds, 20 kg garlic for seed & 10530 vegetable seedlings besides 43.5 kg onion seedlings to different stakeholders, vegetable growers & research organization etc. During the year 2024-25, overall revenue of the Institute from all sources was 73.10 lakh and out of which 54.59 lakh was from sale from planting material and farm produce/ as well as from training, sale of technologies, publication etc. Besides the major portion from fruit crops, the revenue generated from vegetables was 99818 rupees and 49341 rupees from floriculture. To increase the production of quality produce, institute is continuously generating technologies through various experimentations for the benefit of the farmers. Institute has licensed three technologies with stakeholders. The outcomes of various experiments on production aspect for generating farmer friendly technologies presented below:

Assessment of Soil Carbon Dynamics and Carbon Sequestration Potential of Selected Temperate Fruit Crops of Arunachal Pradesh

About 432 soil samples were (depth wise) collected from apple, walnut, and kiwi orchards of Arunachal Pradesh elevation wise (<1600 mt, 1600-2000mt and > 2000mts) and 108 composite soil samples were made. Soil parameters such as pH, OC, N, P, K, Ca & Mg, S, TPA, Ex A, Ex Al, Ex H, pH dependent acidity, SMBC, Labile OC, Very labile OC, Low labile OC, Nonlabile TOC, pH of Buffer suspension, Urase and Dehydrogenase activity parameters were completed for two years soil samples (216 samples). Soil parameters such as bulk density, texture, micro-nutrients (Fe,Zn,Mn and Cu), nitratre reductase, phosphatase, Beta-glucosidase, SOC stock, CMI, CEC, lime requirement, dissolved organic carbon and hot water exch. organic carbon analysis are under process.

Impact of Combined Application of Phosphorous and Silicon on Apple Rootstock Performance Under Various Soil Moisture Regimes

Among the three different rootstocks, MM-106 showed better growth and root parameters. Increasing phosphorous levels along with silicon under 60% field capacity has shown better root performance. The water use efficiency and nutrient use efficiency were better under MM-106 rootstock under higher phosphorous levels with 60% field capacity. The soil's physical, chemical and biological properties were also better under the same conditions.

Development and Evaluation of Integrated Nutrient Management Module for High-Quality Temperate Vegetables Production

In kale and long day onion, among the different treatments T6-treatment consisting of 50% inorganic + 50% organic (Trichoderma enriched vermicompost) treatment was best performing followed by natural farming treatment. The soil biological properties and soil fertility was significantly higher under T6 treatment. However, in garlic the soil fertility and quality were significantly higher under treatment T_6-50% inorganic + 50% organic (Trichoderma enriched vermicompost) followed by T_8 – 75

Table. 22. Some plant and root parameters of different rootstocks

Rootstock	Plant Ht. (cm)	Plant Dia (mm)	Root length (cm)	Root Dia (mm)	No. of Adven. Roots	Internodal distance (cm)
MM-106	85.48	6.21	1.57	13.42	5	14.22
C1VP-21	29	7.03	3.54	13	1	14.765
G-11	39.50	8.80	2.26	18.50	4	17.44
G-202	42.45	6.71	1.41	18.95	2	18.55

% Inorganic + 25 % organic (Trichoderma enriched Vermicompost). In integrated nutrient management in kale, long-day onion, and garlic along with crop growth and yield parameters, soil fertility including microbial diversity was evaluated. The *Trichoderma*-enriched vermicompost was best performed among all crops. However, natural farming treatment was outperformed under kale and long-day onion.

Development of Different techniques for Enhancing Multiplication Rate of Temperate Fruits Under

Enhancement in multiplication rate of clonal rootstocks of apple for production of quality planting material

Air layering in apple rootstocks under greenhouse conditions

In this experiment, four different rootstocks (MM-106, CIVP-21, G-11 and G-202) were evaluated based on six key plant growth parameters under polyhouse conditions using cocopeat as the rooting medium. MM-106 exhibited the maximum plant height at 85.48 cm, indicating superior vertical growth. On the other hand, C1VP-21 showed the least plant height of 29.00 cm, suggesting limited vertical development. The thickest stem was observed in G-11 with a diameter of 8.80 mm, followed by C1VP-21 and G-202. MM-106 had the thinnest stem at 6.21 mm. C1VP-21 recorded the longest root length as 3.54 cm, whereas G-202 had the shortest roots measuring 1.41 cm. The maximum root diameter was observed in G-202 at 18.95 mm, closely followed by G-11 at 18.50 mm. MM-106 showed the smallest root diameter of 13.42 mm, indicating a comparatively finer root system. MM-106 yielded the highest number of adventitious roots with an average of 5.20, demonstrating strong rooting potential. G-11 produced 4.00 roots, while C1VP-21 showed the lowest number as 1.00. The maximum internodal length was observed in G-202, indicating more elongated shoot growth. MM-106 exhibited the shortest internodal distance, which may favor more compact plant architecture.


MM-106


CIVP-21


MM-106


CIVP-21


G- 202


G-11


G- 202


G-11

Propagation of Olive by Air Layering

Olive is also important crop and getting lot of

attention. Although olives are propagated through cuttings but ICAR-CITH tried to promote rooting using growth regulators and a soilless rooting medium through air layering. Initial success has been achieved; nonetheless, further research is required to improve rooting potential, plant growth and survival rates.

Air layering of Quince rootstocks in polyhouse conditions (Pots)


Rooting through air layering and separated air layered plant of olive

Three quince rootstocks (Quince-A, Quince-C and Quince BA-29C) were tried for air layering in pots and revealed apparent variations in growth and root traits. Among them, Quince-C exhibited the tallest plants with a height of 52.64 cm, while Quince BA-29C had the shortest height of 46.82 cm. The highest diameter was measured in Quince BA-29C (9.84 mm) and the lowest was in Quince-A (7.95 mm). Regarding root length, Quince BA-29C showed the longest roots (18.50 cm), whereas Quince BA-29C had the shortest (12.22 cm). Root diameter was maximum in Quince-C (7.22 mm) and minimum in Quince-A (3.84 mm). The number of adventitious roots was relatively consistent across rootstocks, ranging from 3.40 (Quince-A and Quince-C) to 3.80 (Quince BA-29C). Lastly, root fresh weight was highest in Quince BA-29 C with 2.70 g, suggesting better root biomass development, while Quince-C had the lowest at 1.55 g. These results highlight Quince BA-29 as a promising rootstock with strong vegetative and rooting characteristics.


Quince-A


Quince-A


Quince-A


Quince-C


Quince-C


Quince-C


Quince BA-29C


Quince BA-29C


Quince BA-29C

Propagation of apple rootstock through cutting

In this study, propagation through cuttings was tried in three apple rootsocks viz. CIVP-21, MM-111 and MM106. Rootstock MM-106 showed the highest success upto 95% with average rate of 89.3%, plant height was 77.26 cm, stem diameter (6.60 mm), root length (2.67 cm) and root diameter (21.20 mm). It produced

5.00 adventitious roots, and longest internodal distance , indicating wider node spacing. MM-111 had the second-highest success rate (90%). It produced the tallest plants (99.84 cm) but had a moderate stem thickness (8.00 mm). Root length was 4.80 cm, better than MM-106 but lower than CIVP-21. Its root diameter was the second-highest at 33.86 mm. However, it had the fewest adventitious roots (4.20), indicating less root branching. The internodal distance was the shortest, suggesting a more compact plant structure. CIVP-21 showed high rooting success (85%) with excellent root system development. It had the shortest plant height (47.90 cm) but the thickest stem (8.69 mm). The root length (13.42 cm) and root diameter (40.50 mm) were the highest among all, indicating strong root growth. It also had the highest number of adventitious roots (5.50), making it the best in root density. Internodal distance was slightly less than MM-106, indicating moderate shoot spacing.

Olive

In olive, lowest success rate of 50 % was recorded through cuttings.

Effect of IBA concentration on growth parameters of different Quince cuttings under Green house conditions.

The application of Indole-3-butyric acid (IBA) at different concentrations (4000, 5000, and 6000 ppm) significantly influenced the morphological parameters of cuttings in various Quince rootstocks. The maximum plant height was recorded in Quince-BA-29 at 4000 ppm (88.80 cm), suggesting enhanced shoot elongation at lower IBA levels, while the minimum height (25.33 cm) was observed in Quince-BA-29 C at 5000 ppm. Stem thickness followed a similar trend, with the highest


Quince-A


Quince-A


Quince-A


Quince-C


Quince-C


Quince-C


Quince BA-29C


Quince BA-29C


Quince BA-29C


Quince BA-29


Quince BA-29


Quince BA-29

diameter in Quince-BA-29 at 4000 ppm (7.14 mm) and the lowest in Quince-C at 5000 ppm (1.00 mm), indicating superior vegetative growth at lower concentrations. Root length was greatest in Quince-A at 6000 ppm (49.43 cm), reflecting the positive influence of higher IBA on vertical root development, whereas Quince-C at 5000 ppm produced the shortest roots (23.17 cm). The thickest roots were obtained in Quince-C at 5000 ppm (5.76 mm), while the thinnest (1.15 mm) appeared in the same genotype at 6000 ppm, demonstrating a decline in root girth at elevated hormone levels. Quince-A at 4000 ppm exhibited the highest number of adventitious roots (5.00), while the lowest count (1.67) was recorded across multiple rootstocks at various concentrations. Internodal distance peaked in Quince-BA-29 C at 6000 ppm, whereas the shortest internode was found in Quince-A at the same concentration. The most substantial variation was observed in root fresh weight, where Quince-A at 5000 ppm exhibited the highest value (46.09 g), compared to the lowest (2.55 g) in the same genotype at 4000 ppm. Overall, the study highlights that 5000 ppm IBA is optimal for enhancing root biomass and thickness, while 4000 ppm favors shoot growth. The variation among rootstocks indicates that genotype plays a critical role in determining the effectiveness of IBA concentrations, with Quince-A consistently outperforming others across multiple growth parameters.

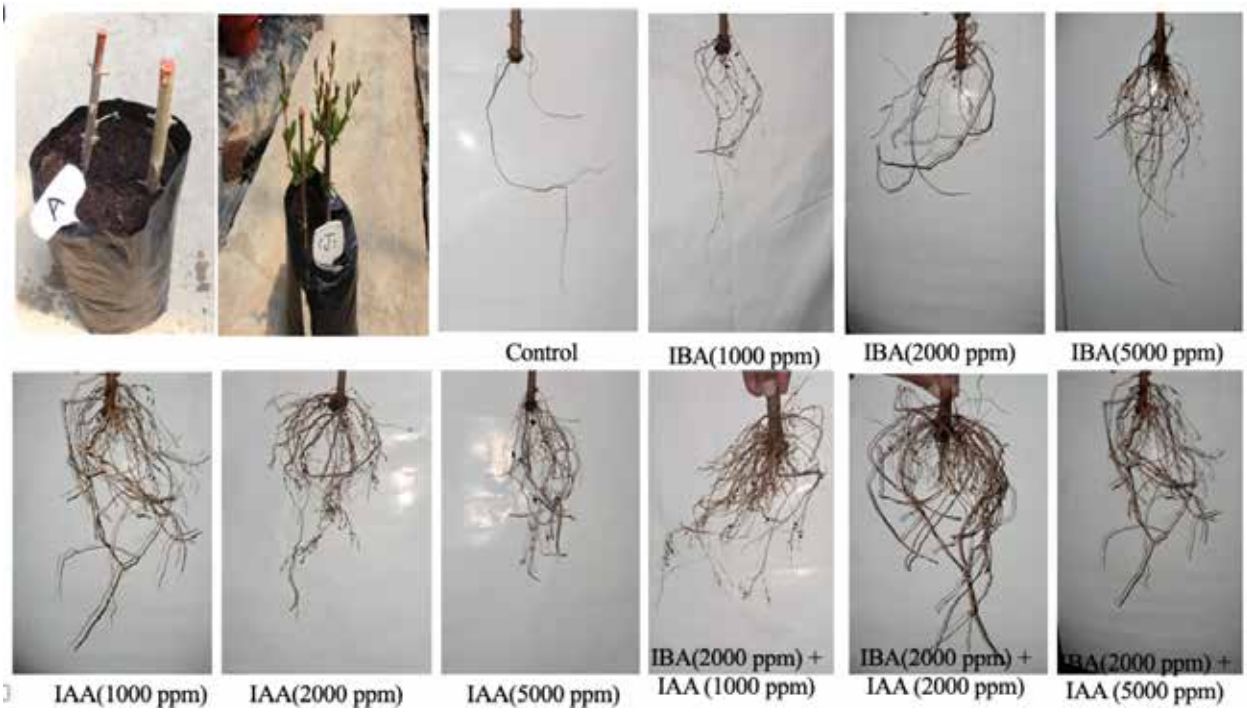
Pomegranate

Response of different auxin treatments in hardwood cuttings of pomegranate cv. Bhagwa

Different treatments containing auxin (IAA and IBA) at various concentrations were used to assess the rooting of hardwood cuttings in pomegranate cv. Bhagwa. Among these treatments, IBA (200 ppm) + IAA (200 ppm) performed best in rooting (78%), root length (38.05 cm), root fresh weight (5.95 g), turgid weight (9.51 g), dry weight (2.69 g), root volume (13.75 ml) and shortest period to rooting (18.68 days). Root density was noticed to be superior in IBA (200 ppm) + IAA (100 ppm) treatment.

Effect time of heading back in budded plants of almond

In J&K, mostly budding is practiced in stone fruits especially in almond during July-August. The heading back in these plants is done during February- March. To shorten the nursery cycle, in this study, the heading back is practiced



Rooting in hardwood cuttings of pomegranate cv. Bhagwa in response to different auxin treatments

during September and February- March. From the preliminary data it was revealed that heading back after budding can give the plants with better growth. Moreover, the bud success can also be known early instead of next March -April and failed plants can be grafted during February-March. As the nursery is labour intensive job and the labour nedded during March-April for heading back can be used for other operations. Although the plants were not of larger size for sale but can used for planting. This is an indication for raising plants in a single season from seed to planting instead of two year cycle, thus reducing one year. Preliminary results indicated the positiveness of the earlier heding back in other crops like apricot, pear, cherry and plums also.

Canopy Management and Plant Architectural Engineering in Temperate Fruit Crops

In canopy architectural engineering experiment in apple; six training systems (vertical axis, cordon, espalier, head & spread, spindle bush and modified central leader system) with two cultivars (Oregon Spur & Red Delicious) on

Growth of plants of different stone fruits headed back during September- October

four rootstocks (Seedling, MM 111, MM 106 & M 9) were evaluated for various fruit and yield traits. Among various rootstocks, varieties and training systems, maximum productivity was recorded in Oregon Spur (62.69t/ha) on MM 106 rootstock closely followed by same variety on M 9 rootstock (53.18 t/ha). As far as training systems is concerned, mean productivity was higher in Oregon Spur as compared to Red Delicious except in Spindle Bush and Modified Central Leader system. Similarly, among rootstocks productivity was higher on MM 9 followed by MM-106, MM 111 and seedling in Oregon Spur while in Red Delicious it was higher on MM 106 followed by M 9, MM 111 and seedling. The average yield per plant was also higher in Oregon Spur in all systems except Head and Spread & Spindle Bush as compared to Red Delicious. The effect of drought was also observed in fruit size and yield during 2024.

In canopy architectural engineering in pear experiment, 4 varieties (Red Bartlett, Starkrimson, William Bartlett & Kashmiri Nakh), 2 rootstocks (BA 29 C & Q C) and 4 training systems (Vertical Axis, Espalier, Tatura Trellies and Modified Central Leader System) were used for experimentation. Overall highest productivity was recorded in William Bartlett (36.88 t/ha) on BA 29 C rootstock on vertical axis system. In BA 29 C rootstock, higher average productivity was recorded in Vertical Axis followed by MCLS, Espalier and Tatura Trellis on BA 29 C rootstock. In case of Q C rootstock, mean productivity was recorded in Vertical axis followed by Modified central Leader System and Tatura Trellis. In comparison of means of different varieties on BA 29 C rootstock planted in different training systems, productivity was more in Red Bartlett (15.787 t/ha) closely followed by William Bartlett (15.72, Starkrimson & Kashmiri Nakh while on QC rootstock, Kashmiri Nakh gave more productivity followed by William Bartlett, Red Bartlett and Starkrimson. The average fruit weight was higher on BA 29C rootstock as compared to QC rootstock. The average weight in Red Bartlett was 285.76 g followed by William Bartlett (254.28 g), Starkrimson (184.82g) and

Kashmiri Nakh (138.87g) on BA 29C rootstock while on QC rootstock it was higher in Wiiliam Bartlett followed by Kashmiri Nakh, Red Bartlett and Starkrimson. As far as average yield /plant is concerned , it was higher in Tatura trellies followed by MCLS, Espalier and Vertical axis System while among varieties, higher yield / plant was recorded in Red Bartlett followed by William Bartlett, Kashmiri Nakh and Starkrimson on BA 29C rootstock. The average yield per plant in different training systems and yield/ plant in different varieties was lower on Q C rootstock as compared to BA 29C.

At ICAR-CITH, RS Mukteshwar, in canopy architectural engineering in apple, the highest fruit yield (12.5 kg) was recorded under vertical axis system in CITH Lodh Apple-1 followed by Red Delicious cultivar on vertical axis as compared to other training systems. In peach trial, the highest fruit yield (35.5 kg) were recorded under open center system in Red June cultivar while the lowest fruit yield (22.5 kg) were recorded under open centre system in Red Nectarine.

Development of saffron based intercropping system involving almond

In saffron based intercropping system involving almond, saffron was cultivated under the almond varieties having different growth habits viz. erect, semi spreading and spreading. Insignificant differences were recorded for most of the flower traits like flower weight, flower length, pistil length and stigma length. As far as almond yield is concerned, highest average yield per plant & per hectare (2.02kg & 12.625 q/ha) was recorded in almond variety having spreading type of growth habit followed by erect type (1.372 kg & 8.75 q/ha) and semi spreading (1.226kg & 7.62 q/ha). Hence from almond, additional equivalent yield to saffron can be taken as 0.875kg, 0.766kg and 1.262 kg in erect type, semi spreading and spreading type with an additional income can be achieved. In biochemical characters, crocin content (mg/g) were maximum in saffron under erect type almond (30.19 mg/g) followed by semi spreading (26.27 mg/g) and spreading type (25.60 mg/g). The picocrocin contents were found maximum in saffron grown under semi spreading type (2.44 mg/g) followed by spreading type (2.41 mg/g) and control (2.34 mg/g). Not much differences were recorded in safanal content but it was more than control (sole saffron).

In another study, the effect of planting density and planting system was also recorded for floral, yield and biochemical traits of saffron and presented briefly below:

Effect of spacing and planting system on yield and biochemical contents

In this experiment, saffron was grown at 4 spacings (20x10, 20x5, 15x10&15x5 cm) in raised bed system and highest fresh & dry saffron yield was recorded in 20x10 cm spacing followed by 20x5cm, 15x5 & 15x10cm spacing. In flat bed system, highest yield of fresh and dry saffron was recorded in 15x10cm followed by 20x5cm, 15x5cm and 20x10 cm spacing. Maximum crocin content was recorded in 20x5 cm spacing (26.94 mg/g) in fat bed followed by 15x5 cm (26.45 mg/g) & 15x 5cm in raised bed. The picocrocin contents were higher at 20x10 cm in raised bed followed by 15x10 cm in flat beds. Similarly safaranal contents were higher in 15x5 cm in raised beds while in flat beds it was higher 20x5cm spacing.

In ridge and furrow planting with six spacings, highest saffron yield was recorded at the spacing of 50x5 followed by 30x5, 50x10,20x10, 20x5 and 30x10 cm, respectively. Under ridge & furrow system, the spacing of 50x10 was found more beneficial as far as crocin, picocrocin and safaranal content is concerned. In cluster planting @3,6,9 & 12 at spacing of 20x20cm in raised bed, highest yield was recorded with planting of 12 corms/ cluster followed by planting of 6 corms, 3 corms while at 20 x10 cm spacing yield was more in the planting of corms in 12 followed by 6,9 & 3 corms / cluster. Similarly, at spacing of 15x 10 cm planting @ 9 cluster gave more yield followed by 12 corms, 6 corms and 3 corms / cluster. Similarly in raised beds planting of corms @ 3,6,9 &12, maximum crocin contents were recorded in planting of 9 corms per cluster while picocrocin in 6 corms / cluster and safranal in 12 corms/cluster. In flat bed planting at the rate of 1,2,3,4 corms/ cluster

at two spacing (20x10&15x10cm) was evaluated for yield and other traits. The increase in number of corms per cluster increased the saffron yield in most of the cases. In planting of one and more than one corm at single place (in flat beds as 1,2,3,&4), maximum crocin content were recorded in planting of three corms per cluster while pico crocin was more one corm planting and no significant differences were recorded for safranal contents.

As far as average biochemical contents is concerned in different planting systems,(raised bed, flat bed, ridge &furrow and cluster planting) crocin, pico crocin & safaranal content were more in cluster planting. The order of crocin content was as cluster planting followed by ridge & furrow,raised bed, flat bed while pico crocin was more in cluster planting followed by flat bed , raised bed and ridge & furrow planting system while no significant differences were found for safaranal contents.

Standardization of Integrated Nutrient Management of Vegetables as Intercrop in Apple Orchard.

The technology of of integrated nutrient management of vegetables as intercrop in apple orchard was demonstrated among farmer under MGMG and SCSP scheme at Sunkiya, Nainital, Gahena, Nainital, Odlohar-Simsyari, Bageshwar villages with the aim to promote crop diversification for sustainable production and to utilize better space as well as natural resources per unit area without eroding soil health for enhancing production per unit area.

Development of Efficient Organic Production Practices of Persimmon (Diospyrous kaki L.) for North-Eastern Region

Under this project availability of different organic manures were analysed and procurement of manures were done. All the treatments fixed and were imposed on the one-year-old persimmon plants which is at ICAR-CITH, RS, Dirang with three replications. The treatments include T1- Sheep manure; T2- Farm Yard manure; T3- Poultry manure; T4- Vermicompost; T5- Vermicompost + Poultry; T6- Vermicompost + Sheep manure; T7- Vermicompost + FYM; T8- Poultry + Sheep manure; T9- Poultry + FYM; T10 – Sheep manure + FYM; T11- Vermicompost + Poultry manure+ Sheep manure + FYM. Growth parameters are being recorded at monthly intervals.

Diseases and Pest Identification Models for Various Temperate Horticultural Crops using Deep learning Techniques

In this project, approximately 5000 leaf images of apple crop for four distinct diseases namely Aternaria, Apple Scab, Apple Mosaic Virus and Powdery Mildew were collected. We develop a Vision Transformer (ViT) model and named it Multilayer Transformer-based Apple Disease Classification (MTADC) model for robust and accurate classification of different apple

View of saffron flowering in different planting systems and experimental farm

leaf diseases in their early stages. The proposed MTADC model has demonstrated exceptional performance and surpassed established models like CNN, ResNet, and VGG16. Through rigorous training and hyperparameter tuning, we achieved an impressive accuracy of 96.32% on the testing set, with class-wise accuracies ranging from 92.84% to 99.58%. The stability of MTADC model's training process, converging around 30 epochs, reflects its efficient learning capabilities.

Kharif onion: A new crop for Kashmir

After 3 years of on-station trials, two farmers were identified in 2024 and provided with 200 seedlings each for *kharif* onion production on farmer fields. Simultaneously, the technology was also demonstrated on CITH farm in 2024.

On-station trial of *Kharif* onion technology for Kashmir region (July to December, 2024)

Intensification of technology popularization

iii. Crop Protection

The temperate horticultural crops are prone to attack of large number of insect, pests and diseases which ultimately leads to a great loss of quality produce. Institute is continuously doing need based research on plant protection aspect, so that losses of farmers can be saved. The results of various studies carried out during 2024 are presented below:

Survey, Collection, Characterization and Documentation of Temperate Horticultural Crops

Screening of apple germplasm for Powdery mildew resistance

ICAR-CITH has very good strength of germplasm of different fruit crops and continuously evaluating for various traits of interest. During 2024, apple grmplasm is evaluated and 50 cultivars/genotypes were identified resistant to powdery mildew disease based on three year screening data. Various new diseases were recorded in germplasm, viz., Brown rot, Rust and little leaf were observed in almond, where as flat branch was observed in apple.

Almond Rust (*Tranzschelia discolor)*

Brown Rot in almond (*Monilinia fructicola*

Little leaf in almond (Un known)

Flat branch in apple (Un Known)

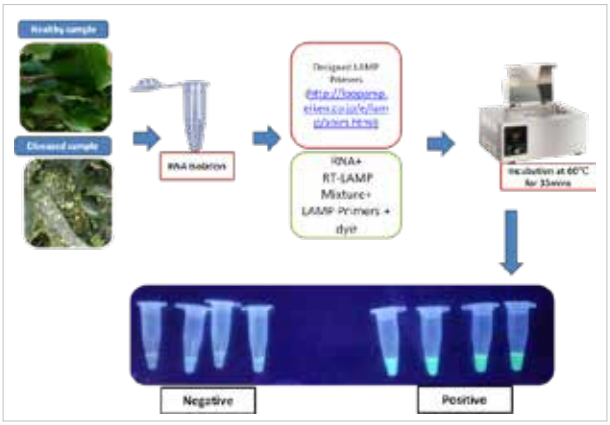
Diagnosis, Transmission and Management of Virus/Virus like Diseases of Temperate Fruit Crops

High throughput sequencing for elucidation of Virome in temperate fruit crops

Virome analysis was carried out in apple, quince and plum using RNA-sequencing. In apple 8 viruses and 2 viroids were identified which includes, citrus concave gum-associated virus (CCGaV), apple rubbery wood virus 1 (ARWV-1), ARWV-2, apple necrotic mosaic virus (ApNMV), apple mosaic virus, apple stem pitting virus, apple stem grooving virus, apple chlorotic leaf spot virus, apple hammerhead viroid and apple scar skin viroid. In plum, five viruses and one viroid was identified which includes prunus necrotic ringspot virus (PNRSV), American plum line pattern virus (APLPV), apple chlorotic leaf spot virus (ACLSV), little cherry virus 1 (LChV-1), plum bark necrosis stem pitting-associated virus (PBNSPaV) and hop stunt viroid (HSVd). Only one virus, apple necrotic mosaic virus (ApNMV) was found associated with Quince.

Development of RT-LAMP based diagnostics for apple virus (ApNMV) for quick detection

Reverse transcription loop-mediated isothermal amplification (RT-LAMP) assay was developed for detection of apple necrotic mosaic virus (ApNMV). In this study, as a first step towards the rapid detection of ApNMV, the virus positive samples were confirmed through RT-PCR and for development of RT-LAMP assay, two sets



RT-LAMP protocol for detection of ApNMV

of primers consisting of two outer (F3 and B3), two inner (FIP and BIP) and two loop primers (BL) were designed targeting the coat protein genes of ApNMV. After incubation of RT-LAMP reaction mixture at an isothermal temperature (60°C/30 min), the amplified products were visually confirmed using SYBR Green I whereas in negative samples no colour was observed.

Impact of viruses/virus like agents on quality of apple

During 2023-2024, the quality parameters were studies in cultivars infected with mosaic disease in comparison to asymptomatic plants. Mosaic virus infection significantly impacted various fruit quality parameters in apple varieties Ambri, Golden Delicious and Red Delicious during 2022-2023. Infected trees showed notable reductions in fruit weight, diameter and fruit length, with Golden Delicious being the most sensitive and Red Delicious the least. Pedicle length increased in infected fruits, while firmness decreased. Titratable acidity (TA) was higher in infected fruits, while total soluble solids (TSS) and TSS/TA ratios were significantly lower. Anthocyanin levels dropped sharply in infected fruits, especially in Red Delicious, while ascorbic acid content increased. The virus also alters the fruit's visual and textural attributes, as evidenced by changes in chromaticity parameters. Chromaticity parameters (L*, a*, b*, hue and chroma) were also adversely affected, with Red Delicious showing the most reduction in hue and Ambri in chroma. These differences between mosaic-infected and mosaic-free trees were statistically significant across all parameters. Genotypes responded differently to apple mosaic, with severely affected fruit shape on Golden Delicious and minimum in Red Delicious but taste and colour related attributes were severely affected in Red Delicious. AMD significantly reduces fruit yield and quality, posing a major threat to apple production in the region, impacting farmers' income and the local economy.

Elucidating the Diversity, Species Spectrum and Management of Alternaria spp. Infecting Apple (*Malus x domestica* Borkh)

Fungicidal scheduling for management of Alternaria diseases at different dates

Eleven fungicides, including propineb, ziram, captan, copper oxychloride, hexaconazole, myclobutanil, and several combination products, were tested *in vitro* to assess their inhibitory effects on fungal growth. The results indicated that hexaconazole and fluxapyroxad + pyraclostrobin were the most effective, completely inhibiting fungal growth at all tested concentrations. Fungicides such as hexaconazole + carbendazim and tebaconazole + trifloxystrobin, also showed significant inhibition, but to a lesser extent. Based on these *in vitro* findings, selected fungicides were further evaluated under field conditions to develop a spray schedule for successful disease management. Five fungicides that performed best under *in vitro* conditions were used in field trials to test various spray programs, which include combination treatments of hexaconazole, ziram, fluxapyroxad + pyraclostrobin, myclobutanil, and hexaconazole + carbendazim. The treatments significantly reduced disease severity compared to untreated controls, with the highest efficacy observed in the early application schedules. The pooled data of all three treatments revealed that T2 (Ziram @ 3gm/L, Fluxapyraxod+Pyra clostrobin@0.2ml/L, Myclobutanil @0.6gm/L, Hexaconazole+Carbandazim @0.5ml/L, Hexaconazole@0.5ml/L of water) was best among all the treatments (Fig.8) with mean disease intensity of 16.24 % and disease inhibition of 53.45 %. When comparing treatments on different dates, Date 1 (2nd week of May) was found to be most effective in inhibiting the pathogen growth with a percent disease intensity of 10.67 and inhibition of 50.29 % (Fig. 9).

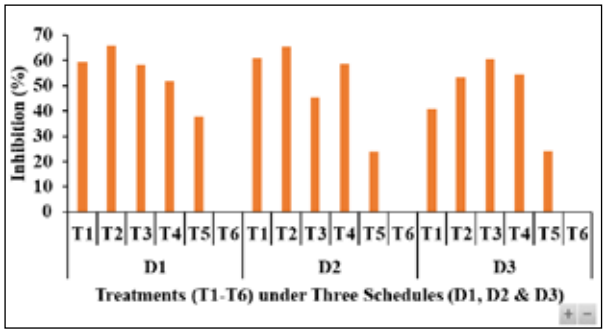


Fig.8. *Graph depicting inhibition percentage of ALB under various treatments*

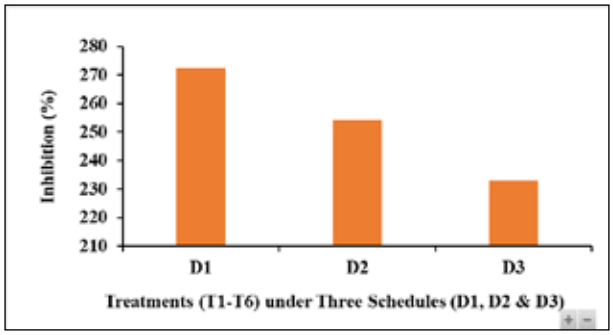


Fig 9. *Graph depicting percent disease inhibition of different treatments on different dates*

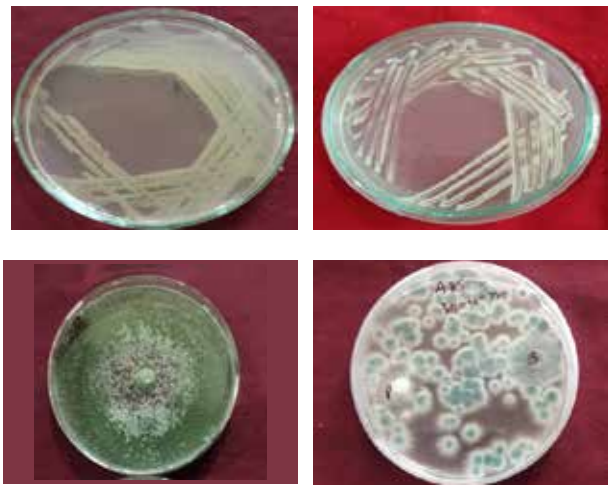
Bioprospecting of Rhizo-cum-Endospheric Microbiota of Apple Rootstocks for Management of Soil Borne Diseases of Temperate Fruit Crops

Identification of the potential microbial strains using phenotypic and genotypic approaches

Two fungal bioagents inhibiting root rot causing fungus *Dematophora necatrix* were identified as *Trichoderma lentiforme, Trichoderma longibrachiatum*, *Aspergillus fumigates.* Three bacterial bioagents inhibiting root rot causing fungus *Dematophora necatrix* were *Bacillus subtilis, Pseudomonas putida Pseudochrobactrumasaccharolyticum, Alcaligens faecalis* .

GC-MS & LC-MS for volatilome

Potential bioactive compounds (Disulphide dimethyl, Isoprene, Methyl Alcohol, Acetonitrile, 1,3-Pentadiene, Methanethiol) were identified from volatiles of identified bioagents

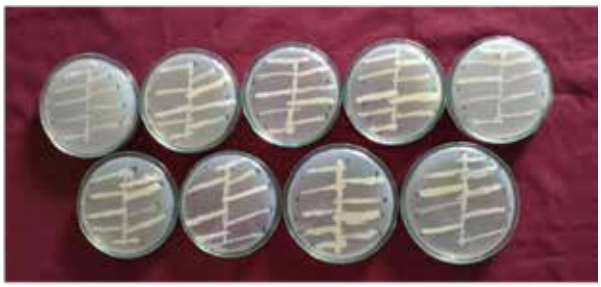


Potential bacterial and fungal bioagents

Development of bio-formulations of potential bioagents

First Bacterial and fungal isolates were compatible among themselves and also with each other except *Bacillus subtilis* with fungal isolates . Based on compatibility test six Talc/Kaolin based bio-formulations were developed either individually or in consortium which are being evaluated in field.

Compatibility test between Fungal-Fungal Bio agents (All were compatible)



Compatibility test between Bacterial-Bacterial Bio agents (All were compatible)

Compatibility test between fungal and bacterial bioagents

ICAR-Regional Station Mukteshwar

Evaluation of fungicides for the management of of Peach Leaf Curl (Taphrina deformans) disease in the Peach cultivar Red June

Peach is an important fruit crop of Uttarakhand and its cultivation is associated with many problems and peach leaf curl is one of the major problem. Peach leaf curl (PLC), caused by *Taphrina deformans*, significantly impacts peach, nectarine, and occasionally other stone fruits worldwide. The disease disrupts photosynthesis, deforms leaves, causes premature leaf drop, and can kill annual shoots, reducing fruit production. Field studies at ICAR-CITH, Mukteshwar, Uttarakhand (2023-2024), evaluated seven fungicides for PLC control, Bordeaux mixture, Metalaxyl 8% + Mancozeb 64% WP, Carbendazim 50% WP, Copper oxychloride 50% WP, Mitram 55% + Pyraclostrobin 5% WG, Carbendazim 12% + Mancozeb 63% WP, and Metalaxyl 8% + Mancozeb 64% WP. Results showed all treatments significantly reduced disease severity versus the control. Mitram 55% + Pyraclostrobin 5% WG (0.1%) was the most effective, achieving 71.27% disease control, followed by Carbendazim 12% + Mancozeb 63% WP (69.14%) and Carbendazim 50% WP (68%). The study suggests that combining systemic and contact fungicides offers superior PLC control, as systemic fungicides provide extended protection when paired with contact fungicides. Timely application of fungicide at critical growth stages of peach can reduce chemical use, cost and support environmental health

Bionomics, Modelling, and Management of Aphid-Pest Complex of Temperate Fruits

Population dynamics of green apple aphid, Aphis pomi De Geer (Hemiptera: Aphididae) in apple orchards

The seasonal population fluctuation of green apple aphid was studied in medium and high-density apple orchards throughout the year. The incidence of green apple started from the third week of March as occasional colonies, mostly

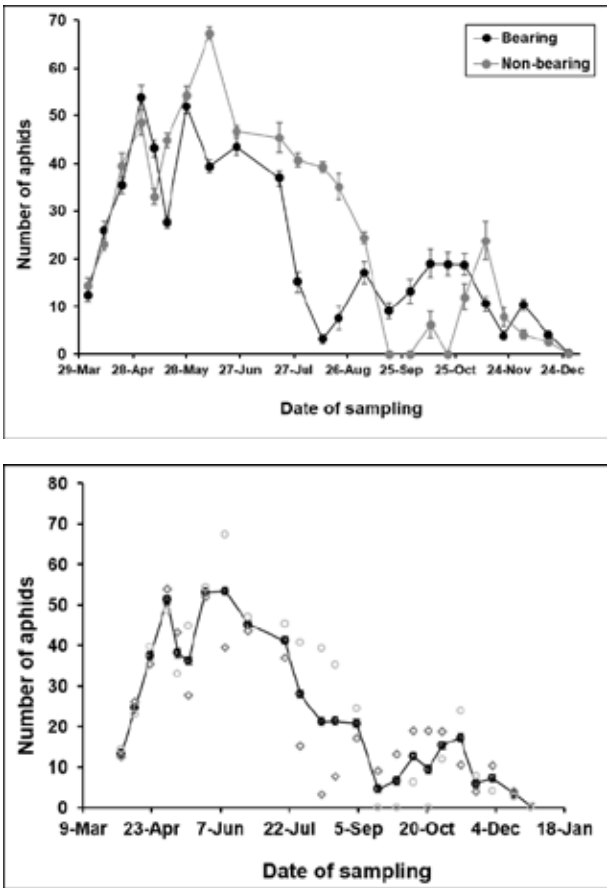


Fig. 10. *Seasonal population fluctuation (2024) of green apple aphid, Aphis pomi in bearing and non-bearing apple orchards (left) and production of winged morphs (right).*

on spots that did not receive delayed dormant horticultural mineral oil spray. The incidence continued as wingless viviparous females for two generations and by the 2nd week of April, the production of winged spring migrants started (Fig. 10). The aphid population peaked from mid-June to July and subsequently decreased towards the third week of August. The incidence of green apple aphid during 2024 was comparatively lower as compared to previous season.

Growers' perception survey on the incidence and management of green apple aphids in apple orchards of Kashmir

The online survey program was conducted for two years to understand the perception of apple orchardists of Kashmir valley about the incidence and management of green apple aphid, *Aphis pomi*. A total of 275 growers participated in the survey, from all 10 apple growing districts of the Kashmir valley of Jammu and Kashmir, India (Table 23).

Table 23. Grower participation summary on the incidence and management of green apple aphids in apple orchards of Kashmir

Sl. No.	District	Number of Tehsils	Number of villages	Participants	
				Number	%
1	Anantnag	10	42	49	17.82
2	Budgam	05	15	15	5.45
3	Bandipora	03	06	06	2.18
4	Baramulla	7	30	33	12.00
5	Kulgam	06	32	41	14.91
6	Kupwara	04	08	08	2.91
7	Shopian	07	56	84	30.55
8	Srinagar	01	02	02	0.73
9	Ganderbal	03	06	07	2.55
10	Pulwama	06	25	30	10.91
	Total	**52**	**222**	**275**	**100**

Orchard characteristics

The per cent response share of the various orchard characteristics is indicated in Fig. 11. The average holding (orchard size) of most respondents was less than 10 kanal (56.70%, n = 156). Based on the location of the orchards, majority of the orchards are located in the lowland area (40.7%, n = 112) while as the remaining orchards are almost equally distributed in the upland areas (25.1%, n = 69) and plain areas (29.5%, n = 81). The most grown varieties are Red Delicious (31.08%, n = 198), Royal Delicious (22.76%, n = 145) and

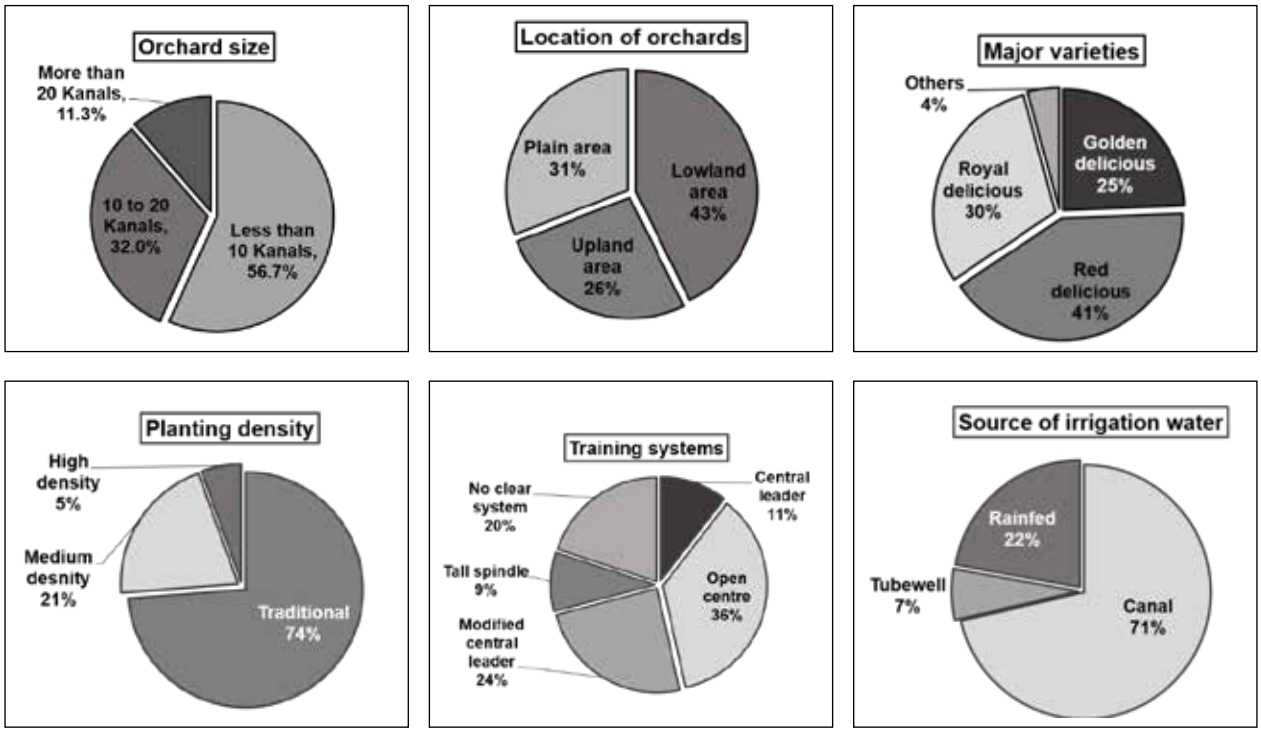


Fig. 11. Summary statistics of orchard characteristics

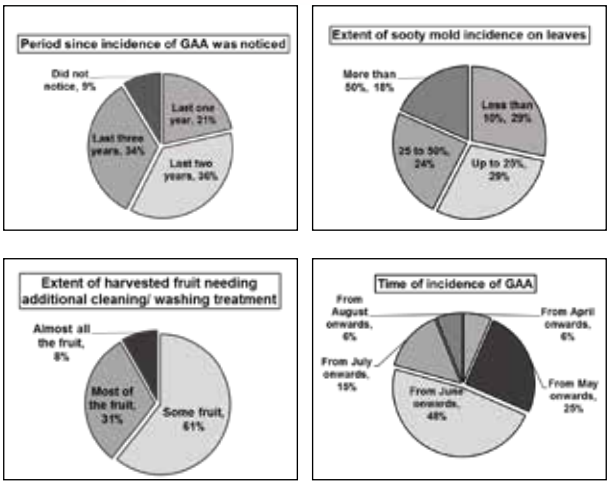


Fig. 12. *Per cent response share regarding incidence and damage symptoms of Aphis pomi*

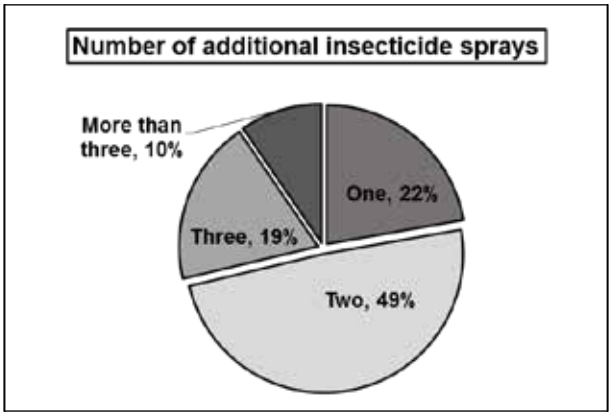
Golden Delicious (Delicious) (18.36%, n = 117).

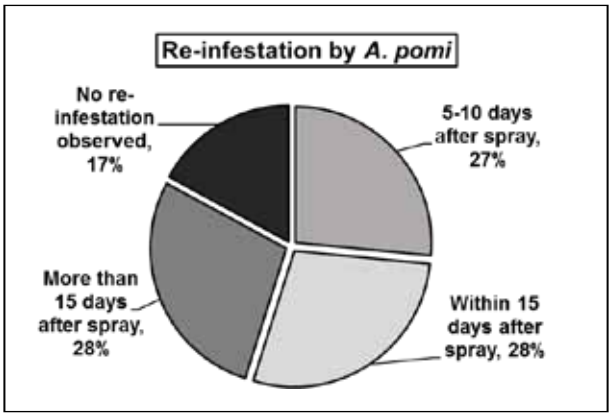
Scenario of Aphis pomi incidence and management

Most respondents reported that they noticed significant incidence of GAA for the previous one or more seasons (91.3%, n = 251). 33.8% (n = 93) have had the problem of GAA since three previous seasons, 36.0% (n = 99) since the last two seasons, and 21.5% (n = 59) reported significant incidence of GAA since the last one season (Fig. 12). All the major varieties grown by the respondents have been reported to be infested by GAA.

Majority of the growers reported the incidence of sooty mold on leaves (84%, n = 231) and fruits (69.5%, n = 191). In addition, 72.7% (n = 200) reported that the general appearance of the trees turned blackish due to the sooty mold. In case of harvested fruits, 69.8% respondents reported that the fruit with sooty mold needed additional cleaning or washing treatment. In this survey, 6.2% (n = 17) reported that almost all the harvested fruit had sooty mold blackening and needed cleaning while 23.3% (n = 64) reported that most of fruit needed cleaning treatments to get rid of sooty mold (Fig. 13). Regarding the induction of lateral growth of the terminal shoots induced by feeding and devitalization of apical bud by GAA, 78.9% (n = 217) respondents observed at least some instances of the phenomenon in their orchards. Only one half of the respondents reported observing eggs of GAA on apple shoots in their orchards (50.5%, n = 139).

Majority of the respondents sprayed the recommended delayed dormancy HMO in their orchards (76.0%, n = 209). A wide array of responses was obtained about the timing of the incidence of green apple aphid in apple orchards. While as 6.2% (n = 17) and 23% (n = 65) respondents reported the incidence of green apple aphid from April and May onwards, respectively, majority reported incidence from June onwards (45.1%, n = 124). About the number of insecticide sprays needed for the management of green apple aphid during the last season, the growers provided varying responses ranging from one to more than three additional sprays needed specifically for the management of green apple aphid (94.9%, n = 261). Majority of growers needed 2 additional sprays (46.5%, n = 128) while as 21.1% (n = 58) and 18.2% (n = 50) needed one or three additional sprays, respectively. Some growers indicated that more than three additional sprays were needed for the effective management of green apple aphid (9.1%, n = 25). Among the multiple insecticides chosen by the growers from the list of most common





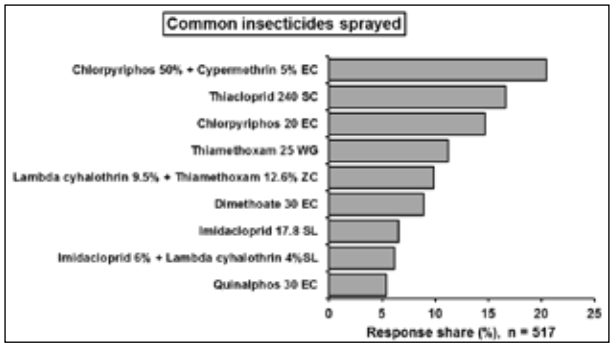


Fig. 13. *Per cent response share regarding various management factors for Aphis pomi*

insecticides sprayed for the management of green apple aphid, top share of answers/ responses was found for chlorpyriphos 50% + cypermethrin 5% EC (38.5%, n = 106), followed by thiacloprid 240 SC (31.3%, n = 86), chlorpyriphos 20 EC (27.6%, n = 76), thiamethoxam 25 WG (21.1%, n = 58), lambda cyhalothrin 9.5% + thiamethoxam 12.6% ZC (18.5%, n = 51), dimethoate 30 EC (16.7%, n = 46), imidacloprid 17.8 SL (12.4%, n = 34), and imidacloprid 6% + lambda cyhalothrin 4% SL (11.6%, n = 32). The phenomenon of re-infestation of GAA after spray was commonly noted by the growers. In extreme case, re-infestation was noted by the growers within 5-10 days of spray (26.5%, n = 73). In 56.4% (n = 155) cases, re-infestation was noted within 15 days or more than 15 days after spray. In 17.1% (n = 47) cases, no re-infestation was noted **(Fig. 4).**

Biology, Ecology and Management of Fruit Flies Infesting Temperate Fruits

Species diversity of fruit flies in temperate fruit orchards

The species diversity of drosophilids was studied with the help of McPhail traps charged with apple cider vinegar and protein hydrolysate-based baits and by rearing of fruit larvae from infested fruits of cherry. In all five species of fruit flies were recovered from the traps and rearing of infested fruits viz., *Drosophila suzukii* (Matsumura, 1931), *Drosophila busckii*Coquillett, 1901, *Drosophila melanogaster* Meigen, 1830, *Drosophila immigrans*Sturtevant, 1921, *Drosophila repleta* Wollaston, 1858, and *Zaprionusindianus* Gupta, 1970.

Seasonal population dynamics of fruit flies in temperate fruit orchards

The seasonal population fluctuation of spotted wing drosophila, *Drosophila suzukii*was monitored with the help of McPhail traps charged with apple cider vinegar and protein hydrolysate-based baits. The traps were deployed in cherry fruit orchards from April to December. The trap catch was cleared at weekly interval and preserved in 70% ethanol. The samples were later sorted, identified, sexed and counted. The seasonal incidence of *Drosophila suzukii* is depicted in Fig. 14. Highest fruit fly activity was noted during last week of May to 2nd week of June followed by last fortnight of July when the fruit was present in the field.

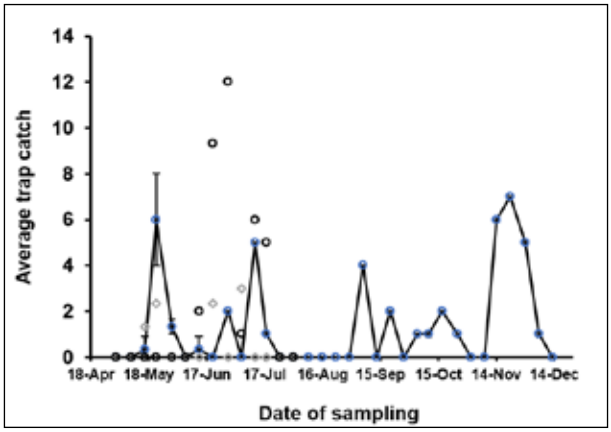
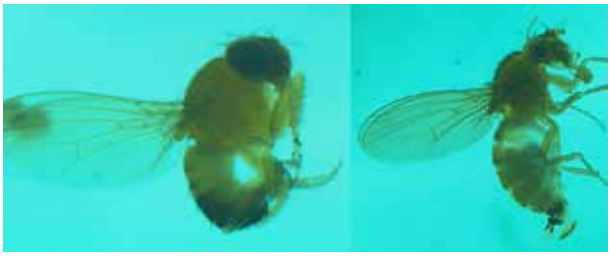


Fig. 14. *Seasonal incidence of Drosophila suzukii in cherry crop in mixed fruit orchard system*



Male (left) and female (right) adults of Drosophila suzukii

Infestation of cherry fruits by Drosophila suzukii

Cherries were plucked from the fruit trees and brought to laboratory for inspection of infestation by the SWD followed by rearing of the larvae. To further corroborate the results, samples of dropped fruit were also collected and inspected

for the presence and larvae and reared accordingly. The adults thus obtained were identified and a mixture of fruit flies was found, dominated by the *Drosophila suzukii*. The variation in percent incidence over the maturity period is indicated in Table 24 which corresponds well with the population dynamics pattern of SWD.

Table 24. Percent infestation of cherries by SWD, Drosophila suzukii

SMW	Cherries sampled from plant			Cherries sampled from ground		
Sample size (N)		Number infested	% infestation	Sample size (N)	Number infested	% infestation
21	79	46	58.23	127	7	5.51
22	437	40	9.15	-	-	-
23(1)	362	17	4.70	32	6	18.75
23(2)	283	108	38.16	-	-	-
24	82	71	86.59	87	25	28.74
25	143	128	89.51	51	9	17.65
26	81	43	53.09	55	12	21.82

IV. Post-Harvest Technology

To save huge losses of produce from horticultural crops and economy of farmers, post -harvest management in temperate horticultural crop is also major area which needs a great attention. Majority of crops have very less shelf life and needs to be send market as soon as possible. The ultimate returns to the farmer largely depend on pre and post- harvest handling as well as management. The stone fruits and vegetable crops are more perishable as compared to others. ICAR-CITH is continuously doing need based research to enhance the post- harvest life of produce as well as value addition. The research work carried out during 2024 is briefly presented in different heads.

Synthesis of Nanocellulose from Horticultural Waste Material and Development of Packaging Film by Incorporating Biodegradable Polymer

Keeping in view for alternatives to petroleum-based packaging materials, a project was initiated on synthesis of nanocellulose from horticultural waste material and development of packaging film by incorporating biodegradable polymer. Under this project, the waste material generated primarily from cutting and pruning of apple, and waste material from onion and garlic leaves was collected for preliminary study to identify the source for extraction of nanocellulose.

The waste material collected from different crops was dried at 45 °C for 24 hours in hot air dryer followed by grinding in fine powder (pass through 60 mesh sieve). Biomass proximate composition parameters such as cellulose, hemicellulose, lignin and extractive frees of crops waste material was studied. In preliminary study it was observed that onion and garlic have 47.44 & 51.47, 22.47 and 15.37, 27.59 & 30.71 and 2.5 &2.45% cellulose, hemicellulose, lignins and extractive frees, respectively. The biochemical proximate composition was in accordance to the reported by Reddy and Rhim, 2018, although cellulose composition in onion and garlic is much lower than cotton (90%), kenaf (72%) and hemp (68%) as reported by John and Rajesh, 2008.

Crop waste (leavses and stem) dried and grounded into fine powder, (1) Onion and (2) Garlic crops.

Upcycling of Temperate Fruit and Vegetable Derived Pomace into a Sustainable Carotenoid Avenue for Functional Food Product Development

A new research proposal was started along with the scope, importance and objectives of the research proposal. Temperate fruits and vegetables are highly valued for its rich bioactive potential contributed by its phytochemical diversity. The pomace materials which largely gets wasted from the food industry after conversion into commercial products are left to decay in the environment causing significant environmental hazards. As the pomace materials holds immense phytochemical compounds, it becomes essential to utilise the waste and convert to a highly value-added commodity.

Rosehip Seed Oil-Based Oleogels as Sustainable Fat Substitute in Food Applications

Rosehips are nutritionally rich and medicinally potent temperate underutilised fruit crop which is slowly gaining importance in recent years. In order to captivate the thereaupatic benefits of rosehip seeds, the extraction of oils followed by transformation into oleogel format is desirable. Further this phytochemically rich oleogels can be used as fat substitute in various commercial bakery operations.

During the year 2024, 85 rosehips samples were collected from the field boundaries of ICAR-CITH, Srinagar and 11 accessions were selected based on color, appearance and their physical & engineering property evaluation were made. The collected rosehip fruit shape varied from smaller oval to conical and oblong shaped . In addition, the presence of trichomes in certain accessions marked their difference with respect to visual and aesthetic appeal. The collected data (Fig 15)

Ruits of some collected Rosehip accessions around the orchards of ICAR-CITH

reveals that weight of rosehip fruit varied from 0.369 ± 0.01 to 2.00 ± 0.20 g which shows a diverse fruit filling behaviour among the accessions. The length, width and thickness of the rosehips were found to range from (11.42 ± 1.08 to 22.05 ±1.34 mm), (7.32 ± 0.86 to 14.09 ± 1.09 mm) and (8.97±0.96 to 19.08 ±1.05 mm), respectively. The firmness evaluation as done using firmness tester ranged from 10.72 ± 0.75 to 37.41 ± 3.73 RV. This indicates the cell wall adhesion and thickness property which is a characteristic suited to respective accessions.

The color profile (Fig.16) showed that majority of the accessions were more oriented towards lower L* and increased a* indicating the redness characteristic. The a* value ranged from 16.14 to 30.38, the highest being a dark red colored fruit. The b* value that indicates the color range between (+) yellow and (-) blue, when analysed for collected fruits showed that R56 and R59 showed a relatively higher b* indicating the yellowness component. Increased yellowness component can be attributed for carotenoid accumulation. Further the rosehips were evaluated for engineering property evaluation, which showed that arithmetic mean diameter (AMD), geometric mean diameter (GMD) ranged from 9.52 ±1.07 to 17.88 ± 0.75 and 9.08 ± 0.86 to 17.38 ± 0.70 mm, the highest being observed in R9 accession. The sphericity values ranged from 0.77± 0.03 to 0.91 ± 0.03 % which indicates the shape diversity. A sphericity value closer to 1 indicates the absolute spherical nature. Since the collected accessions were more of ovoid to conical, there was a lower value observed for sphericity. Other engineering parameters relevant to industrial significance includes the calculation of flakiness ratio and elongation ratio respectively.

Value Added Products

Formulation and quality evaluation of Jaggery-based Quince Tutty fruty

Quince (*Cydonia oblonga* Mill.) is a nutrient dense pome fruit which is used widely in many of culinary preparations and as a source of traditional

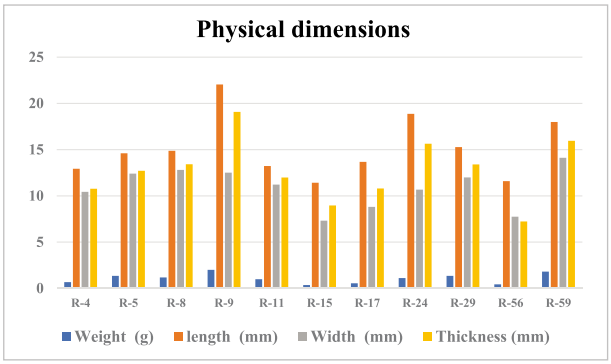


Fig .15. *Physical parameters of selected rosehip accessions*

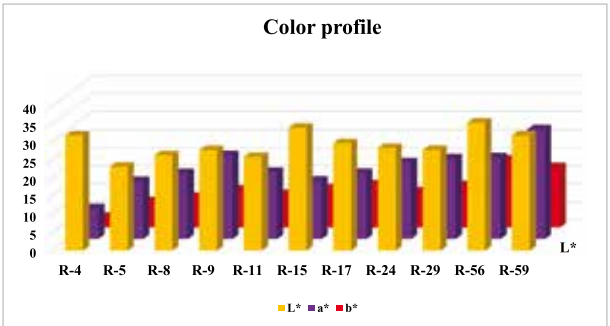


Fig.16. *Colour profile study on selected rosehip accessions*

medication. The fruit is a greater source of vitamin C, dietary fiber and many health promoting phytochemicals. Often the fruit owing to the presence of polyphenolics, gets rejected in its fresh format for consumption. In order to increase the consumption of this nutrient rich fruit, processing strategy of jaggery infusion followed by drying was followed. Quince fruits from the ICAR-CITH orchard were harvested and used for processing. The harvested quince was cleaned and washed with water followed by peeling and size reduction into smaller cubes resembling tutty fruty. Further the tutu fruty shaped fruits were infused with jaggery syrup of 60 °Brix and allowed for infusion process. The infusion process was maintained for 20 hours at room temperature which was further drained and dried in cabinet drier at 65°C for 8 hours and packed in airtight container.

Preparation of Persimmon pulp by hot pulping method

Persimmon is a rich source of vitamins, dietary fibre, carbohydrate, phenolic molecules and carotenoids. The shelf life of fresh persimmon is limited owing to higher moisture content which may be prone for spoilage. Thus, converting fruits to pulp format offers significant scope in food industry to utilise the fruit throughout the year, ensuring continuity in supply chain. Freshly harvested Fuyu type persimmon fruits were collected from ICAR-CITH, Srinagar and were immediately brought to Post Harvest technology lab and washed with potable water. The calyx was removed and the fruit with peel was cut into smaller pieces which underwent hot water cooking in a domestic cooker. The soften cooked fruit pieces was pulped thoroughly by using mixer grinder and sieved to remove the sediments. Further the sieved pulp was pasteurised and dosed with sodium benzoate preservative.

Green walnut pickle

Green walnuts which are characterised by soft and immature kernel together with easy to cut shell is a greater source of bioactive phytochemicals. These green walnuts owing to its astringent taste behaviour is less accepted by consumers, hence there needs to be some technological intervention to reduce or lower the astringency causing phenolics. The green walnuts were immediately washed with water to remove the dirt and foreign materials. Then they were subjected for four treatments: Conventional soaking for 7 days, Hydrothermal treatment, brining and stand alone drying. The green walnuts after the treatments were analysed for phenolic reduction and converted to pickle format. The pretreated green walnuts along with spices, salt and condiments were weighed and pickle was formulated by adopting hot cooking method. Further the pickle was transferred to presterilized glass jar and poured with enough heated oil to create anaerobic condition.

Value-Added Products Developed from different fruits at ICAR-CITH, Srinagar

Jaggery Infused Quince Tutty fruty

Persimmon Pulp

Green Walnut Pickle

Persimmon Nectar

Golden Currant Pulp

Ready to Serve (RTS) loquat beverage

V. Externally Funded /Network projects

Institute used to compete for need based externally funded projects from different agencies to cater the need of stakeholders arisen time to time. The scientists of the Institute are handling very good number of externally funded projects with excellent output. The salient outcome of various externally projects funded handled by different scientist during 2024 at ICAR-CITH are presented below:

Production of Quality Planting Material of Elite Walnut Cultivars and Demonstration of Improved Agro-Technology for Walnut Orchards in Kashmir and Arunachal Pradesh

During 2024-2025, the ICAR-Central Institute of Temperate Horticulture (CITH), propagated CITH-walnut varieties through cleft grafting for establishment of mother orchards. A total of 301 grafted plants and 2000 budwood sticks were provided to SKUAST-K, Srinagar and farmers in Jammu & Kashmir and Arunachal Pradesh. These resources will be utilized for establishment of mother blocks at Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir (SKUAST-K), Srinagar; Farmers' fields in Jammu & Kashmir and Research organizations in Arunachal Pradesh.This initiative aims to promote the cultivation of improved walnut varieties in these regions, potentially leading to increased production and better-quality walnuts.

Establishment of walnut mother orchard

Imported Chandler and Franquette walnut varieties were planted as a separate demonstration block at ICAR-CITH, Srinagar. This will allow researchers and farmers to observe the growth and performance of these varieties under local conditions. The ongoing evaluation of these plants will be important to determine their suitability for cultivation in India. Researchers will be looking at a variety of factors, including yield, nut quality, disease resistance, and adaptability to local conditions. If the results are encouraging, these varieties could play a significant role in the future of the Indian walnut industry.

Walnut mother block at dormant stage

Chandler & Franquette walnut tree at dormancy

Franquette walnut at fruiting stage

Chandler & Franquette walnut in fruiting

DUS Centre for Temperate Fruits and Nuts

Reference varieties maintained

About 383 reference varieties of temperate horticultural crops are being maintained and 137 were characterized during 2024 (Table 25 & Table 26) Characterization of apple, walnut, almond, peach, plum and cherry was performed as per the DUS descriptor developed PPV&FRA, New Delhi. The characterized data was converted into different notes which can act as data base for comparing candidate varieties with reference varieties at any time. Maintenance of reference varieties is being done and all traits/characters are being tested at nodal center ICAR-CITH, Srinagar for their uniformity and stability. Databases of apple (60 varieties), almond (13 varieties), and walnut (27 varieties) were prepared. Monogram of apple based on DUS descriptor for almond varieties has been published. During 2024 four candidate varieties (farmer's varieties) were tested through *onsite* testing and data was submitted to PPV&FRA, New Delhi (Table 27).

Table 25. Reference varieties of temperate horticultural crops under maintenance at DUS centre

Crops	No. of varieties under maintenance and characterized as per DUS descriptor during 2024
Apple	130
Pear	21
Walnut	27
Almond	13
Peach	31
Plum	25
Apricot	18
Cherry	10
Strawberry	107
Total	**382**

Table 26. Reference varieties characterized using respective DUS descriptor

Crops	No. of varieties under maintenance and characterized as per DUS descriptor during 2024
Apple	40
Walnut	27
Almond	13
Peach	22
Plum	12
Cherry	10
Pear	13
Total	**137**

Table 27. DUS testing of candidate varieties

S. No.	Crop	Variety name	Location
1.	Apple	Kanwar Majohli	Shimla, Himachal Pradesh
2.		WA38	Narayan Bagh, Ganderbal, Jammu & Kashmir
3.		NY1	Narayan Bagh, Ganderbal, Jammu & Kashmir
4.		CIV 323	Zainapora, Shopian, Jammu & Kashmir

Representative states of different characteristics of crop varieties in temperate fruits

I. Variation of flower color at balloon stage in apple genotypes

Kanwar Majohli

Maribelle

II. Variability of number of flowers (on 15 cm length) in peach genotypes

EC-312412

Silver King

Paradelux

May Fire

III. Internode distance variability in peach genotypes

EC-312412

May Fire

IV. Fruit size, shape and color variability peach genotypes

Paradelux

Glohaven

Quetta

Southland Peach -2

V. Petiole size variation in almond genotypes

Primorskij

Makhdoom

VI. Petal colour and shape variation in almond genotypes

California paper shell

Feralase

Shalimar

Waris

VII. Variation of flower bud shape in almond genotypes

Waris

Merced

Walnut Propagation for Production of Quality Planting Material for Walnut Promotion in Uttrakhand

To see the success of cleft grafting in open field conditions, trial were conducted on last year planted rootstock on 12 walnut varieties (CITH W1 to CITH W-10, CITH Prolific and CITH Early) at four dates (15th February, 26th February, 4th March and 13th March, 2024. Among all the varieties when the grafting was done on 15th February, maximum success of 60 percent was recorded in CITH -W-10 while it was maximum in CITH -W-9 (53.33%) when performed on 26th February. Similarly in grafting performed on 4th March, maximum success (73.33%) was recorded in CITH Early followed by CITH-W-7 (66.66%) while CITH-W-1 gave maximum success (58.18%) when performed on 13th March. Overall, average of success of grafting performed on different dates, maximum success was recorded in grafting performed on 4th March followed by 13th March, 26th February and minimum in 15th February. The technical know how was provided during 2024 as and when required. During 2024, five one day training programmes were organized in different nurseries of Deptt of Forest, Uttarakhand on walnut propagation for staff of UFRMP & department of Forest, Uttarakhand from 18th

Glimpses of training program on walnut propagation at Maldevta on 18th February, 2024

Glimpses of training program on walnut propagation at Magra on 19th February, 2024

Glimpses of training program on walnut propagation at Sony on 21st February, 2024

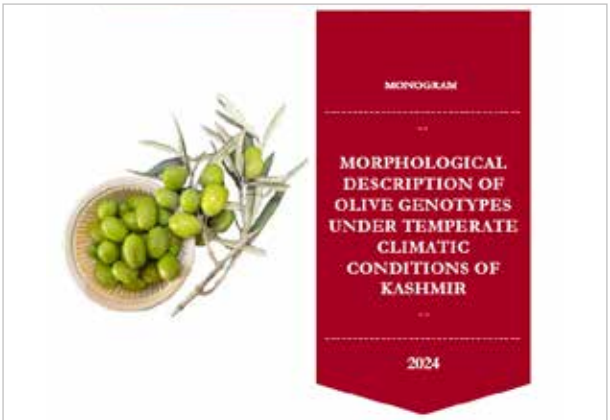
Glimpses of training program on walnut propagation at Silalekh on 22nd February, 2024

Glimpses of training program on walnut propagation at Ladiyakata on 23rd February, 2024

February to 23rd February,2024 at Maldevta, Magara, Sony, Silalekh and Ladiyakata in which 82 participants participated. The impact of these programmes can be seen with the production of about 2005 plants initially and 1800 finally were produced by these nurseries. Plants were also produced at ICAR-CITH, Srinagar and its Regional Station Mukteshwar. In ICAR-CITH RS Mukteshwar, in evaluation of CITH walnut cultivars for scion wood production, total ten cultivars were evaluated for scion wood production and maximum number of shoot per plant was recorded in CITH W-4 (59.3) as compared to other cultivars. In wlnut propagation, 500 plants were grafted and 365 plants were success till May, 2024 (73.0 % success rate recorded).

DUS Centre for Olive

Over the past year, significant progress has been made in the DUS (Distinctness, Uniformity, and Stability) Centre for Olive Crop, focusing on the morphological characterization of different olive genotypes under the temperate climatic conditions of Kashmir. This initiative, undertaken at ICAR-



Central Institute of Temperate Horticulture (CITH), Rangreth, Srinagar in collaboration with the Protection of Plant Varieties and Farmers' Rights Authority (PPV&FRA), Government of India, aims to establish a comprehensive database of olive genotypes suited for regional adaptation. During 2024 a total of 15 olive genotypes were characterized during DUS descriptor of olive, including Tonda Iblea, Baincolilla, Frantoio, Picholine, Cipressino, Etnea, Toffhoio, Belice, Moraiolo, Zaituna, Leccino, Pendolino, Messinese, Coratina, and Cerignola.

Characterization of Morphological Traits

Documented detailed key morphological traits, covering tree vigour, leaf structure, flowering patterns, fruit characteristics, and stone traits which are crucial for DUS testing and varietal identification. Data on growth habit, flowering patterns, and fruit maturity stages were also systematically recorded.

Establishment of database

A database (Monogram) critical for DUS testing, aiding breeders and farmers in varietal selection was prepared for publication.

The findings serve as a reference for breeders and farmers to select superior genotypes based on adaptability and yield potential. This study contributes towards promoting olive cultivation in Kashmir by identifying genotypes best suited for commercial cultivation.

National Agriculture Innovation Fund/ Intellectual Property Management and Transfer/Commercialization of Agriculture

Technology

Identification, documentation, registration, release etc. of technologies and varieties

Seven crop varieties which include three apple varieties (CITH-PRIDE, CITH-AMMOL, CITH-Priame), two walnut varieties (CITH Early, CITH Prolific) one onion (CITH-Red Gem) and one garlic (CITH-Jumbo) have been approved by the State Variety Release Committee and have been forwarded to Central Variety Release Committee for notification.

Identified Varieties for Approval by State Variety Release Committee

Technology Commercialization and MOUs

To bring the technology from research to farmer's field, ICAR-CITH successfully transferred technology relating to apple rootstock

Walnut Material Transfer Agreement

Rootstock Multiplication in Apple

Feathering in Apple

Technology Transfer and Commercialization

Vista Processed Foods Pvt. Ltd

Nursery Growers

Nursery Growers

MOUs

multiplication, feathering in apple and walnut propagation by licensing the technology to nursery growers. Licensing was done with 18 stakeholders including farmers and nurserymen for transfer of these three technologies by signing MoU. Licensing of CITH released walnut varieties with private nursery through Agrinnovate India Limited was also done.

Patents and Registration

Patent for design for Automated Spraying Robot for Real Time Weed and Pest Management in Field and Vegetable Crops and Plummet the Incidence of Pests in Seed Processing Plants (MMDU, Amballa) has been granted (16.08.24).

Walnut variety "CITH-W-5" has been registered for protection of denomination and variety through PPV&FRA, New Delhi.

Trainings, meetings and workshops conducted

Three days training programme with the aim to promote skill development was conducted on "Genomic advances in diseases diagnostics and management in temperate fruit crops" from 6th March to 8th March, 2024 which was attended by faculties of different colleges, research institutes and State Agriculture Universities. To give boost to lettuce cultivation in Kashmir, programme on "Development of Business module for lettuce cultivation in Kashmir under public private partnership" was held on 26th April, 2024. One-day awareness programme on Producing healthy planting material for vegetatively propagated fruit crops was conducted for the benefit of scientists of SKUAST-K and ICAR-CITH, Officers of Horticulture Department, farmers and nursery grower on 21st May, 2024. A mega event in the form of Workshop on "Agrifood systems in India Himalayan Region" was held on 3rd June, 2024 at ICAR-CITH which was attended by National Directors and Heads of various Departments from agriculture and allied research institutions besides scientists and faculty members. Three days training workshop for scientists of ICAR-CITH and SKUAST-K, Officers of Department of Horticulture, researchers, farmers and nursery growers on introduction of Orchids in Kashmir was jointly organized by NRC on Orchids, ICAR-CITH and SKUAST-K from 1st August to 3rd August, 2024.

Genomic advances in diseases diagnostics and management in temperate fruit crops

Development of business module for lettuce cultivation

Agrifood systems in India Himalayan Region

Events conducted under ITMU

A comparative Metabolomics Approach for the Analyses of Scab-Disease Resistance in Apple and Development of a Metabolite-Based Non-Invasive Sensor for Early Scab-Disease Diagnosis

Plant phenotypes are greatly influenced by volatile organic compounds (VOCs), and their emission profile is heavily influenced by genotypes. VOCs can be used as biomarkers in non-destructive phenotyping of plants. A non-destructive evaluation of the scab tolerance potential of resistant (cv. 'Prima') and susceptible (cv. 'Oregon Spur') apple cultivars was conducted by comparing their major leaf VOC compositions and proportions. The leaf VOC profiles of the two cultivars revealed 16 different VOCs, with cis-3-hexenyl acetate (3HA) emerging as a biomarker. 3HA significantly inhibited the growth of *V. inaequalis* in vitro. It was found that 3HA significantly reduced scab symptoms on V. inaequalis-inoculated leaves of 'Oregon Spur,' suggesting it could be used as a non-destructive biomarker for the rapid identification of scab-resistant apple germplasm. With the help of VC information, we have developed a non-invasive hand-held sensor that can predict scab disease in apple plants before symptoms appear. Sensors have been demonstrated and are being tested in the apple orchards of ICAR-CITH. The sensor is capable of predicting scab with an accuracy of 76 percent. Efficiencies of the sensor will be tested in the orchards of ICAR-CITH, Srinagar during 2025.

Development and testing of sensor for scab detection

Physicochemical and biochemical analysis of apple scab-resistant and susceptible varieties

A comprehensive physicochemical analysis was conducted on apple varieties exhibiting resistance and susceptibility to apple scab before and after infection, both at room temperature and in storage (2°C). Eight varieties, namely Prima, Firdous, Shireen, Golden Delicious, Red Delicious, Oregon Spur, Starkrimson, and Vista Bella, were evaluated for parameters such as fruit weight, firmness, total soluble solids (TSS), color, ascorbic acid content, and pH. The findings indicated that the reduction in weight, firmness, and ascorbic acid was significantly higher in susceptible varieties at room temperature after infection compared to resistant varieties. However, in storage, the reduction in these properties was less pronounced after infection. The TSS of resistant varieties increased more rapidly at room temperature before infection compared to susceptible varieties, but the increase in TSS was slow in storage for both groups. The

pH of susceptible varieties increased more at room temperature after infection compared to resistant varieties, while the increase in pH was slower in storage. Additionally, enzyme assays were performed using the detached leaf technique on apple scab-resistant varieties (Prima, Firdous, Shireen) and susceptible varieties (Oregon Spur, Starkrimson, Vista Bella) to assess the activity of antioxidant defense enzymes, including ascorbate peroxidase (APX), superoxide dismutase (SOD), catalase (CAT), and malondialdehyde (MDA) content. The results demonstrated that APX, SOD, CAT, and POD activities were significantly elevated in resistant apple varieties, indicating a more robust antioxidative response. Conversely, MDA content, a marker of oxidative stress, was substantially higher in susceptible varieties, highlighting their vulnerability to oxidative damage caused by scab infection.

- The APX activity of resistant varieties increased and peaked at 3 days after infection (DAI), then gradually decreased, whereas in susceptible varieties, APX activity increased with time.
- The CAT activity of resistant varieties increased rapidly until 3 DAI, followed by a slower increase, peaking at 10 DAI. In susceptible varieties, a moderate increase was recorded but remained significantly lower than that in resistant varieties at 7 and 10 DAI.
- The LPX activity of resistant varieties increased slightly after inoculation but remained relatively stable over time, whereas in susceptible varieties, LPX activity significantly increased post-inoculation, peaking at 10 DAI.
- The SOD activity of resistant varieties significantly increased by 3 DAI, peaking at 7 DAI, then increased at a decreasing rate and stabilized at 10 DAI. In susceptible varieties, moderate increases were observed at 3 DAI, but activity remained significantly lower compared to resistant varieties.

Furthermore, quantification of key phytochemical compounds, including total phenols, flavonoids, flavonols, DPPH radical scavenging activity, and individual phenolic compounds such as rutin, catechin, epicatechin, quercetin, gallic acid, and chlorogenic acid, was conducted under storage and room temperature conditions. The resistant varieties (Prima, Shireen, and Firdous), along with the moderately resistant Golden Delicious, exhibited higher levels of DPPH radical scavenging activity, flavonols, flavonoids, and total phenols compared to the susceptible varieties. This suggests that enhanced phenolic accumulation may contribute to the defense mechanism against apple scab in resistant cultivars.

Expression Analysis of Differentially Expressing Resistance Genes in Six Apple Varieties

This study aimed to analyze the expression of 20 differentially expressing resistance genes in six apple varieties with varying levels of resistance to apple scab. The varieties included Prima, Firdous, Shireen, Oregon Spur, Red Delicious, and Golden Delicious. Leaf samples were collected from all six apple varieties, and total RNA was extracted for cDNA synthesis. Gene expression analysis was conducted using quantitative PCR, with Prima serving as the positive calibrator. Firdous and Shireen were classified as resistant varieties, Golden Delicious as moderately resistant, and Oregon Spur and Red Delicious as susceptible. The expression levels of resistance genes varied among the tested varieties. Firdous exhibited the highest expression among all varieties, followed by Shireen and Golden Delicious. The susceptible varieties, Oregon Spur and Red Delicious, showed relatively lower expression of the resistance genes.

Genome Editing using CRISPR Cas-9 for Inducing Precocity in Apple

The TERMINAL FLOWER LOCUS 1 (TFL1) gene is a key regulator of flowering time and inflorescence in plants. It belongs to the phosphatidylethanolamine-binding protein (PEBP) family and plays an antagonistic role to FLOWERING LOCUS T (FT) in determining whether a plant continues vegetative growth or transitions to reproductive development. TFL1

acts as a floral repressor, delaying flowering by inhibiting the expression of floral identity genes such as APETALA1 (AP1) and LEAFY (LFY).It competes with FT, where FT promotes flowering by activating FLOWERING LOCUS C (FLC), while TFL1 counteracts this process. Suppressing TFL1 function can lead to compact growth habits and early flowering in plants.

Guide RNA (gRNA) designing

We in our study used CRISPR technology to mutate this gene. First, we designed gRNA Using CRISPOR Software to ensure high efficiency and specificity. Once the gRNA sequence was finalized, gRNA oligonucleotides were synthesized and adapter sequences were synthetically integrated into the designed gRNA to mimic a cut BsaI restriction site, facilitating the downstream steps in molecular cloning.

Double digestion of pRGEB31 vector

The pRGEB31 vector is a CRISPR/Cas9-based binary vector designed for genome editing in plants. It has two BsaI restriction sites inserted on two opposite strands at a distance of 20bp. Once cut with BSaI restriction enzyme, it gives cut at two places leaving a 20bp region from the vector.

Preparation of gRNA Duplex for ligation

The synthesized gRNA oligonucleotides were annealed to form a double-stranded gRNA duplex. This step was carried out using PCR.

Ligation of prepared gRNA duplex and double digested pRGEB31 vector

The prepared gRNA duplex was then ligated into the double-digested pRGEB31 vector using T4 DNA ligase. This step enabled the seamless integration of the gRNA sequence into the plasmid backbone.

Characterization of DH5α Cells for Antibiotic Resistance

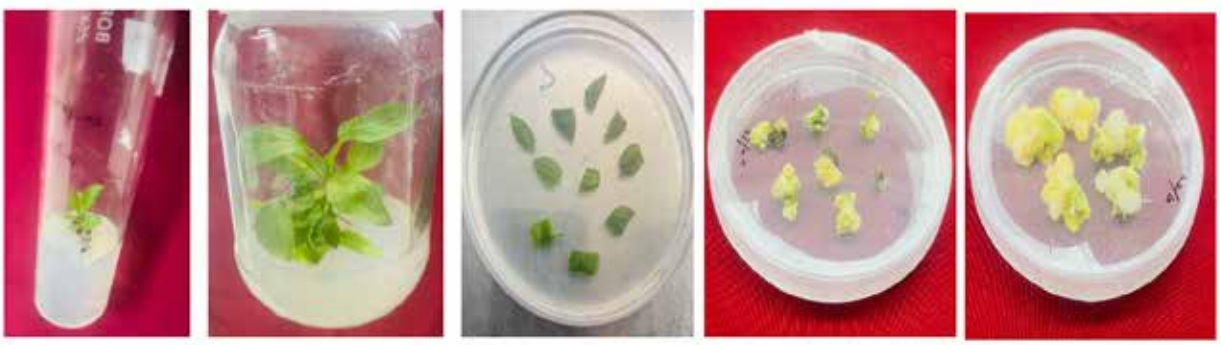
Before transformation, DH5α cells were characterized for their resistance or sensitivity to various antibiotics by plating them onto LB agar plates containing ampicillin, kanamycin, rifampicin, and a combination of kanamycin and rifampicin. This step ensured that the bacterial strain used for transformation was susceptible to these antibiotics, which are essential for selection after transformation.

Transformation of DH5α Cells with the ligation mixture

Competent DH5α cells were transformed with the ligation mixture of double digested vector and prepared gRNA insert. The transformation was performed using heat shock method, where bacteria were briefly exposed to 42°C to facilitate plasmid uptake and then plated onto the kanamycin containing LB agar plates for selection purposes. Only successfully transformed colonies containing the pRGEB31 plasmid (with or without the gRNA insert) were expected to survive under kanamycin selection pressure.

Screening of Recombinant Colonies via Colony PCR

To confirm the presence of the gRNA insert within the vector, colony PCR was performed on selected transformants. This step is still ongoing to validate successful cloning and identify recombinant colonies carrying the gRNA construct.



Culturing of nodal segments for plantlets and leaf discs for callus culture

Regeneration from leaf disc in apple

Nodal segments collected from field were used for culture and development of plantlets. The nodal segments (1-1.5 cm) was cultured in induction medium constituting MS medium supplemented with BAP (0.5 mg L^{-1}) and IBA (0.2 mg L^{-1}). Subculturing was done at fortnight interval for micro-shoot initiation and multiplication. Leaf-discs from the cultured plantlets were used as an explant for the callus culture. MS medium supplemented with plant growth regulators (auxin and cytokinin) at different concentrations were used. MS medium containing 2,4-D (2.0 mg L^{-1}) and TDZ (0.1 mg L^{-1}) noted with 100 percent callusing with least days taken for callusing (14.33 days).

All India Network Project on Vertebrate Pest Management (AINP-VPM)

Habitat analysis and distribution of major vertebrate pests

Seasonal activity of rodents in apple orchards

The activity of rodents was monitored in a high-density apple orchard at ICAR-CITH, Srinagar from April to September at biweekly interval. The apple orchard has *Gala Redlum*, *Red Velox* and *Golden Delicious Reindeers* on M9 rootstock having age of 6-7 years. The rodent activity was monitored with Sherman traps (7.6 × 8.9 × 22.8 cm) and Snap traps (16 × 8 × 2 cm) loaded with bait consisting of an apple slice and some peanut butter. The orchard floor was tilled occasionally to control the weed growth and has drip system of irrigation in place. The traps were checked for rodents every morning and deployed again with fresh bait in the evening. The collected rodents were euthanized with CO_2 and stored in ethanol after noting down the basic morphometric data. The incidence varied over the sampling dates with an increasing trend with gradual progress in season. Voles, field mouse, rats and shrews were collected from the apple orchards (Fig. 17). The predominant species identified include *Rattus rattus* (Linnaeus), *Mus booduga* (Gray), *Bandicota bengalensis* (Gray), *Alticolastoliczkanus*(Blanford), and *Sunchus murinus* (Linnaeus).

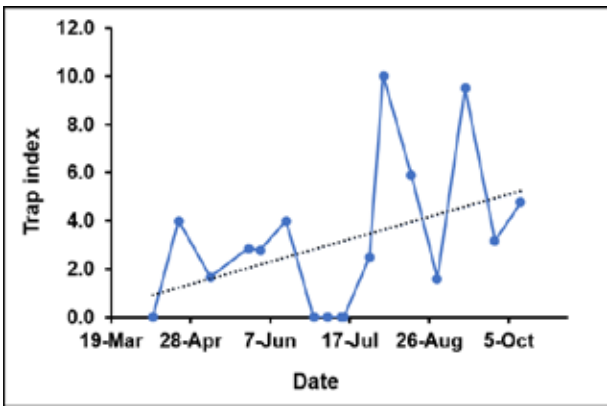


Fig. 17. *Seasonal activity of rodents in high-density apple orchards at Srinagar*

Development of portable euthanasia system for rodents

As carbon dioxide (CO_2) based euthanasia is considered as the best method for rapid death of small animal and rodents, a portable system for quick and safe euthanasia system was developed for use. For this purpose, 4 Kg CO_2 were used and connected to an air tight rectangular plastic container of 5 L capacity through a hose. A pressure regulator is used to regulate the flow of gas to the plastic container. The CO_2 gas is fed in to the plastic box at the bottom level through one side and an exit hole is provided for the air to escape through the top level on the opposite side. The exhaust hole is connected by a plastic pipe and the other end of the pipe is kept immersed in water in a jar. The rodent samples either directly or along with the traps are placed inside in the plastic container and the lid is tightly closed. The CO_2 is released in to the plastic container for 25-30 seconds and then cut off. The rodents to be killed are kept in the container for 4-5 minutes before opening the lid and further processing of the rodent specimen.

Indigenously developed Carbon dioxide based euthanising setup for rodent samples.

Assessment of losses due to vertebrates in predominant cropping systems.

Assessment of nature and quantum of losses due to rodent damage in high-density apple orchards

The high- density apple orchards on clonal rootstock M9 were surveyed for damage by rodents across various locations. The plants were found to be damaged either in the root system or the trunk up to 1 foot from ground level. The rodents were found to feed on bark of the trunk resulting in girdling and loss vascular tissues (phloem and cambium). The damage to roots was inflicted by chewing off all feeder roots leaving behind the main anchor root. The apple plants showed symptoms of wilting in the early season followed by reddening of bark. At later stage, the damaged plants had leaves with reduced size and the fruit size also decreased significantly. By the end of season, the plants became completely wilted and died off. The incidence of plants dying due to rodent damage was found in the range of 2-8% (n = 16) for the surveyed orchards. In the worst-case scenario, 16.66% apple plants on M 9 died due to rodent damage in a high-density apple orchards in Srinagar and had to be replanted.

Apple plants damaged by rodents.

Appraisal of the Dual Ecosystem Services of Syrphid Flies in Apple Orchards: Pollinators and Bioagents

Species composition and abundance of predatory syrphids associated with apple pests

The syrphid flies associated with apple orchards were collected by sweep netting, pinned and identified with the help of available literature. Ten species of syrphids were found foraging in and around the apple orchards. The identified species include *Eristalis* (*Eoseristalis*) *arbustorum* (Linnaeus, 1758), *Eristalis* (*Eoseristalis*) *cerealis* Fabricius, 1805, *Eristalis* (*Eristalis*) *tenax* (Linnaeus, 1758), *Eristalinus*(*Eristalinus*) *megacephalus* (Rossi, 1794), *Eristalinus* (*Eristalodes*) *paria* (Bigot, 1880), *Ischiodonscutellaris* (Fabricius, 1805), *Sphaerophoriascripta* (Linnaeus, 1758), *Sphaerophoria* (*Sphaerophoria*) *bengalensis*Macqaurt, 1842, *Episyrphusbalteatus* (De Geer, 1776), *Eupeodescorollae* (Fabricius, 1794), *Eupeodes confrater* (Wiedemann, 1830), and *Scaevapyrastri* (Linnaeus, 1758). Species identity was further confirmed by generating mitochondrial partial COI gene sequences. Total genomic DNA was isolated from individual samples using DNA extraction kit (Qiagen DNeasy Blood & Tissue Kit) and was quantified using Nano drop (Thermoscientific, Leon-Rot, Germany). PCR was performed in a thermal cycler (Applied Biosystems 9700) as per the standard protocol. The primers used were Sense, LCO-1490; 5′ -GGTCAACAAATCATAAAGATATTG G-3′ and Antisense, HCO-2198;

Eristalisarbustorum

Eristalis tenax

Sphaerophoria scripta

Sphaerophoria scripta

Predominant species of syrphid flies associated with apple orchards

5 , - T A A A C T T C A G G G T G A C C A A A A AATCA-3,. The amplified products were checked on 1.0% agarose gel which was stained with ethidium bromide (10 µg/ml) and visualized in a gel documentation system. The desired DNA fragment was sequenced by employing 3500 Genetic Analyser, Applied Biosystems (Hitachi). The nucleotide sequence was processed and submitted to GenBank under BioProject PRJNA1236226 and accession number was obtained (PV290320-PV290326, PV361699-PV361706, PV278669).

Characterizing Diversity, Genome Profile and Development of Robust Diagnostics for Diplodia spp. Associated with Canker Disease of Apple (*Malus domestica* Borkh.) in North Western Himalayan Region of India

Genome sequencing, identification and functional validation of pathogenesis related genes of Diplodia spp.

The Whole genome assembly and annotation of *Diplodia bulgarica* using PacBio Hi Fi and Ilumina paired end reads was carried out through outsourcing from Nucleome Informatics Private Limited Hyderabad. High molecular weight DNA was isolated using Qiagen DNeasy Power Soil Pro (Cat. No: 47014). Quantification and purity ratios were checked with Nanodrop 2000 Spectrophotometer (Thermo Fisher Scientific, MA, USA) & Qubit 4 (High Sensitivity DNA assay kit), and Agarose Gel Electrophoresis (1%

Agarose Gel) respectively. The integrity of DNA was evaluated on 1% agarose gel and on Agilent FEMTO pulse analyser, DNA size was estimated (Agilent Technologies, California, USA). After purification, SMRT library size was prepared, and after size selection was analyzed using Agilent FEMTO pulse analyser (Agilent Technologies, California, USA). The library was constructed using the SMRTbell Express template Preparation Kit 3.0 (Pacific Biosciences, California, USA) as per manufacturers' protocol. The prepared library was purified using AMPure PB beads (Pacific Biosciences, California, USA). AMPure PB beads size selection carried to remove fragments shorter than 5 kb size. Selected SMRT libraries were purified then subjected to primer annealing, polymerase binding using Sequel II binding kit 3.2 to prepare bound complex. About 90 pM of the library was loaded on SMRTcell containing 8M ZMW and sequenced in PacBio Sequel II system in CCS/HiFi mode. According to the effective concentration of library and output requirements, the sample is sequenced on PacBio Sequel II platform and Illumina HIseq.

The genomic data of 265.63 Gb generated for the samples *Diplodia bulgarica* using the PacBio Sequel II platform. Subsequently, the reads underwent assembly utilizing the Flye assembler, resulting in assemblies comprising 23 contigs with total length of 40924488bp (40.92Mb). The application of Illumina reads for polishing via Pilon led to incremental improvements in total assembly length, resulting in 40924595 (40.92Mb) for *Diplodia bulgarica*, with an equivalent number of contigs. EffectorP was then employed to analyze the refined set of secretory proteins. This analysis identified 168 putative secretory effector proteins in *Diplodia bulgarica*CBS 124136. Several SSR makers were designed across genome for ascertaining the diversity existing within the Diplodia isolates.

Development of easy and robust species specific diagnostics for easy detection and further prevention

Two molecular markers were developed for species specific as well simultaneous detection of *Diplodia bulgarica*& *Botryosphaeria dothidea*

Development of Edible Coating Enriched with Anti-Microbial Bioactive Compounds for Various Stone Fruit

Under this project, the gummosis samples collected from different crops viz. cherry, apricot, peach, nectarine, and almond, were extracted and purified by ultrasonication method (60% amp and 30 min). The purified gummosis from cherry tress had least presence of pigments (whitish colour) and finest sized particles followed by apricot. Although, the quantity collected after purification was comparable in all samples except peach, that produced purified gum with maximum intensity of pigmentation, also quantity was comparatively less. On basis of preliminary study, gummosis collected from cherry trees was screened for further ultrasonication process standardization.

Purified gummosis samples of (1) Cherry, (2) Almond, (3) Apricot, (4) Nectarine and (5) Peach crops using ultrasonication treatment

After identification and screening of source of gummosis, the experimental layout comprising gummosis solution concentration in distilled water (3, 5 and 7%), ultrasonication amplitude (40, 50 and 60%) and time (10, 20 and 30 min) was performed for optimization of extraction and purification process based on ultrasonication. The response surface methodology based on a three-factor, three-level, Box Behnken design was employed to analyse the effect of the independent variables and optimise the processing conditions. The pure gummosis yield (%) and colour value (l*) of purified gummosis were taken as the dependent factors. The coefficient of determination R^2 (pure gummosis yield, %: 0.84) and standard deviation (7.49%) of quadratic model satisfactorily explained the extraction and purification process. Whereas, the quadratic model of colour (l*)

was statistically non-significant with R^2 0.60. Therefore, the optimization of purification process was done based on pure gummosis yield alone and at optimized parameters with desirability of 94.07 per cent.

All India Network Research Project on Onion & Garlic

The All India Network Research Project on Onion & Garlic was implemented at ICAR CITH, Srinagar and its Regional station, Mukteshwar. The silient findings are presented below:

ICAR-CITH, Srinagar

The experiments for the year 2023-24 were conducted during 2024. Under sub-project 'Crop Improvement' experiments were conducted for morpho-agronomic evaluation of two germplasm sets (103 and 50 lines) of onion; three germplasm sets of garlic (85, 19 and 18 lines); hybridization between long day/ exotic & short day onion followed by mass selection; clonal selection in long day garlic and flowering induction & true seed production in garlic and varietal & hybrid trials in red onion, white high TSS onion, short day onion, long day onion, short day garlic and long day garlic were conducted at IET (3 trials), AVT-I (14) and AVT-II (13) levels for 59 entries.

Under sub-project 'Crop Production' three experiments were conducted. These were 'weed management studies in onion seed crop' involving 6 treatments pertaining to chemical (oxyflurfen and quizalofop) and physical weed control, 'Effect of nano-urea on growth, yield and quality of onion' involving 15 treatments having different nitrogen formulations (nano urea and granular urea) & concentrations and 'Fertilizer scheduling through drip fertigation for long day onion' with 8 different treatments of fertilizers in combination with different irrigation methods (drip irrigation and flood irrigation).

Under sub-project 'Crop Health Management', two trials namely 'Management of diseases and pests in garlic' with 8 pesticide treatments and 'Evaluation of insecticide/ miticides against sucking pests and mites of garlic' involving six pesticide treatments were conducted in addition to survey and monitoring of insect-pests and diseases of onion and garlic in different districts of Kashmir valley.

Field view of some experiments

Under this project, 21.50 Kg TL seed of onion (Brown Spanish and Yellow Globe) and 2.70 quintal breeder seed of garlic (CITH-G-1 and CITH-G-3) was produced.

ICAR- CITH, Regional Station Mukteshwar

The salient findings obtained from different experiments t Regional station Mukteshwar are presented below:

Long day garlic

In IET trial, total eight genotypes were evaluated during *Rabi* extended summer 2023-2024 and maximum TSS was recorded in GNA 23-17(45.90 °B) followed by GNA 23-04(43.57°B), GNA 23-09 (43.57°B) while, the minimum TSS was observed in GNA 23-02(31.47°B) with general mean of TSS was 41.35°B. The maximum total weight/plot was recorded in cultivar *i.e.* GNA 23-05 (3.45 kg/plot with 172.43 q/ha yield) followed by GNA 23-19 (2.66 kg/plot with 132.90 q/ha yield), GNA (2.11 kg/plot with 105.40 q/ha yield).

In AVT-I trial, total twelve genotypes were evaluated during *Rabi* extended summer 2023-2024 and maximum TSS was recorded in GNB 23-26 (44.50 °B) followed by GNB 23-47 (43.50°B) and GNB 23-29 (42.97°B). The highest yield was recorded in GNB 23-55 (217.43 q/ha) followed by GNB 23-58 (164.70 q/ha) and GNB 23-50 (156.03 q/ha) respectively.

In AVT-II trial, total seven genotypes were evaluated during *Rabi* extended summer 2023-2024 and maximum TSS was recorded in GNC 23-77 (44.53 °B) followed by GNC 23-61 (42.33°B) and GNC 23-79 (40.93°B). The highest yield was recorded in GNC 23-79 (180.80 q/ha) followed by GNC 23-81 (136.77 q/ha) and GNC 23-77 (104.40 q/ha) respectively.

Long day red onion

In IET trial, total five genotypes were evaluated during *Rabi* 2023-2024 and the highest total weight was observed in RAV-23-21 (7.01 kg/plot with 311.50 q/ha) followed by RAV-23-19 (6.28 kg/plot with 279.05 q/ha yield). However, the highest TSS was recorded in RAV-23-07 (14.50 °B) followed by RAV-23-03 (13.57 °B), RAV-23-21 (12.53 °B), respectively and general mean recorded for TSS was 12.99 °B. The highest marketable yield was recorded in RAV-23-21 (308.39 q/ha) followed by RAV-23-19 (277.96 q/ha).

In LDR-AVT-I trial, total nine genotypes were evaluated and the highest total yield was observed in RBV-23-50 (10.23 kg/plot with 454.79 q/ha yield) followed by RBV-23-27(8.53 kg/plot with 379.24 q/ha yield), RBV-23-24 (7.23 kg/plot with 321.24 q/ha), respectively. However, the highest TSS was recorded in RBV-23-44 (14.20 °B) followed RBV-23-17 (13.87 °B), RBV-23-41 (13.83 °B) respectively. The highest marketable yield was recorded in RBV-23-50 (442.21 q/ha) followed by RBV-23-27 (375.76 q/ha), RBV-23-24 (316.27 q/ha), respectively.

In LDR -AVT-II trial, total eight genotypes were evaluated during *Rabi* 2023-2024 and the highest total yield was observed in RCV-23-72 (8.45 kg/plot with 375.35 q/ha) followed by RCV-23-98 (6.06 kg/plot with 269.50 q/ha), RCV-23-67 (5.60 kg/plot with 249.07 q/ha), respectively. However, the highest TSS was recorded in RCV-23-70 (14.97 °B) followed by RCV-23-98 (14.57 °B), RCV-23-78 (13.83 °B) respectively. The highest marketable yield was recorded in RCV-23-72 (364.18 q/ha) followed by RCV-23-98 (260.01 q/ha), RCV-23-64 (234.33 q/ha), respectively.

Long day red onion hybrid

In LDR-IET HY on long day red onion, total five genotypes were evaluated during *Rabi* 2023-2024 and the highest total yield was observed in RAH-23-62 (1.39 kg/plot with 61.78 q/ha) followed by RAH-23-51 (1.28 kg/plot with 56.74 q/ha), RAH-23-60 (1.24 kg/plot with 54.90 q/ha) respectively. However, the highest TSS was recorded in RAH-23-59 (14.43 °B) followed by RAH-23-55 (14.33 °B), RAH-23-51 (13.60 °B), respectively. The highest marketable yield was recorded in RAH-23-62 (60.74 q/ha) followed by RAH-23-51 (56.30 q/ha), RAH-23-60 (52.47 q/ha), respectively.

In LDR-HY-AVT-I, total five genotypes were evaluated during *Rabi* 2023-2024 and the highest total yield was observed in RBH-23-75 (6.12 kg/plot with 271.88 q/ha) followed by RBH-23-71(5.75 kg/plot with 255.69 q/ha), RBH-23-87(3.80 kg/plot with 169.01 q/ha), respectively. However, the highest TSS was recorded in RBH-23-83 (15.00 °B) followed by RBH-23-81(14.57 °B), RBH-23-75 (14.07 °B) respectively. The highest marketable yield was recorded in RBH-23-75 (270.31 q/ha) followed by RBH-23-71 (245.05 q/ha), RBH-23-83 (157.99 q/ha), respectively.

In LDR-HY-AVT-II, total six genotypes were evaluated during *Rabi* 2023-2024 and total yield was observed in RHC-23-65 (6.74 kg/plot with 299.61 q/ha) followed by RHC-23-90 (6.67 kg/plot with 296.47 q/ha), RHC-23-95(5.23 kg/plot with 232.56 q/ha), respectively. However, the highest TSS was recorded in RHC-23-97 (14.63 °B) followed by RHC-23-88 (14.47 °B), RHC-23-90 (14.30 °B) respectively. The highest marketable yield was recorded in RHC-23-65 (295.67 q/ha) followed by RHC-23-90 (288.03 q/ha), RHC-23-93 (211.67 q/ha), respectively.

Long day white onion

In IET trail, total five genotypes were evaluated during *Rabi* 2023-2024and the highest total yield was observed in WAV 23-13 (4.06 kg/plot with 180.47 q/ha) followed by WAV 23-10 (3.75 kg/plot with 166.49 q/ha), WAV 23-15 (3.35 kg/plot with 148.83 q/ha) respectively. However, the highest TSS was recorded in WAV 23-10 (13.53

°B) followed WAV 23-15 (13.23 °B) WAV 23-06 (13.10 °B) ,respectively. The highest marketable yield was recorded in WAV 23-13 (174.96 q/ha) followed by WAV 23-10 (161.49 q/ha), WAV 23-15 (134.67 q/ha), respectively.

All India Coordinated Research Project (Vegetable Crops) -AICRP (VC)

During 2024, under the sub-project 'Collection, evaluation, conservation and utilization of germplasm', twenty new collections were made in paprika, chilli, kale, kohlrabi, pakchoi, komatsuna, tatsoi, Indian mustard and Chinese cabbage collections were made. In addition, germplasm collected during previous years was conserved and evaluated for important traits. In kale, the leaf yield of germplasm ranged from 188.06 to 284.83 q/ha. Improved Dwarf Siberian (284.83) performed better than check GM Dari (222.86) for leaf yield per hectare. In kholrabi, the knob yield ranged from 186.35 to 212.09 q/ha and there were no significant differences among collections.

In paprika, the red ripe fruit yield of the 40 germplasm ranged from 62.30 to 212.50 q/ha (Table 28. Four genotypes, namely, CITH Paprika-41 (212.50), CITH-Paprika-2 (204.2), CITH-Paprika-5 (182.50), CITH-Paprika-3 (175.90) performed better than the check KTPL-19 (117.10).

AICRP-VC
Tatsoi: *Brassica rapa ssp. narinosa*

AICRP-VC
Kale: *Improved Dwarf Siberian*

Table 28. Plant and fruit characterstics of different Paprika genotypes

Sr. No	Entry/ Genotypes	Plant height (cm)	Plant spread (cm)	Fruit length (cm)	Fruit width (cm)	Average fruit weight (g)	Red ripe fruit yield (q/ha)
1	CITH Paprika-1	86.00	60.94	10.53	1.62	10.33	77.82
2	CITH Paprika-2	88.33	76.50	12.45	1.76	9.00	204.20
3	CITH Paprika-3	66.67	57.89	10.17	2.01	8.67	175.90
4	CITH Paprika-4	72.44	47.22	6.33	2.21	8.67	102.05
5	CITH Paprika-5	74.89	52.78	10.66	2.08	11.33	182.50
6	CITH Paprika-6	66.22	61.00	6.44	1.90	8.67	96.30
7	CITH Paprika-7	79.33	56.89	11.31	2.13	9.00	145.79
8	CITH Paprika-8	67.44	55.50	7.24	1.60	9.67	98.03
9	CITH Paprika-9	62.67	45.22	9.55	1.93	11.67	120.92
10	CITH Paprika-10	74.44	47.44	6.74	1.86	9.33	129.95
11	CITH Paprika-11	82.67	65.83	9.89	2.12	11.33	170.12
12	CITH Paprika-12	104.67	66.33	7.10	3.00	10.67	102.60
13	CITH Paprika-13	81.44	46.72	9.04	1.92	10.33	83.60
14	CITH Paprika-14	71.67	43.28	7.52	2.99	10.67	88.90
15	CITH Paprika-15	64.33	55.42	4.75	3.00	10.67	69.90
16	CITH Paprika-16	97.44	63.17	9.00	2.74	11.00	123.40
17	CITH Paprika-17	83.83	58.33	6.31	3.43	10.00	78.10

Sr. No	Entry/ Genotypes	Plant height (cm)	Plant spread (cm)	Fruit length (cm)	Fruit width (cm)	Average fruit weight (g)	Red ripe fruit yield (q/ha)
18	CITH Paprika-18	87.11	64.44	5.57	3.40	9.00	100.00
19	CITH Paprika-20	80.33	47.67	8.40	3.11	10.67	84.20
20	CITH Paprika-22	75.22	47.78	7.89	2.14	8.00	69.70
21	CITH Paprika-24	77.89	51.67	7.17	2.14	8.00	62.40
22	CITH Paprika-25	74.44	66.33	8.08	2.93	8.33	92.30
23	CITH Paprika-26	77.67	59.11	10.58	1.53	7.00	100.70
24	CITH Paprika-28	74.78	53.33	8.41	1.92	9.33	143.10
25	CITH Paprika-29	80.33	53.22	7.93	1.67	10.00	83.20
26	CITH Paprika-30	85.55	49.39	9.41	2.01	10.00	76.60
27	CITH Paprika-31	82.55	55.50	6.88	2.23	9.33	94.00
28	CITH Paprika-32	87.22	58.33	10.61	2.20	9.67	123.00
29	CITH Paprika-33	90.33	69.11	9.09	2.50	8.67	117.90
30	CITH Paprika-34	81.22	58.33	10.47	1.27	6.00	82.30
31	CITH Paprika-36	89.55	51.78	9.35	1.48	10.00	87.60
32	CITH Paprika-37	83.67	51.61	7.32	1.65	13.33	166.90
33	CITH Paprika-39	75.22	41.67	9.05	2.17	9.00	96.20
34	CITH Paprika-40	76.00	54.05	9.74	1.72	13.67	170.66
35	CITH Paprika-41	85.78	70.11	8.98	1.67	11.67	212.50
36	CITH Paprika-42	81.78	47.61	8.50	2.01	11.33	95.50
37	CITH Paprika-10-1	80.67	42.89	7.09	2.87	10.67	85.00
38	CITH Paprika-5-1	95.67	70.67	11.42	2.87	11.67	95.20
39	CITH Paprika-6-1	84.11	59.50	5.82	3.15	12.00	155.80
40	KTPL-19 (C)	89.78	39.67	9.07	2.48	8.67	117.10
	CD (p≤0.05)	19.98	13.59	1.62	0.51	N.S.	58.27
	CV (%)	15.26	14.9	11.47	14.27	22.63	31.63

CITH-Paprika-8

CITH-Paprika-13

In 14 chilli germplasm, the red ripe fruit yield ranged from 100.66 to 159.60 q/ha. CITH-Chilli-12 (159.60) and CITH-Chilli-10 (137.30) performed better than the check Arka Lohit (112.09) for red ripe fruit yield.

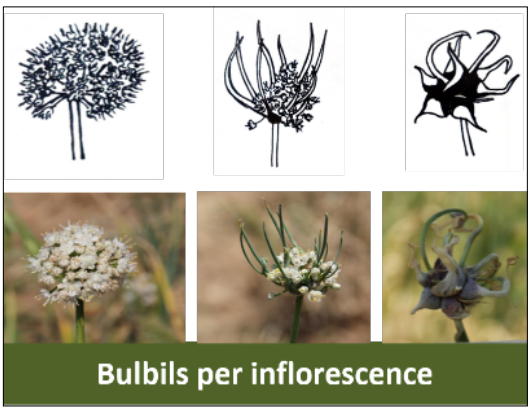
Under sub-project 'Varietal and hybrid trials', 9 AVT-I and 7 AVT-II capsicum variety, 6 AVT-II determinate tomato variety, 8 AVT-II chilli hybrid, 6 AVT-II determinate tomato hybrid and 7 AVT-II cabbage hybrid entries were tested.

Development of DUS Test Guidelines for Vegetable Kale (*Brassica oleracea* L. var. Acephala)

DUS test guidelines for kale were developed using 62 lines involving 54 descriptors.

Development of DUS Test Guidelines for *Pran* (*Allium x proliferum*)

DUS test guidelines for Pran were developed using 17 accessions involving 42 descriptors.



4
MEETINGS, EVENTS AND MOU SIGNED

ICAR-CITH, Srinagar is regularly organizing different meeting/ events/ MOU's s for benefit of stakeholders from across the country. During 2024, institute organized majority of meetings and events on physical mode. Institute has organized number of programmes and participated in the programmes organized by other agencies as resource persons. The events and meetings organized by ICAR- CITH, Srinagar and its Regional Stations *viz*. Mukteshwar & Dirang are presented below and summarized in the Table 29.

Three Days Training workshop organized on Orchids

In a groundbreaking initiative, the ICAR-National Research Centre for Orchids (ICAR-NRCO), ICAR-Central Institute of Temperate Horticulture (ICAR-CITH) and Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir (SKUAST-K) organized a three-day training workshop on introducing exotic orchids to Kashmir from 1st to 3rd August, 2024. The workshop, themed 'Exotic Orchids for Paradise on Earth,' aimed to revolutionize floriculture in the region by promoting the cultivation of these exquisite flowers. The inaugural ceremony held was graced by Mr Manzoor Ahmad Qadri, Director General (Floriculture), Government of Jammu and Kashmir. Dr. M. K Verma, Director, ICAR-CITH, Srinagar, Dr S. P Das, Director NRC Orchids, Dr. Imtiyaz T Nazki, Professor and Head, Division of Floriculture and Landscape Architecture, SKUAST-K, Dr. Neelofar, Professor and Dean Students Welfare, SKUAST-K, Dr Zahoor Ahmad Kaloo, Head Department of Botany, University of Kashmir were also present on the occasion. The workshop featured a special session addressed by the Vice-Chancellor, SKUAST-K, and technical sessions on the floriculture potential in Jammu & Kashmir, production technology of *Cymbidium* and *Paphiopedilum* orchids, improvement and propagation techniques in orchids, and hands-on training on tissue culture and cultivation of *Cymbidium* orchids. The workshop witnessed enthusiastic participation from officers of the Floriculture Department, Government of Jammu and Kashmir, scientists and technical staff of ICAR-CITH, faculty and students from the Division of Floriculture and Landscape Architecture, SKUAST-K. To further boost the initiative, two units of 200 *Cymbidium* orchid plants each were established at ICAR-CITH and SKUAST-K, with plants brought from ICAR-NRCO, Sikkim. This will enable the study of the performance of *Cymbidium* hybrids in the valley. The state government officials, ICAR-CITH, and Faculty of Floriculture, SKUAST-K are keen on making concerted efforts to ensure the successful establishment of orchids in the valley. This initiative aims to extend the tourist season





Glimpses of training workshop on orchids

Table 29. List of various events organized during the year 2024

S. No	Event	Date	Organizers/ Coordinators
1	Three Days Training workshop on Orchids	1st to 3rd August, 2024	M K Verma, O C Sharma, J I Mir & Uzma Mehraj
2	Brain Storming Session on the Development of business modules for the cultivation of lettuce	26th April 2024	Geetika Malik & M K Verma
3	15th Annual Group Meeting (AGM) of All India Network Research Project on Onion & Garlic	29th to 31st August 2024	Geetika Malik & M K Verma
4	Workshop on Agri-food System in Indian Himalayan Region	3rd June, 2024	M K Verma
5	20th Institute Research Council Meeting	10th to 12th December,2024	J I Mir & Md Abas Shah
6	Allium Day	22nd May, 2024	Geetika Malik & Sudhakara N R
7	Three-day workshop on Genomic advances in disease diagnostics and management in temperate fruit crops	6 to 8th March 2024	S U Nabi & J I Mir
8	Awareness programme on producing healthy planting material for vegetatively propagated fruit crops	21st May, 2024.	S U Nabi
9	15th Institute Management Committee (IMC) Meeting	29th April, 2024	J I Mir & Administrative Officer
10	10th International Yoga	21st June, 2024	Sachin Kumar & Arun Kishore
11	Hindi Diwas and Hindi Week-2024	14th September 2024 to21st Sep, 2023	Geetika Malik & Vishal Dinkar

S. No	Event	Date	Organizers/ Coordinators
12	Vigilance Awareness Week	28th October to 3rd November, 2024	O C Sharma & Sadawarte Anand Rajesh
13	Labour Day	1st May, 2024	Anand Sadvarte & Eshan Ahad
14	National Conference on Development of Horticulture in Indian Trans Himalayan Region through Cooperatives and Collectives	14 to 15th March, 2024	M K Verma & J I Mir
15	Parthenium Week	16th to 22nd August, 2024	Vishal Dinkar & Sudhakara N R
16	Ek Ped Maa Ke Naam (#Plant4Mother)	17th September, 2024	Ronit Jaswal, Puneet Kumar, Sarath Kumar N, Sachin Kumar
17	Advisory Committee Meeting of NASF Funded Project	28th September, 2024	S U Nabi & J I Mir
18	Swachhta Abhiyan- Special Campaign 3.0	2nd October to 31st October, 2023	Puneet Kumar & Arun Kishore
19	Swachhta Pakhwara	16th to 31st December, 2023	Puneet Kumar& Arun Kishore
20	Ayurveda day	29th December, 2024	Anand Sadvarte & Eshan Ahad
21	National Farmers Day (*Kisan Diwas*)	23rd December, 2024	S U Nabi, Puneet Kumar, Md Abas Shah & Jyoti Priya

also, when the *Cymbidium* orchids will be in full bloom, thereby boosting the local economy. This collaborative effort marks a significant milestone in introducing exotic orchids to Kashmir, paving the way for a new era in floriculture in the region.

Brain Storming Session on the Development of business modules for the cultivation of lettuce

ICAR-CITH organised Brain Storming Session on the Development of business modules for the cultivation of lettuce under the temperate region through public private partnership on 26th April 2024 at ICAR-CITH Srinagar. Occasion was graced by Prof. Nazeer Ahmad Former Vice Chancellor (SKUAST -K) as Chief Guest, Dr Sudhakar Pandey, ADG (Horticulture) ICAR, New Delhi as Guest of honour, and Dr Pritam Kalia, Former Head, Vegetable Science, IARI, New Delhi. Panellists participated from SKUAST-K Srinagar,

Glimpses of Brain Storming Session on the Development of business modules for the cultivation of lettuce at ICAR-CITH, Srinagar

SKUAST-J Jammu, YSPUHF Solan Himachal Pradesh, VPKAS Almora Uttarakhand, CAU Passighat, DRDO- DIHAR Leh, NBPGR, IGFRI, IARI Katrain, NHB, OSI (Industry), Directorate of Agriculture Kashmir and Progressive Vegetable Growers. During the program, Dr Geetika Malik gave a detailed presentation on Present status, gaps and scope of lettuce research in Kashmir followed by other presentations and discussions. Director CITH, Dr MK Verma is thankful to each and every participant and also compliments to the CITH family for the organisation of the outstanding event at CITH Srinagar, J&K.

Fifteenth Annual Group Meeting (AGM) of All India Network Research Project on Onion & Garlic (AINRPO&G) Organized

Fifteenth Annual Group Meeting (AGM) of All India Network Research Project on Onion & Garlic (AINRPO&G) was jointly organized by ICAR- Central Institute of Temperate Horticulture, Srinagar and ICAR-Directorate of Onion & Garlic Research, Pune at ICAR-CITH Srinagar from 29th to 31st August 2024. The inaugural session was chaired by Dr. K. E. Lawande, Former VC, Dr. BSKKV, Dapoli (Chief Guest), Dr. Major Singh, Member, ASRB (Guest of Honour), Dr. Sudhakar Pandey, ADG (FVS & MP), Horticulture Science, ICAR, New Delhi, (Guest of Honour), Dr. Vijay Mahajan, Director, ICAR-DOGR, Pune and Dr. M. K Verma, Director, CITH, Srinagar. During AGM, different sessions on various aspects viz., crop improvement, crop production, crop protection and post harvest management were covered during three days. The AGM inaugural session was attended by scientists from various centres of the project across India, officials from the department of Agriculture, scientists from ICAR-CITH, Srinagar and SKUAST-K Srinagar, progressive growers, students and researchers. The inaugural session commenced with a warm welcome by Dr M.K Verma, Director ICAR-CITH. He expressed gratitude to all the participants, speakers, and organizers for their attendance and effort in bringing the annual meeting fruitful. Dr. Verma also highlighted the significance of the workshop's theme and the relevance of the topics to be covered. Dr. Vijay Mahajan, Director, ICAR-DOGR, Pune gave the detailed report of the project activities being carried out across all the centres of India. He informed that recently 30 varieties (onion and garlic) have been identified as suitable for cultivation at national level for different zones of the country. This includes one variety of Garlic (CITH-G-10), developed at ICAR-CITH Srinagar has been recommended for release in Hill zone-1 (J&K, HP, UK) of India. Dr. Sudhakar Pandey, ADG highlighted the importance of male sterile lines and biotechnological interventions in developing high yielding and pest and disease resistant varieties. Dr. Major Singh, Member, ASRB informed that the glut and price fluctuation of onion has been brought under considerable control due to the efforts of the ICAR institutes

Glimpses of various sessions of 15th Annual Group Meeting (AGM) of All India Network Research Project on Onion & Garlic

and the Network project. Dr. K. E. Lawande, informed that efforts are underway for developing high yielding hybrids in both the crops. Three publications on various aspects of production and protection of Kashmiri chilli, Cauliflower and Pran were released by the chief guest during the session. At last vote of thanks was delivered by Dr Geetika Malik, organizing secretary of 15th AGM of AINRPO&G. Later, new technologies and varieties developed by ICAR-CITH Srinagar and some progressive farmers were shown to the participants.

Workshop on Agri-Food System in Indian Himalayan Region Organized

One day workshop on Agri-Food Systems in the Indian Himalayan Region (IHR) was organized on 3rd June, 2024 at the Central Institute of Temperate Horticulture (CITH). The event brought together a host of scientists, national directors, and department heads from prestigious agriculture and allied research institutions. The workshop was graced by Prof. (Dr.) Nazir Ahmad Ganie, Vice Chancellor of SKUAST-Kashmir, as the chief guest while S.K. Chaudhari, Deputy Director General of National Resource Management (NRM), New Delhi chaired the event. M.K. Verma, Director of CITH, served as the organizing secretary. During the inaugural session, Prof. Nazir Ahmad Ganie provided a comprehensive overview of the possibilities and opportunities for creating a roadmap focused on economic development and food security in the Himalayan ecosystem. Dr. S.K. Chaudhari highlighted the workshop's importance and outlined strategic development possibilities for the Indian Himalayan Region. He underscored the necessity of addressing challenges in crop science, horticulture science, natural resource management, animal husbandry, fisheries, and other allied sectors to boost the region's economy. Dr. S.K. Chaudhari stressed the importance of addressing the diverse issues faced by the Indian Himalayan Region, which stretches from Kashmir to the Northeast states like Meghalaya and Arunachal Pradesh. He highlighted the visible impacts of climate change, such as landslides, heavy rainfall, and loss of biodiversity. Directors from 13 ICAR Institutes located in the Indian Himalayan Region presented concept notes aimed at developing a sustainable and strategic roadmap. Dr. M.K. Verma presented project proposals for crop diversification of temperate fruit crops and the promotion of nut crops to reduce imports and increase export possibilities. The event saw representation from all temperate states, including Jammu and Kashmir, Ladakh, Himachal Pradesh, Uttarakhand & NEH region. The workshop participants agreed to work on forming a base paper for research in the Himalayan region. The discussions aimed at identifying key areas for research collaboration

Glimpses of Workshop on Agri-food System in Indian Himalayan Region

and development strategies to enhance the region's agricultural sustainability and economic growth. The workshop concluded with a collective commitment to give new direction to agricultural development in the Indian Himalayan Region.

Allium Day

ICAR -CITH Srinagar celebrated *Allium* day on 22nd May, 2024 at ICAR -CITH Srinagar. The day was blessed by the auspicious presence of Dr. Vijay Mahajan, Director, ICAR- DOGR Pune as chief guest who is a renowned Scientist. Dr. M. K. Verma Director ICAR CITH welcomed the chief guest and highlighted about the achievements. The Program coordinator Dr. Geetika Malik presented about the *Allium* research achievements of the institute in detail while Dr. Sudhakara NR co coordinated the program. Scientists from SKUAST- Kashmir including some progressive farmers participated in this occasion. The chief guest visited the farm field and appreciated about the work being done by ICAR CITH Srinagar.

Glimpses of of Allium Day organized at ICAR-CITH, Srinagar

Three-Days Workshop on Genomic Advances in Disease Diagnostics and Management in Temperate Fruit Crops

A three three-day's workshop was organised under the SSR initiative of DST-SERB on, Genomic advances in disease diagnostics and management in temperate fruit crops" from 6 to 8th March, 2024 at ICAR-CITH Srinagar for

Glimpses of Three-day workshop on Genomic advances in disease diagnostics and management in temperate fruit crops at ICAR-CITH, Srinagar

faculties from colleges, universities and research institutes. During the workshop 8 lectures were organised from distinguished experts from ICAR-CITH, ICAR-IARI & SKUAST-K on various aspects of diseases diagnostics and management with special focus on molecular diagnostics like PCR, whole genome sequencing, next generation sequencing, isothermal approaches and resistance breeding with special focus on scab and root rot resistance in various temperate fruit crops. The workshop was attended by 25 participants from Kashmir University, SKUAST-K, ICAR-IGFRI, Degree colleges and ICAR-CITH Srinagar. Organizers are thankful to DST-SERB for funding and Director CITH for logistics for organising the workshop. Organizers thanks all participants and their concerned departments and universities for allowing them to participate in the workshop as well as to all external distinguished speakers Prof V K Baranwal, Dr Bilal A Paddar, Dr M D Shah, Dr Deeba Kamil and Dr Susheel K Sharma for delivering the valuable lectures in the workshop. The participants were highly satisfied with the program and urged for conducted such programs in future also.

Awareness Programme on Producing Healthy Planting Material for Vegetatively Propagated Fruit Crops

The ICAR-Central Institute of Temperate Horticulture (CITH), hosted a one-day awareness programme on producing healthy planting material for vegetatively propagated fruit crops on 21st May, 2024. The event aimed to enhance the production and productivity of temperate fruits through supply of high-quality and disease free planting material. Dr M K Verma Director ICAR-CITH highlighted the importance of production true to type and healthy planting material especially in perennial fruit crops. Experts from ICAR-IARI New Delhi, SKUAST-K, the Department of Horticulture Kashmir & ICAR-CITH stressed the importance of production of virus-free planting material. Prof. V.K. Baranwal, National professor from ICAR-IARI New Delhi highlighted the global impact of viruses on temperate fruits and the need for rigorous virus testing and ultimately the production of clean plants. Nursery growers discussed implementing virus testing protocols to ensure high-quality, disease-free plants. The programme emphasized continuous education and training for sustainable temperate fruit cultivation. Director CITH thanked to all the stakeholders who participated in the program.

Glimpses of Awareness programme on producing healthy planting material

15th IMC Meeting

The 15th Institute Management Committee (IMC) Meeting was conducted under the chairmanship of Dr M K Verma Director CITH Srinagar on 29th April, 2024. The committee meeting was attended by Dr V B Patel ADG Horticulture-ICAR-New Delhi, Director Research SKUAST-K, Director Horticulture-Kashmir, HOD Horticulture from ICAR-IARI, ICAR-CISH, SKUAST-K and other members from various institutes and organizations. The committee discusses the issues related to the institute and also approves for suitable action. Later Plant Virology Lab was also inaugurated by Dr V B Patel (ADG Horticulture) in the presence of Dr M K Verma (Director CITH Srinagar)

Glimpses of IMC Meeting and in inaugural of plant virology lab

and Lab Incharge Dr Sajad Un Nabi (Scientist plant pathology) and other scientific staff of the institute.

20th Institute Research Council meeting

The 20th Institute Research Council meeting of ICAR-CITH, Srinagar was held from 10th to 12th December, 2024 under the chairmanship of Dr MK Verma. All the scientist of main campus, and Regional Stations attended the meeting in physically. Dr D B Singh, Ex Director also invited as external expert. All scientists gave presentation of their on going research work in detail and new

Glimpses of 20th IRC Meeting

work to be started. The Chairman, external expert and house critically reviewed the projects and suggested critical inputs. The Director also gave future line of action for the Institute. Some new project proposal were also approved by the house.

Vigilance Awareness Week

ICAR- Central Institute of Temperate Horticulture, Srinagar observed Vigilance Awareness week from 28th October to 3rd November, 2024. The theme of the Vigilance Week was **"सत्यनिष्ठा की संस्कृति से राष्ट्र की समृद्धि"** (Culture of Integrity for Nation's Prosperity). The programme was started with welcome address by Administrative Officer and importance of vigilance week on 28th October, 2024 followed by address of Dr M K Verma, Director who emphasized to adopt various practices for achieving transparency, accountability and corruption free governance. A Pledge ceremony was held in which all staff members took pledge. All the staff of the institute (23) took part in observance of vigilance awareness week with enthusiasm and zeal. Dr O C Sharma and other Scientists also emphasized for creation of awareness and regarding organization of awareness campaign and e pledge. Many staff took e pledge also. At inaugural function, the participants shared their views on vigilance awareness and how we, as common man, can contribute to making India a corruption free nation. Posters were displayed at various locations at main campus and its units for benefit of people. Dr M K Verma, Director, ICAR-CITH, urged the staff to work in rule frames. He also told about the ways by which we can reduce the corruption and how individual can contribute for its eradication. The vigilance awareness week was also celebrated at ICAR-RS Mukteshwar. A

Discussion and pledge during Vigilance Week & Awareness regarding vigilance week for students

discussion on vigilance week was also held with a group of 37 students from district Kargil during their visit to Institute on 28th October, 2021.

National Conference on Development of Horticulture in Indian Trans Himalayan Region through Cooperatives and Collectives

Two days National Conference on Development of Horticulture in Indian Trans Himalayan Region through Cooperatives and Collectives, organized by World Cooperation Economic Forum in collaboration with ICAR-Central Institute of Temperate Horticulture (CITH), Srinagar, Confederation of NGOs of Rural India (CNRI), National Cooperative Union of India (NCUI) from 14th to 15th March, 2024 at SKUAST-K, Shalimar, Srinagar. The important dignitaries who expressed their views were Dr Ramesh Chand, Prof Nazir Ahmed Ganai, Vice Chancellor, Dr RB Singh, Faiz Ahmad Kidwai, Additional Secretary MOA&FW, Dileep Sanghani, Dr Rajvir Sharma, Dr Amitabh Kundu, Ms Neel Kamal Darbari, Amit Vyas-MD Amul, Dr M K Verma, Dr SK Singla, Shri RG Agarwal-Group Chairman, Dhanuka, Binod Anand, Secretary General CNRI, Director Agriculture, Director Horticulture Kashmir etc participated and deliberated on way forward in horticulture development in Trans Himalayan region of India. At the end of the programme the CNRI has

Glimpses of National Conference on "Development of Horticulture in Indian Trans Himalayan Region through Cooperatives and Collectives

conferred various awards to the distinguished persons in various fields of their expertise. Dr M K Verma was also conferred with 1st Manish Anand Memorial Award during the conference.

International Yoga Day

ICAR-Central Institute of Temperate Horticulture observed 10thInternational Yoga Day on 21st June, 2024 at ICAR-CITH, Srinagar. The theme was Yoga for Self and Society. The staff of ICAR-CITH, Srinagar also enthusiastically participated in the program and showed extra zeal and enthusiasm while performing and participating in this great event. In the programme organized at ICAR-CITH main campus, Dr. M. K. Verma, Director (ICAR-CITH, Srinagar) highlighted the importance including its history and need of yoga invigorating overall mental and physical status of a person, meditation and spread the message about establishing harmony between mind and body by mean of Yoga. Dr Sachin Kumar gave demonstration of various basic exercises and yoga and all participants performed various exercises and asanas. At Regional Station Mukteshwar, Dr. Arun Kishore briefed about importance of Yoga Day followed by demonstration of yoga asana and postures and repeated by the staff.

Glimpses of Yoga day at Mukteshwar

9th Ayurveda day

ICAR-CITH, Srinagar celebrated Ayurveda Day on 29th October, 2024. The theme of the program was Ayurveda innovation for Global health. During the program, Director ICAR-CITH, highlighted the importance of ayurveda from ancient time. All the staff of the Institute participated in the program and expressed their views.

Kisan Diwas-2024 (National Farmers Day)

ICAR-CITH Srinagar celebrated Kisan Diwas-2024 on 23rd December, 2024. ICAR-CITH proudly commemorates the dedication,

Glimpses of Yoga Day at ICAR-CITH, Srinagar

Glimpses of Kisan Diwas, 2024

resilience, and invaluable contributions of farmers, the backbone of our nation. Through various initiatives and research advancements, we continue to support and empower the farming community. Let us all pledge to work towards sustainable and prosperous horticulture/ agriculture for the future. A heartfelt tribute to our farmers who tirelessly feed the nation!. Many farmers from nearby villages participated in the program. Dr. Puneet Kumar, Scientist (AS & PE) started the program with formal welcome address of the farmers. He also briefed the genesis of this day, their importance and different initiatives taken by government to improve the socio-economics status of farmers. Dr. Sajad Un Nabi, Scientist (Plant Pathology) briefed about the current status of the agriculture in India, primarily in Jammu and Kashmir. He pointed out the common problems faced by the farming community and also suggested their possible solutions. He put light on various schemes or initiatives taken by GOI to promote the sustainable agriculture and wellbeing of the farming community. The farmers were also assured any kind of technical support from our institute to resolves their problems and the upliftment of farmers socio-economic status. Dr. Reena Prusty, Scientist (Fruit Science) spoken about the role of women farmers in India. She emphasizes on increasing the participation of women farmers in agriculture to walk shoulder-to-shoulder along with male farmers. Also, she mentioned the about the possibilities of the women empowerment by establishing cottage or small-scale food processing enterprises and generating jobs for others. Dr. Mohd. Abas Shah, Scientist (Agricultural Entomology) put light on importance of farmers role in production of food and agricultural activities, and impact on everyone's life. He also discussed about the adoption of modern techniques and production of high-quality produce and compete with external factors. The program was concluded with formal vote of thanks given by Dr. Sajad Un Nabi.

Labour's Day

Labour's Day was celebrated at ICAR CITH on 1st May, 2024 under the chairmanship of Director, Dr. M.K. Verma. During the day, Director, ICAR-CITH, Srinagar highlighted the contribution of labour in Nation building. Other scientists and staff also share their views for the protection of labour right. Some labours also flagged of their issues.

Celebration of Labour's Day at ICAR-CITH, Srinagar

19th Parthenium Awareness Week organised

19th Parthenium Awareness Week was observed during 16th to 22nd August, 2024 at ICAR-CITH, Srinagar to raise awareness about the invasive weed *Parthenium hysterophorus* L., commonly known as Congress grass or carrot grass. This weed poses significant threats to agriculture, biodiversity, and human health, causing issues such as reduced crop yields and allergies. During the period, permanent and contractual employees and field workers of the institute actively participated and empowered their awareness against this obnoxious weed. Since, Parthenium is a problem of whole community, Dr. Vishal Dinkar (Scientist) and Dr. Sudhakara NR (Scientist), ICAR-CITH, Srinagar organized community-based approaches to aware and eradicate Parthenium, including displaying banners and posters across the campus, distribution of pamphlets and organising interactive sessions. During the week, employees were educated on Parthenium identification and mode of dispersal/spread, biological control methods using Mexican beetle, *Zygogramma bicolorata Pallister* (Coleoptera) and use of stubbles for compost and vermicompost.

Glimpses of Parthenium week at ICAR-CITH, Srinagar

Advisory Committee Meeting of NASF Funded Project

ICAR-CITH, Srinagar organized Advisory committee meeting of NASF funded project on Infectious clone development and point of care diagnostics for apple necrotic mosaic virus on 28th December, 2024 at ICAR-CITH Srinagar. The

Glimpses of Advisory committee meeting of NASF funded project

Hindi Diwas and Hindi Week-2024

The *Hindi Diwas* was celebrated on 14th September, 2024 at ICAR-CITH, Srinagar.The programme started with the west wishes to all staff of ICAR-CITH on *Hindi Diwas* followed celebration of Hindi week from 14th September to 21st September, 2024. Dr M K Verma emphasized on promotion of Hindi in their day to day official work. He also elaborated in detail the importance and history of the language. All staff of Institute assured to work more in Hindi at all the plate forms as well as in official work. During the week, various hindi promoting activities were organized, which included essay writing competition, hindi translation competition, poem recitation, extempore, poster making and antakshari etc. Employees from all sections including contractual and out sourced work-force participated with full fervour in all the competitions. The Saptah concluded on 21st September in an elaborate closing ceremony graced by on-dais presence of Dr M K Verma, Director, ICAR-CITH, Srinagar. All scientific, administrative, finance, technical and contractual staffs attended the closing ceremony, wherein, cash prize distribution was done among the winners of various functions. The closing ceremony ended with remarks of Director, ICAR-CITH, Srinagar.

ICAR-CITH, RS Mukteshwar, also celebrated Hindi Diwas. Dr Arun Kishor scientist In charge welcomes the chief guest and guests. Y P Malik, Joint Director ICAR-IVRI Mukteshwar and chief guest told to the audience for more use of hindi in office and research work. Dr Sher Singh, Principal Scientist IVRI and Mr Pavan Lohani, PGT Teacher KV IVRI Mukteshwar stressed on use of hindi in day to activities. The programme was attended by the all staff of the station and the programme was ended with the vote of thanks by Shri Diwan Chandra on the same day. Station also observed Hindi Pakhwara from 14th September, 2024 to 30th September, 2024 in which two events namely essay writing and debate competition were organized and prizes were distributed among the participants.

Glimpses of closing ceremony of Hindi Saptah at ICAR-CITH, Srinagar

Glimpses of Hindi Pakhwara at ICAR-CITH, RS Mukteshwar

Ek Ped Maa Ke Naam (#Plant4Mother)

The ICAR-Central Institute of Temperate Horticulture, Srinagar, successfully organized a one-day plantation program on 17th September, 2024 under the nationwide campaign "Ek Ped Maa Ke Naam" (#Plant4Mother). The campaign aimed to promote environmental awareness and encourage the planting of trees as a tribute to the selfless love of mothers, while also fostering a sense of responsibility towards environmental conservation. The plantation event was held near the CITH Guest House and saw active participation from more than 30 attendees, including scientists and staff members. A total of 70 trees (50 Willows and 20 Chinars) were planted during the event. These trees will serve as a long-term contribution to enhancing the green cover and biodiversity around the institute, while also improving the aesthetic value of the surroundings near the guest house. The participants took the LiFE pledge, committing to live more environmentally responsible lives. This pledge will act as a guiding principle for each individual, encouraging them to integrate sustainability into their everyday actions. The event helped foster a sense of community and shared responsibility among the participants. The ICAR-CITH remains dedicated to continuing such initiatives in the future, ensuring that environmental conservation becomes an integral part of its activities and mission.

Special Campaign 3.0

The ICAR-Central Institute of Temperate Horticulture (CITH), Srinagar actively participated in the Government of India's nation-wide initiative "Special Campaign 4.0," aimed at promoting cleanliness, good governance, and public awareness. The campaign was held in alignment with the broader objectives of the Swachh Bharat Abhiyan and included a series of activities focusing on sanitation and cleanliness within the institute's campus. The event began with the celebration of *Gandhi Jayanti* on October 2nd, 2024, commemorating the birth anniversary of Mahatma Gandhi. The staff and scientists of ICAR-CITH gathered to pay floral tribute to Gandhiji and took a collective pledge to uphold the values of cleanliness, discipline, and responsibility. The occasion served as a reminder of the importance of community efforts in achieving a cleaner and greener nation.

As part of the Special Campaign 4.0, a month-long cleanliness drive was organized covering various critical areas of the institute. The campaign included intensive cleaning and sanitation activities near the boiler house, in and around

Pledge and planting during Ek Ped Maa Ke Naam

the vehicle section, and the areas surrounding the polyhouses. Additionally, the front area of the main entrance was thoroughly cleaned, enhancing the overall appearance and hygiene of the institute's entry point. The road leading to the training block, frequently used by staff, researchers, and trainees, was also cleared of debris, litter, and overgrown vegetation. This contributed not only to a more aesthetically pleasing environment but also to the safety and comfort of pedestrians. All staff members, including scientists, technical personnel, administrative staff, and supporting staff, enthusiastically participated in the campaign. The campaign highlighted the importance of consistent cleanliness practices and encouraged all staff members to actively participate and maintain their efforts beyond the duration of the event. It also helped foster a sense of ownership among employees toward maintaining a healthy and clean work environment. The "Special Campaign 4.0" at ICAR-CITH, Srinagar was not just a symbolic activity but a meaningful step toward reinforcing Gandhiji's vision of a Swachh Bharat. The institute reaffirmed its dedication to the cause and pledged to continue contributing to a cleaner and more sustainable future through regular cleanliness drives and awareness initiatives.

Garland Offering by Director ICAR-CITH

Director, ICAR-CITH addressing the programme

Cleaning drive at Institute

Swachhta Pakhwada-2024

ICAR-Central Institute of Temperate Horticulture (CITH), Srinagar, observed "*Swachhta Pakhwada* 2024" from 16th to 31st December with a series of cleanliness and awareness activities aimed at promoting hygiene, sanitation, and environmental responsibility. The *Pakhwada* began with a pledge-taking ceremony, where all staff members took the Swachhta pledge to commit themselves to maintaining cleanliness in all spheres of life. The ceremony commenced with opening remarks by Dr. Javid Iqbal Mir, Principal Scientist, who highlighted the importance of cleanliness in institutional and personal spaces, aligning with Mahatma Gandhi's vision of a clean and self-reliant India. During this period, as part of the *Pakhwada*, various cleaning and sweeping drives were conducted across the institute premises primarily in front of main building, near guesthouse, in and around vehicle section etc. Scientists, technical staff, administrative personnel, and supporting staff actively participated in cleaning office areas, corridors, roads, and surroundings, demonstrating collective responsibility towards a clean work environment. The *Pakhwada* also included the celebration of *Kisan Diwas* on 23rd December, honouring the contributions of farmers to the nation. The event began with insightful opening remarks by Dr. Abas Shah, Scientist, who acknowledged the invaluable contributions

of farmers and emphasized the link between sustainable agriculture and cleanliness. The event concluded on a positive note, reinforcing ICAR-CITH's commitment to Swachh Bharat Abhiyan and continued efforts for cleanliness and community responsibility.

Pledge taking ceremony

Cleaning drive at different locations in institute

Celebration of Kisan Diwas

Scientist-farmers interaction at ICAR-CITH, Srinagar

Swachhta Abhiyan at ICAR-CITH, RS Mukteshwar

1st Swachhta Abhiyan at ICAR-CITH, RS Mukteshwar was organized from 15 September 2024 to 2nd October 2024. In this two programmes with the theme of " Swabhav Swachhata, Sanskaar Swachhata" were organized at weekly intervals at CITH RS Mukteshwar, in which people were aware about cleanness and safe disposal of garbage. Cleaning of the station premises was done during all the working days in which roads,

Glimpses of Swachhta Abhiyan at ICAR-CITH, RS Mukteshwar

channels, water bodies as well as office, chambers, laboratories, farm office, surrounding the residential quarters of the premises were cleaned.

MOU's Signed/ Technologies Licensed

During 2024, ICAR-CITH Srinagar signed four MoU's and licenced / sold three technologies for 18 stakeholders/ nurserymen and brief details are given below:

- ICAR-CITH and Parashar Agrobiotech Bio PVT LTD entered Into MOU for Mutual Cooperation on 29th February,2024 for R&D activities to develop and evaluate stem banding technique for management of Woolly Apple Aphid, *Eriosoma Ianigerum* in Apple orchards.
- ICAR-CITH and Ahsaan Horticulture Nursery and Agrinnovate India Ltd., (Agln) entered Into MOU for Mutual Cooperation on 13th March,2024 for material transfer agreement for ICAR CITH Walnut varieties CITH-W-1, CITH-W-4 and CITH-W-5.
- ICAR-CITH and HAPICO INDUSTRIES Pvt. Ltd. IGC SIDCO Lassipora Pulwama J&K entered Into MOU for Mutual Cooperation on 19th April,2024 for evaluation of products, organizing joint training and awareness events, capacity building, submission of collaborative research projects and formulation of collaborative products for Agri and Horticulture produce
- ICAR-CITH and Vista Processed Foods Pvt. Ltd.(An OSI Group Company) entered Into MOU for Mutual Cooperation on 16th July,2024 for providing necessary training and training support programme to value chain farmers/farmer groups specifically lettuce iceberg value chain development activities in region with financial assistance from Vista.
- ICAR-CITH and M/S Baghat Ram Fruit Nursery, HP entered Into MOU for Mutual Cooperation on 13th August,2024 for Licensing of technology namely Robust and high throughput apple clonal rootstock multiplication technology under controlled/open conditions for enhancing domestic supply and reducing import of apple rootstocks.
- ICAR-CITH and M/S Khanna Fruit Nursery, HP entered Into MOU for Mutual Cooperation on 13th August,2024 for Licensing of technology namely Robust and high throughput apple clonal rootstock multiplication technology under controlled/open conditions for enhancing domestic supply and reducing import of apple rootstocks.
- ICAR-CITH and M/S Malhotra Fruit Nursery, HP entered Into MOU for Mutual Cooperation on 13th August,2024 for Licensing of technology namely Robust and high throughput apple clonal rootstock multiplication technology under controlled/open conditions for enhancing domestic supply and reducing import of apple rootstocks.
- ICAR-CITH and M/S Mr Aarif Rashid Malik, Anantnag entered Into MOU for Mutual Cooperation on 13th August,2024 for Licensing of technology namely Robust and high throughput apple clonal rootstock multiplication technology under controlled/open conditions for enhancing domestic supply and reducing import of apple rootstocks.
- ICAR-CITH and M/S Ahsaan Horticulture Nursery, B.K.pora, Budgam entered Into MOU for Mutual Cooperation on 13th August,2024 for Licensing of technology namely Robust and high throughput apple clonal rootstock multiplication technology

under controlled/open conditions for enhancing domestic supply and reducing import of apple rootstocks.

- ICAR-CITH and M/S Abid Raja Fruit Nursery, Yaripora, Kulgam entered Into MOU for Mutual Cooperation on 13th August,2024 for Licensing of technology namely Robust and high throughput apple clonal rootstock multiplication technology under controlled/open conditions for enhancing domestic supply and reducing import of apple rootstocks.
- ICAR-CITH and M/S Mr Noor ul Haq, Shalteng, Srinagar entered Into MOU for Mutual Cooperation on 13th August,2024 for Licensing of technology namely Robust and high throughput apple clonal rootstock multiplication technology under controlled/open conditions for enhancing domestic supply and reducing import of apple rootstocks.
- ICAR-CITH and M/S Mr Mohd Ayoub, Jawalpora, Budgam entered Into MOU for Mutual Cooperation on 13th August,2024 for Licensing of technology namely Robust and high throughput apple clonal rootstock multiplication technology under controlled/open conditions for enhancing domestic supply and reducing import of apple rootstocks.
- ICAR-CITH and M/S Mr Raja Naseem Gul, Budgam entered Into MOU for Mutual Cooperation on 13th August,2024 for Licensing of technology namely Robust and high throughput apple clonal rootstock multiplication technology under controlled/open conditions for enhancing domestic supply and reducing import of apple rootstocks.
- ICAR-CITH and M/S Al –Falah Farm, Nowpora, Bandipora entered Into MOU for Mutual Cooperation on 27th August,2024 for Licensing of technology namely Robust and high throughput apple clonal rootstock multiplication technology under controlled/open conditions for enhancing domestic supply and reducing import of apple rootstocks.
- ICAR-CITH and M/S JDO Nursery, HP entered Into MOU for Mutual Cooperation on 27th August,2024 for Licensing of technology namely Robust and high throughput apple clonal rootstock multiplication technology under controlled/open conditions for enhancing domestic supply and reducing import of apple rootstocks.
- ICAR-CITH and M/S Krishna Nursery, Hamirpur (Himachal Pradesh) entered Into MOU for Mutual Cooperation on 19th August,2024 for Licensing of technology namely Robust and high throughput apple clonal rootstock multiplication technology under controlled/open conditions for enhancing domestic supply and reducing import of apple rootstocks.
- ICAR-CITH and M/S Meva Nursery, Srinagar entered Into MOU for Mutual Cooperation on 27th August,2024 for Licensing of technology namely Licensing of technology namely High quality feathered nursery plant production in apple by manipulating the shoot growth formation patterns.
- ICAR-CITH and M/S Alamdar Nursery, Budgam entered Into MOU for Mutual Cooperation on 27th August,2024 for Licensing of technology namely Licensing of technology namely High quality feathered nursery plant production in apple by manipulating the shoot growth formation patterns.
- ICAR-CITH and M/S Baghat Ram Fruit Nursery, HP entered Into MOU for Mutual Cooperation on 27th August,2024 for Licensing of technology namely High quality feathered nursery plant production in apple by manipulating the shoot growth formation patterns.
- ICAR-CITH and M/S Tantray Farms, Mamoosa, Pattan entered Into MOU for Mutual Cooperation on 3rd September,2024 for Licensing of technology namely Robust and high throughput apple clonal rootstock multiplication technology under controlled/open conditions for enhancing

domestic supply and reducing import of apple rootstocks.

- ICAR-CITH and M/S Chunil Fruit Plant Nursery, Gunderna, Tagood, Mughal Maidan, entered Into MOU for Mutual Cooperation on 30th October,2024 for Technology for higher grafting and budding success in Walnut.
- ICAR-CITH and M/S Bangalore Nursery, Taluk, Bangalore, entered Into MOU for Mutual Cooperation on 25th November,2024 for Licensing of technology namely Robust and high throughput apple clonal rootstock multiplication technology under controlled/open conditions for enhancing domestic supply and reducing import of apple rootstocks

Glimpses of licencing of some technologies of ICAR-CITH Srinagar with some stakeholders

5 EXTENSION AND OTHER PROGRAMS

Extension Activities

Productivity of quality temperate horticultural crops in India remains low compared to advanced countries due to several challenges. As these crops are vital to the hill economy, ICAR-CITH, Srinagar, is focused on developing and promoting technologies that enhance productivity, reduce input costs, and improve farmer incomes. The Institute has emerged as a hub for farmer-friendly, need-based innovations in temperate horticulture. Through its main campus and regional stations, ICAR-CITH actively disseminates these technologies via trainings, demonstrations, Kisan Melas, media outreach, and digital platforms. Several such programs were conducted in 2024 for farmers, officers, and students, as summarized below.

ICAR-CITH, Srinagar

Training programs for officers/ scientists/faculties

ICAR-CITH, Srinagar organized nine one-day training programs for officers, scientists, and staff from various organizations, along with field and lab visits. Participants were exposed to ongoing R&D activities and technologies aimed at enhancing the productivity of quality temperate horticultural produce. Attendees included personnel from short courses, BSF, Department of Agriculture, CIPMC Jammu, and ISTM (Principal Private Secretaries, Assistant Section Officers), among others. The programs received positive feedback, providing participants with valuable insights into temperate horticulture. A summary is presented in Table 30.

Table 30. List of training program organized for officers/ staff of line department/ ISTM training participants by ICAR-CITH, Srinagar

S. No.	Date	Name of Programme	Venue	No. of Participants	Organizers/ coordinators
1	28th Feb., 2024	One day visit /training for the Principal Private Secretaries (participants of ISTM 42nd Level IV)	ICAR-CITH, Srinagar	30	O.C. Sharma
2	6th March, 202	One day programme for the participants of 10 days short course entitled Harvesting Brilliance Empowerment Agricultural Scientists in Next Gen Organic Farming	ICAR-CITH, Srinagar	18	Geetika Malik
3	13th March, 2024	One day visit /training on temperate horticulture for Horticulture officer from Himachal Pradesh	ICAR-CITH, Srinagar	20	O.C. Sharma
4	24th April, 2024	One day training program on entrepreneurship development in bee keeping for the personnel of Security Forces (BSF)	ICAR-CITH, Srinagar	30	Md Abas Shah & W.H. Raja
5	27th April, 2024	One day visit /training for the Assistant Section officers (participants of ISTM training -Level B-185)	ICAR-CITH, Srinagar	24	O.C. Sharma, Vishal Dinkar, Eshan Ahad & Sadawarte Anand Rajesh

S. No.	Date	Name of Programme	Venue	No. of Participants	Organizers/ coordinators
6	7th May, 2024	One day training program on Alternate system of Agriculture for the officers/staff of Deptt of Agriculture, Khansaheb, Budgam	ICAR-CITH, Srinagar	15	O.C.Sharma & W.H. Raja
7	29th May, 2024	Exposure visits cum training of Assistant Section Officers from Govt of India	ICAR-CITH, Srinagar	25	O.C. Sharma
8	22nd June, 2024	Exposure visit-cum-training of Assistant Section Officers (189th Level B Training Program organized by for officers from Govt of India	ICAR-CITH, Srinagar	24	O.C. Sharma
9	23rd July, 2024	Exposure and hand on training in temperate horticulture for Participants of Season Long training Programme (SLTP) on apple organized by CIPMC, Jammu	ICAR-CITH, Srinagar	37	S.U. Nabi, Md Abas Shah, J.I. Mir & O.C. Sharma
	Total			**191**	

Training programs organized for officers/ staff of line department/ Under Secretaries by ICAR-CITH, Srinagar

Training program on entrepreneurship development in bee keeping for the personnel of Security Forces (BSF) on 24th April,2024

Training for the Assistant Section officers (participants of ISTM training -Level B-185) on 27th April, 2024


One day programme for Horticulture officers from Deptt of Horticulture, Himachal Pradesh on 13th March, 2024

Study visit/ training for the Principal Private Secretaries, Govt of India

Visit and Short Course on 6th March,2024


Training program on Alternate system of Agriculture for the officers/staff of Deptt of Agriculture, Khansaheb, Budgam


Exposure and hand on training in temperate horticulture for Participants of Season Long training Programme (SLTP) on 23rd July, 2024


Exposure visit-cum-training of Assistant Section Officers of the different Ministries of the Govt. of India

Five training programs of one day duration on walnut propagation organized for staff of UFRMP & department of Forest, Uttarakhand

In 2024, five one-day training programs on walnut propagation were conducted from 18th to 23rd February at nurseries in Maldevta, Magara, Sony, Silalekh, and Ladiyakata, Uttarakhand. These programs were organized for staff of UFRMP and the Department of Forest, Uttarakhand, with a total of 82 participants. A summary of the programs is provided in Table 31.

Table 31. Training programs organized staff of UFRMP & department of Forest, Uttarakhand

Date	Topic	Venue	No. of participants	Category of participants	Coordinators
18th Feb, 2024	Walnut propagation	Maldevta, Dehradun	11	Forest staff	O. C. Sharma & B. A. Ganai
19th Feb,2024	Walnut propagation	Magra	18	Forest staff	O. C. Sharma & B A Ganai
21st Feb, 2024	Walnut propagation	Sony	13	Forest staff & Farmers	O. C. Sharma & B. A. Ganai
22nd Feb,2024	Walnut propagation	Silalekh	19	Forest staff & Farmers	O. C. Sharma, & B. A. Ganai
23rd Feb, 2024	Walnut propagation	Ladiyakata	21	Forest staff	O. C. Sharma, & B. A. Ganai
Total	**5**		**82**		




Training programs on walnut propagation at Maldevta, Magra, Sony, Silalekh and Ladiyakata in Uttarakhand

Training programs/ visits for students

ICAR-CITH, Srinagar, with its advanced labs and diverse temperate horticultural crops, attracted significant interest from students and researchers. In 2024, 23 student visits/trainings were organized at the Institute and two at HNBGU, Srinagar (Uttarakhand). Students from various schools and colleges of J&K, Kargil, IARI New Delhi, Kerala Agricultural University, and Neotia University, West Bengal participated. They received practical exposure to field and lab activities and expressed high satisfaction. Details are summarized in Table 32.

Table 32. List of schools/colleges/institutes who visited the ICAR-CITH during the year 2024

Sr. No.	Date	Name of School/ University/ Training	No. of Students/ participants	Organizers/ coordinators
1	13th February, 2023	Kerla Agriculture University, College of Agriculture Vellani Thiruvanavllipurtam	15	O.C. Sharma
2	24th February, 2024	Kerla Agriculture University, Ambalavayal Wayanad	63	Vishal Dinkar
3	20th March,2024	Visit of students of M. Tech & Ph.D., Division of Agriculture Engineering, IARI, New Delhi	27	O.C. Sharma, Puneet Kumar & Sharath Kumar N
4	21st March,2024	Visit of students of MSc. & Ph.D. from Division of Plant Physiology, IARI, New Delhi	17	S.U. Nabi
5	22nd March, 2024	Visit of students from Division of Post- Harvest Technology, IARI, New Delhi	11	Punnet Kumar & Sharath Kumar N
6	23rd March, 2024	Visit of students from Division of Floriculture, IARI, New Delhi	37	O.C. Sharma & Puneet Kumar
7	3rd April, 2024	Visit of students from Division of Biotechnology, IARI, New Delhi	27	J.I. Mir, S.U. Nabi & O.C. Sharma
8	2nd May, 2024	Govt Boys High School, Raithan, Zone Khansaheb, Distt Budgam	35	O.C. Sharma & J.I. Mir
9	25th May, 2024	AL-HUDA International School, Kralpora Dist. Budgam	52	O.C. Sharma & Vishal Dinkar
10	1st June, 2024	Govt High School, Rakhshalina	29	O.C. Sharma, J.I. Mir & MK Verma
11	6th June, 2024	Govt Girls High School, Chanpora, Budgam	25	O.C. Sharma
12	6th June, 2024	Jamia Ul Uloom Higher Secondary School, Cheekpora, BKpora	80	O.C. Sharma
13	8th June, 2024	Govt Boys High School, Kralpora, Distt Budgam	87	O.C. Sharma
14	26th June, 2024	Islamic Public Secondary School, Kralpora, Distt Budgam	170	O.C. Sharma, Ronit Jaswal & Reena Prusty
15	26th June, 2024	Hunar- The School of Creativity	66	O.C. Sharma, Ronit Jaswal & Reena Prusty

Sr. No.	Date	Name of School/ University/ Training	No. of Students/ participants	Organizers/ coordinators
16	8th July, 2024	Neotia University, West Bengal	24	Sudhakara N.R. & O.C. Sharma
17	12th September, 2024	The Kashmir Valley School, Humhama	86	O.C. Sharma, Ronit Jaswal &Reena Prusty
18	28th October, 2024	Govt Degree College, Kargil	41	O.C. Sharma, J I Mir, Md Abas Shah & Sachin Kumar
19	7th November, 2024	Govt Degree College, Pulwama	24	S.U. Nabi, Md Abas Shah, O.C. Sharma
20	14th December, 2024	PM Shri UPS Chewaullar, Tral Distt Pulwama	24	Sudhakara N.R.
21	17th December, 2024	PM Shri Govt Girls high School, Rajpora Distt Kupwara	78	O.C. Sharma, Jyoti Priya, Kavita, Reena Prusty & Sachin Kumar
22	6th May, 2024	One day training and awareness program on Incidence and management for the UG and PG students of the Dept. of Horticulture at HNBGU, Srinagar (Uttarakhand)	65	Md Abas Shah
23	7th May, 2024	One day training cum Awareness program on incidence and management of green apple aphid in apple orchards for the PG students of the Dept. of Zoology at HNBGU, Srinagar (Uttarakhand)	43	Md Abas Shah
Total			**1126**	

Student's Study Visits during 2024 at ICAR-CITH, Srinagar

Kerla Agriculture University, College of Agriculture Vellani Thiruvananthapuram on 13th February, 2024


Kerla Agriculture University, Ambalavayal Wayanad on 24th February, 2024

Division of Biotechnology IARI, New Delhi

Division of Agriculture Engineering, IARI,

Division of Post Harvest Technology, IARI, New Delhi

Division of Plant Physiology & Division of FLS, IARI, New Delhi


Govt Boys High School, Raithan, Khansaheb, Budgam, Kashmir


Neotia University, West Bengal


Jamia Ul Uloom Higher Secondary School, Cheekpora, BKPora


Govt Girls high school, Chanpora


Govt Boys High School, Kralpora,


AL-HUDA International School, Kralpora Distt. Budgam


Islamic Public Secondary School, Kralpora, Budgam


The School of Creativity, Hunar

Govt Degree College Kargil

Govt Degree college Kargil on 28th October, 2024 in different labs

Govt Degree college Pulwama on 7th November, 2024

PM Shri Upper Primary School Chewaullar, Tral on 14th December, 2024

PM Shri Govt Girls High School, Rajpora, Kupwara on 17th December, 2024

Training Programs/ visits for Farmers

ICAR-CITH, Srinagar conducted need-based trainings and farm visits for farmers from Himachal Pradesh, Ladakh, and J&K in temperate horticulture. Program details are summarized below.

ICAR-CITH, Srinagar

Training programmes/ visits for the farmers of Himachal Pradesh

In 2024, ICAR-CITH organized one three-day and two one-day programs for 68 progressive farmers from Himachal Pradesh. Details are summarized in Table 33.

Three days training program on Technological advances in temperate fruit production for enhancing productivity of quality produce

A three-day training program on "Technological Advances in Temperate Fruit Production" was organized from 19th to 21st November 2024 for 20 farmers from the Kullu

Training programme for the farmers of Kullu Fruit Growers Association, Himachal Pradesh

Table 33. Training programs/ farm visit organized for the progressive farmers of Himachal Pradesh

Sr No	Date	Training/ visit/ Topic	Organization	No of participants	Coordinator(s)
1	19th to 21st November, 2024	Technological advances in temperate fruit production for enhancing productivity of quality produce	Kullu fruit Growers Association, Distt Kullu, Himachal Pradesh	20	Md Abas Shah, Ronit Jaswal and Mr Sarath Kumar
2	7th March, 2024	One day exposure visit/ training on temperate fruit production for the progressive farmers of Himachal Pradesh	Department of Horticulture, Himachal Pradesh	25	O C Sharma
3	8th March, 2024	One day exposure visit/ training on temperate fruit production for the progressive farmers of Himachal Pradesh	Department of Horticulture, Himachal Pradesh	23	O C Sharma
	Total			**68**	

Verma, Director, ICAR-CITH, who emphasized the adoption of advanced technologies to enhance quality fruit production. Technical sessions were conducted by Dr. J. I. Mir (high-density planting and tall spindle system), Dr. O. C. Sharma (nursery management, training and pruning), Dr. S. U. Nabi (disease management), Dr. Md Abas Shah (insect-pest management), Dr. K. L. Kumawat (feathered nursery plant production), and Dr. W. H. Raja (rootstocks, rapid multiplication, and physiological disorders). Exposure visits were also arranged to NBPGR & IGFRI Regional Stations, Center of Excellence (Dept. of Horticulture, Srinagar), and KVK Baramulla. The farmers expressed high satisfaction and requested similar trainings in the future.

Two programmes/ visits of one day duration organized for farmers of Himachal Pradesh

ICAR-CITH, Srinagar organized two one-day programs on 7th and 8th March 2024 for progressive farmers from various districts of Himachal Pradesh, with 25 and 23 participants respectively. Organized in collaboration with the Department of Horticulture, Himachal Pradesh, the programs focused on technologies for improving productivity, covering nursery production, propagation, training & pruning, and plant protection.

Training progressive farmers from different districts of Himachal Pradesh on 7th March, 2024


Training of progressive farmers from different districts of Himachal Pradesh on 8th March, 2024

Training programme/ Farm visit organized for Farmers of Jammu and Kashmir.

Farmers are the end-users of agricultural technologies. In 2024, 17 farmer groups from J&K, sponsored by various agencies, visited ICAR-CITH, Srinagar for one-day trainings and farm visits. They were introduced to technologies developed by the Institute in various horticultural crops. Program details are summarized below and in Table 34.

Table 34. List of visits/ trainings organized for farmers of J&K at ICAR-Central Institute of Temperate Horticulture during the year 2024

Sr No	Date	Training/ visit/Topic	Department/ Organization	Zone/ Area/ District	No of participants	Facilitator/ Coordinator
1	4th January, 2024	Organic farming in Kashmir: How to reap its potential	SKUAST-K	Srinagar	18	J I Mir
2	13th February, 2024	One day training/ visit on temperate horticulture	Deptt of Horticulture	Shopian	25	S U Nabi, W H Raja & O C Sharma
3	27th February, 2024	One day training/ visit on temperate fruit production	Deptt of Horticulture	Kulgam	45	O C Sharma
4	18th March, 2024	One day programme on Integrated pest management in crops	KVK Badgam	Budgam	27	S U Nabi & O C Sharma
5	19th March, 2024	One day programme/ visit on technologies for temperate fruit production	Deptt of Horticulture	Srinagar	25	O C Sharma & W H Raja
6	25th March, 2024	One day training/ visit on temperate horticulture	Deptt of Agriculture	Budgam	110	Sudhakara N R, Sarathkumar N & Reena Prusty
7	27th September, 2024	One day training/ exposure visit on latest technologies for management of orchards for quality produce	Deptt of Horticulture,	Shopian	38	S U Nabi, Md Abas Shah O C Sharma

Sr No	Date	Training/ visit/Topic	Department/ Organization	Zone/ Area/ District	No of participants	Facilitator/ Coordinator
8	25th October, 2024	One day training/ exposure visit on temperate fruit and vegetable production	Deptt of Horticulture	Srinagar	100	O C Sharma, J I Mir and Sachin Kumar
9	4th November, 2024	One day training/ exposure visit on temperate fruit and vegetable production	Deptt of Agriculture, Sub Division Khansaheb	Budgam	60	O C Sharma & W H Raja
10	5th November, 2024	exposure visit on temperate fruit and vegetable production	Deptt of Agriculture, subdivision Chadoora	Budgam	91	O C Sharma, Ronit Jaiswal, Puneet Kumar & M A Sheikh
11	6th November, 2024	Training cum exposure visit on production and plant protection measures in fruit and vegetable crops	Deptt of Agriculture, Subdivision Chadoora	Budgam	140	S U Nabi & O C Sharma &
12	7th November	Training cum exposure visit on vegetable and fruit production	Deptt of Agriculture, Zone Pampore	Pulwama	25	Vishal Dinkar, Uzma Mehraj, Puneet Kumar & O C Sharma
13	7th November	Training cum exposure visit on vegetable and fruit production	Deptt of Agriculture, Zone Newa	Pulwama	30	O C Sharma Vishal Dinkar, Uzma Mehraj& Puneet Kumar
14	7th November	Training cum exposure visit on Temperate fruit production	Deptt of Horticulture, Doda,	Doda	25	O C Sharma, Puneet Kumar &Vishal Dinkar
15	11th November, 2014	Training cum exposure visit on Temperate fruits and vegetable production	Deptt of Agriculture, Srinagar	Srinagar	69	Geetika Malik, O C Sharma, & Sachin Kumar
16	26th November, 2024	Important practices in vegetable and fruit production for higher productivity	Dept of Agriculture, Sub Division Budgam	Budgam	201	O C Sharma, J I Mir & Geetika Malik
17	24th December, 2024	Innovative horticultural practices in and modern farming	Deptt of Horticultur, HDO Zangam	Baramulla	50	S U Nabi, Md Abas Shah, Sudhakara NR, Ronit Jaswal & Sachin Kumar
Total					1079	


Visit of farmers from District Shopian on 13th February, 2024


Visit of farmers from District Kulgam on 27th February, 2024


Visit of farmers from District Srinagar on 19th March,2024


Visit of farmers from district Badgam by KVK budgam on 18th March, 2024


Visit of farmers from district Shopian on 27th September, 2024


Visit of farmers from Faqir gujari, distt Srinagar on 25th October,2024


Visit of farmers from Sub Division Khansahab, Distt Budgam on 4th November, 2024


Visit of farmers from Sub division Chadoora on 5th November 2024


Visit of farmers from Sub division Chadoora district Budgam on 6th November, 2024


Visit of women farmers from pampore district Pulwama on 7th November, 2024


Visit of from pampore district Pulwama on 7th November, 2024


Visit of farmers from district Doda on 7th November, 2024


Visit of farmers from district Srinagar on 11th November, 2024


Visit of farmers from district from Distt Budgam 26th November,2024


Visit of farmers from District Baramulla on 24th December, 2024

Training programs organized under MIDH

ICAR-CITH, Srinagar conducted 10 one-day training programs across Kashmir Division on nursery production, pruning, fruit production, and plant protection. Farmers were also provided with farm inputs like secateurs and pruning saws. Details are summarized in Table 35.

Table 35. List of visits/ trainings organized for farmers of Kashmir Division under MIDH by ICAR-Central Institute of Temperate Horticulture during the year 2024

S No	Date	Training/ visit/ Topic	Department/ Organization	Zone/ Area/ District	No of participants	Inputs supplied	Facilitator/ Coordinator
1	10th September, 2024	Training and pruning and nursey management in Fruit crops	MIDH	Handwara area of Distt Kupwara	26	Pruning Secateur	W H Raja
2	29th October, 2024	Training and pruning in fruit crops	MIDH	Wathoora and Chadoora area of dist. Budgam	25	Pruning Secateur	W H Raja & O C Sharma
3	9th November, 2024	Scientific nursery management in temperate fruits in collaboration with Deptt of Horticulture, Srinagar (j & K)	MIDH	Centre of Excellence, Zawoora, Khanmo Srinagar	59	Pruning Secateur	W H Raja
4	11 November, 2024	Training, pruning and nursery management under MIDH	MIDH	KVK Baramulla at Kunzer	57	Pruning Secateur	W H Raja, S N Kirmani & Anjali Goirala, S Ahmad & N Kumar
5	19th November, 2024	Training , pruning and nursery management under MIDH	MIDH	Baramulla	15	Pruning Secateur	W H Raja & Dr S.N Kirmani
6	3rd December, 2024	Canopy management in temperate fruits at Shangus village	MIDH	Anantnag	49	Pruning Secateur	W H Raja
7	5th December, 2024	Canopy management in temperate fruits	MIDH	Pulwama	8	Pruning saw	W H Raja, O C Sharma & Mohd Abas Shah
8	19th December, 2024	Scientific Training and Pruning techniques in traditional Apple orchards.	MIDH	Hygam, Sopore Baramulla	4	Pruning Secateur	W H Raja & S. N. Kirmani
9	19th December, 2024	Training and pruning for yield and quality improvement.	MIDH	Dardpora, Khanpora, Baramulla	26	Pruning Secateur	W H Raja & S N Kirmani
10	20th December, 2024	Basic training and pruning principles in fruit crops	MIDH	Lolpora Baramulla	50	Pruning Secateur	W H Raja & S N Kirmani
	Total				**319**		

Training program conducted under MIDH on 10th September, 2024

Training program conducted under MIDH on 29th October, 2024

Training program conducted under MIDH on 9th November, 2024

Training program conducted under MIDH on 11th November, 2024

Training program conducted under MIDH on 19th November, 2024 for farmers of district Baramulla

Training program conducted under MIDH on 3rd December,2024 for the farmers of district Anantnag

Training program conducted under MIDH on 5th December, 2024 for the farmers of district Pulwama

Training program conducted under MIDH on 19th December, 2024 at Hygam Sopore, distt Baramulla

Training program conducted under MIDH on 19th December, 2024 for farmers of Bandpora & Khanpora of distt Baramulla

Training program Training program conducted under MIDH on 20th December, 2024 at Lolpora Baramulla conducted under MIDH on 29th October, 2024

ICAR-CITH, Regional Station, Mukteshwar

ICAR-CITH, RS Mukteshwar organized 14 exposure and diagnostic visit programs for line department officials, students from various institutions, and farmers, focusing on temperate horticulture and hill farming. Program details are summarized in Tables 36, 37, 38, and 39.

Table 36. List of training programs organized for staff of line department by ICAR-CITH, Regional Station, Mukteshwar

S.N.	Date	Name of Programme	Venue	No. of Participants	Organizers/ coordinators
1	25th Jan., 2024	Exposure visit of trainees of NEH ATTARI Zone-6 (NRH Assam, A.P. and Sikkim)	ICAR-CITH, Regional Station, Mukteshwar	36	Arun Kishor

Table 37. List of training programs organized for students by ICAR-CITH, Regional Station, Mukteshwar

S.N.	Date	Name of Programme	Venue	No. of Participants	Organizers/ coordinators
1	26th April,2024	Exposure visit of B.Sc 3rd year Zoology students from Kalindi College, Delhi University, New Dehli	ICAR-CITH, Regional Station, Mukteshwar	36	Arun Kishor

Table 38. List of training programs organized for farmers by ICAR-CITH, Regional Station, Mukteshwar

S.N.	Date	Name of Programme	Venue	No. of Participants	Organizers/ coordinators
1	1st Jan., 2024	Exposure visits cum Training on pruning of temperate fruits for farmers of Lohaghat, Champawat	ICAR-CITH, Regional Station, Mukteshwar	11	Arun Kishor
2	15th Jan., 2024	Awareness programme on training and pruning of high-density apple orchard	Orakhan	5	Arun Kishor

S.N.	Date	Name of Programme	Venue	No. of Participants	Organizers/ coordinators
3	20th Jan., 2024	Awareness programme on training and pruning of high-density apple orchard	Nathukhan	7	Arun Kishor
4	5th June,2024	Awareness programme on the occasion of World Environment Day	ICAR- CITH, RS Mukteshwar	9	Arun Kishor and all staff
		Total		**32**	

Exposure visit of farmer cum Training on pruning of temperate fruits on 10th January,2024

Exposer visit of NEH trainees on 25th January, 2024

Exposure visit of B.Sc. 3rd year (Zoology) students from Kalindi College, Delhi University 26th April,2024

Awareness programme on the occasion of "World Environment Day on 05th June,2024

Table 39. List of Diagnostic visits organized by ICAR-CITH, Regional Station, Mukteshwar

S.N.	Date	Name of Programme	Venue	No. of Participants	Organizers/ coordinators
1	4th March, 2024	Diagnostics visit at farmer's field	Odlohar-Simsyari, Bageshwar	5	Arun Kishor
2	5th May, 2024	Nursery visit with CPP team	Khujethi and Chafi village	10	M K Verma, Arun Kishor and CPP team
3	7th May, 2024	Diagnostics visit at farmer's field	Gahena	5	M.K. Verma & Arun Kishor
4	6th June, 2024	Diagnostics visit at farmer's field	Hartola village	7	Arun Kishor

S.N.	Date	Name of Programme	Venue	No. of Participants	Organizers/ coordinators
5	29th July,2024	Diagnostics visit at farmer's field	Gahena	10	Arun Kishor & Chandni
6	2nd Aug., 2024	Diagnostics visit at farmer's field	Gagar	4	Arun Kishor, Rashmi E R& Chandni
7	6th Aug., 2024	Diagnostics visit at farmer's field	Bhurashi	3	Arun Kishor, Rashmi E.R.& Chadni
8	21st August,2024	Diagnostics visit at farmer's field	Khujethi,	4	Arun Kishor, Rashmi E.R & Chandni
Total				48	

Visit of the Hon'ble Director, Dr M. K. Verma

Hon'ble Director, ICAR-CITH, Dr. M. K. Verma visited the Regional Station Mukteshwar from 5th to 7th May 2024. He visited the SCSP-adopted village Ghana and reviewed the PEQ site progress with CPWD on 6th May. Following a meeting with the CPC team, he reviewed ongoing research and extension activities and directed the establishment of new blocks of kiwifruit, persimmon, and pecan, along with introduction of promising temperate crop germplasm.


Visit of CPP team on 5th & 6th May, 2024


Visit of the Hon'ble Director Dr M K Verma to SCSP village Gahna on 7th May, 2024

Exposure visit of farmer cum training on pruning of temperate fruits on 10th January,2024

Exposer visit of trainees from NEH

ICAR-CITH, Regional Station, Dirang

The diverse climate of the NEH region is well-suited for temperate horticultural crops, offering significant potential for expansion. However, limited availability of quality planting material has been a major constraint. To address this, ICAR-CITH, Regional Station Dirang, is actively engaged in need-based research, technology dissemination, capacity building, and supplying quality planting material to boost temperate horticulture in the region. The station is currently focused on germplasm collection, establishing elite mother blocks, and developing infrastructure, including a PEQ facility. In 2024, a total of 20 programs were organized, benefiting 1,718 farmers. Program details and input distributions are summarized in Table 40.

Table 40. List of training cum farm input distribution programmes under NEH during 2024

Sr No	Date	Name of Programme	Venue	No. of Participants			Organizers/ coordinators
				M	F	Total	
1	5th March, 2024	Training cum demonstration program for distribution of avocado planting material, vegetable seed kits& bio-pesticide	Nakhu village, Nafra, West Kameng District	32	20	52	Supreetha BG, Pradeepkumara N. & Dorjee Drakpa
2	11th March 2024	Training cum demonstration program for of kiwifruit & persimmon planting material	Yewang Village, West Kameng District	05	03	08	Supreetha BG, Pradeepkumara N. & Dorjee Drakpa
3	11th March 2024	Training cum demonstration program on vegetables & distribution of vegetable seed kits	Yewang Village, West Kameng District	13	13	26	Supreetha BG, Pradeepkumara N. & Dorjee Drakpa
4	12th March 2024	Training cum demonstration program on kiwifruit planting material & vegetables & distribution of vegetable seed kits	ICAR-CITH, RS, Dirang	13	05	18	Supreetha BG, Pradeepkumara N. & Dorjee Drakpa
5	16th March, 2024	Demonstration of agro technologies for sustainable vegetable production and distribution of superior quality seeds	Celery village of West Kameng, Arunachal Pradesh)	52	33	85	Sudhakara N R, Ronit Jaiswal, Supreetha B G & Pradeepkumara N
6	17th March,2024	Demonstration of quality planting material of persimmon and kiwi fruit	Chuke village of Dirang district West Kameng, Arunachal Pradesh.	10	08	18	Sudhakara N R & Ronit Jaiswal
7	13th May 2024	Training cum distribution program on vegetables seed kit and IIHR seed	KVK, Papumpare Itanagar	29	21	50	Supreetha BG & Dorjee Drakpa

Sr No	Date	Name of Programme	Venue	No. of Participants			Organizers/ coordinators
				M	F	Total	
8	8th June 2024	Training cum distribution programme of Pusa vegetable seed kit and IIHR seed	Shergeon Village, West Kameng District	82	48	130	Supreetha BG, Pradeepkumara N & Dorjee Drakpa
9	15th June 2024	Training cum distribution programme of Pusa vegetable seed kit and IIHR seed	Kalaktang Town, West Kameng District	105	95	200	Supreetha BG, Pradeepkumara N & Dorjee Drakpa
10	24th June 2024	Training cum distribution programme of Pusa vegetable seed kit and IIHR seed	Yewang Village, West Kameng District	64	36	100	Supreetha BG, Pradeepkumara N & Dorjee Drakpa
11	5th July 2024	Training cum distribution programme of Pusa vegetable seed kit and IIHR seed	Sangti Village, West Kameng District	42	68	110	Pradeepkumara N & Dorjee Drakpa
12	6th July 2024	Training cum distribution programme of Pusa vegetable seed kit and IIHR seed	Zimthung Village, West Kameng District	30	30	60	Pradeepkumara N & Dorjee Drakpa
14	13th July 2024	Training cum distribution programme of Pusa vegetable seed kit and IIHR seed	Rupa Town, West Kameng District	140	60	200	Supreetha BG, Pradeepkumara N & Dorjee Drakpa
14	20th July 2024	Training cum distribution programme of Pusa vegetable seed kit	Dengzi village, Kalaktang, West Kameng District	57	43	100	Supreetha BG, Pradeepkumara N & Dorjee Drakpa
15	5th October 2024	Training cum distribution programme of Pusa vegetable seed kit, IIHR seed and bio-pesticide	Chug village, Dirang, West Kameng District	66	134	200	Pradeepkumara N & Dorjee Drakpa
16	20th November 2024	Training cum distribution programme of Pusa vegetable seed kit	Khinmey village, Tawang District	06	27	33	Supreetha BG, Pradeepkumara N & Dorjee Drakpa

Sr No	Date	Name of Programme	Venue	No. of Participants			Organizers/ coordinators
				M	F	Total	
17	20th November 2024	Training cum distribution programme of Pusa vegetable seed kit	Khrimu village, Tawang District	26	74	100	Supreetha BG, Dr. Pradeepkumara N & Dorjee Drakpa
18	21th November 2024	Training cum distribution programme of Pusa vegetable seed kit	Gyanghar village, Tawang District	20	80	100	Supreetha BG, Pradeepkumara N & Dorjee Drakpa
19	6th December 2024	Training cum distribution programme of Pusa vegetable seed kit	Thembang village, West Kameng District	45	23	68	Dr. Supreetha BG, & Dorjee Drakpa
20	26th December 2024	Training cum distribution programme of Pusa vegetable seed kit	Lish village, West Kameng District	20	40	60	Wasim Hasan Raja, Supreetha BG, Pradeepkumara N & Dorjee Drakpa
Total				**857**	**861**	**1718**	

Training cum demonstration/ distribution programme on avacado, Vegetables and bio-pesticides at Nakhu village, District West Kameng

A training-cum-distribution program under the NEH Scheme was organized on 5th March 2024 at Nakhu village, West Kameng, Arunachal Pradesh, with participation from 52 farmers. Dr. Supreetha B.G., SIC, CITH RS Dirang, briefed farmers on the distributed materials, while Dr. Pradeep Kumar demonstrated avocado planting. A total of 5,000 avocado plants, 100 bio-pesticide packets, and 200 vegetable seed packets were distributed.

Training cum distribution programme on kiwifruit & persimmon and vegetable seed at ICAR- CITH RS, Dirang

On 11th March 2024, ICAR-CITH, RS Dirang organized a demonstration and distribution program under the NEH Scheme for kiwifruit, persimmon plants, and vegetable seeds. Eight farmers participated. Dr. Supreetha B.G., SIC, briefed on the distributed materials, and Dr. Pradeep Kumar demonstrated planting techniques. A total of 1,385 plants were distributed, along with vegetable seed kits.

Training cum distribution programme on kiwifruit planting materials and vegetable seed for demonstration at ICAR-CITH, RS, Dirang

A training-cum-distribution program was held on 12th March 2024 at ICAR-CITH, RS Dirang under the NEH Scheme, focusing on kiwifruit planting material and vegetable seeds. Eighteen farmers participated. Dr. Supreetha B.G., SIC, briefed on the materials, and Dr. Pradeep Kumar demonstrated kiwifruit planting. A total of 900 kiwifruit plants and vegetable seed kits were distributed.

Training cum distribution program held at Celery & Chuke villages of West Kameng, Arunachal Pradesh

ICAR-CITH, RS Dirang conducted training-

cum-distribution programs at Celery and Chuke villages, West Kameng, Arunachal Pradesh on 16th and 17th March 2024. At Celery, 85 farmers were trained on sustainable vegetable production and received PUSA vegetable seed kits. At Chuke, 18 farmers were sensitized on temperate horticulture, and quality planting materials of persimmon and kiwifruit were distributed for demonstration.

Training cum distribution program on vegetable seeds at KVK, District Papum-pare

ICAR-CITH, RS Dirang organized a vegetable seed distribution program at KVK Papum Pare, Itanagar, on 13th May 2024. The event began with a welcome address by Dr. Bangkeng Perme, Senior Scientist, KVK. SIC Dr. Supreetha B.G. briefed 50 participating farmers about the distributed materials, which included Pusa seed kits and IIHR chilli seeds.

Training cum distribution program on Vegetable Seed Kits (Tomato, Chilli and Brinjal) at Kalaktang, district West Kameng

A training-cum-distribution program under the NEH Scheme was held on 15th June 2024 at Kalaktang, West Kameng, Arunachal Pradesh, with participation from 200 farmers. Dr. Supreetha B.G., SIC, briefed on the distributed materials, and Dr. Pradeep Kumara N demonstrated vegetable cultivation techniques. A total of 800 Pusa vegetable seed kits, 200 packets each of IIHR tomato (Arka Rakshak), brinjal (Arka Harshita), and 201 packets of chilli (Arka Meghana) seeds were distributed.

Training cum distribution program on vegetable held at Shergaon Village, West Kameng District

A training-cum-distribution program was held on 8th June 2024 at Shergaon village, West Kameng, Arunachal Pradesh under the NEH Scheme. Organized by Dr. Supreetha B.G., the event saw participation from 130 farmers. Dr. Supreetha briefed farmers on the distributed materials, and Dr. Pradeep Kumara N demonstrated vegetable cultivation techniques. A total of 600 Pusa vegetable seed kits and 150 packets of IIHR tomato (Arka Samrat) seeds were distributed.

Training cum distribution program on vegetable held at Yewang Village, West Kameng District

ICAR-CITH, RS Dirang organized a one-day training-cum-distribution program on 24th June 2024 at Yewang Village, West Kameng, Arunachal Pradesh. Attended by 100 farmers, Dr. Pradeep Kumara N provided information on vegetable seed kits, demonstrated cultivation techniques, and visited farmers' fields. A total of 200 Pusa vegetable seed kits, 100 packets each of IIHR tomato (Arka Rakshak) and brinjal (Arka Harshita), 39 packets of chilli (Arka Meghana), and 61 packets of chilli (Arka Yashasvi) seeds were distributed.

Training cum distribution programme on vegetable held at Sangti Village, West Kameng District

A one-day training-cum-distribution program and farmers' field visit was organized on 5th July 2024 at Sangti Village, West Kameng, Arunachal Pradesh under the NEH Scheme. Attended by 110 farmers, Dr. Pradeepkumara N., Vegetable Scientist, provided guidance on the distributed materials, demonstrated cultivation techniques, and addressed farmers' queries during field visits. A total of 220 Pusa vegetable seed kits, and 110 packets each of IIHR tomato (Arka Rakshak), brinjal (Arka Harshita), and chilli (Arka Yashasvi) seeds were distributed.

Training cum distribution program on vegetable held at Zimthung Village, West Kameng District

A one-day training-cum-distribution program and farmers' field visit was conducted on 6th July 2024 at Zimthung Village, West Kameng, Arunachal Pradesh under the NEH Scheme, with participation from 60 farmers. Dr. Pradeepkumara N., Vegetable Scientist, provided information on the distributed materials, demonstrated vegetable cultivation techniques, and addressed field-level issues. A total of 120 Pusa vegetable seed kits, 10 packets of IIHR tomato (Arka Rakshak), 50 of

Arka Samrat, 60 of brinjal (Arka Harshita), and 60 of chilli (Arka Yashasvi) seeds were distributed.

Training cum distribution program on vegetable held at Rupa, West Kameng District of Arunachal Pradesh

ICAR-CITH, RS Dirang organized a one-day training-cum-distribution program on vegetables at Rupa, West Kameng, Arunachal Pradesh on 13th July 2024. The program witnessed participation from 200 farmers. Dr. Supreetha B.G., SIC, interacted with local leaders and briefed farmers on the inputs, while Dr. Pradeep Kumara N., Vegetable Scientist, demonstrated vegetable cultivation techniques and visited farmers' fields. A total of 410 Pusa vegetable seed kits and 200 packets of IIHR tomato (Arka Abhed) seeds were distributed.

Training cum distribution program on vegetable at Dengzi village in Kalaktang, West Kameng District

A one-day training-cum-distribution program was held on 20th July 2024 at Dengzi Village, Kalaktang, West Kameng, Arunachal Pradesh, with participation from 100 farmers. Dr. Supreetha B.G. and Dr. Pradeepkumara N. from CITH RS Dirang provided information on the distributed materials and demonstrated vegetable cultivation techniques in the farmers' fields. A total of 200 Pusa vegetable seed kits were distributed.

Training cum distribution program of Pusa Vegetable Seed Kits, IIHR Vegetable Seed and Bio-pesticide

A training-cum-distribution program and exhibition on Pusa vegetable seed kits, IIHR vegetable seeds, and bio-pesticides was held on 5th October 2024 at Chug Village, West Kameng, Arunachal Pradesh, under the NEH Scheme. The event, attended by 200 farmers, was inaugurated by Shri Phurpa Tsering, MLA, Dirang, who highlighted the benefits of the kits. Dr. Pradeep Kumara N., Vegetable Scientist, CITH RS Dirang, provided information and demonstrated cultivation techniques.

Training cum distribution Program of Pusa Vegetable Seed Kits at Khinmey, Khrimu and Gyangkhar Villages

A training-cum-distribution program on Pusa vegetable seed kits was held on 20th–21st November 2024 at Khinmey, Khrimu, and Gyangkhar villages of Tawang District, Arunachal Pradesh, under the NEH Scheme. The program benefited 240 farmers (30 from Khinmey, 100 from Khrimu, and 110 from Gyangkhar). Dr. Supreetha B.G., SIC, briefed farmers on the seed kits, while Dr. Pradeepkumara N. demonstrated planting and management techniques. The initiative aimed to boost sustainable vegetable cultivation and farm productivity.

Training cum distribution program for Pusa Vegetable Seed Kits at Thembang Village, West Kameng District, Arunachal Pradesh

A one-day training-cum-distribution program on Pusa Vegetable Seed Kits was held at Thembang Village, West Kameng District, Arunachal Pradesh on 6th December 2024 under the NEH Scheme. A total of 68 farmers participated. Dr. Supreetha B.G., SIC, provided insights on the seed kits, while Shri Dorjee Drakpa (YP-II) demonstrated planting and management techniques. The program aimed to promote sustainable vegetable cultivation and boost productivity.

Training cum distribution program for Pusa vegetable seed kits and pruning at Lish Village

A one-day training-cum-distribution program was organized by ICAR-CITH, RS Dirang at Lish Village, West Kameng District, Arunachal Pradesh on 26th December 2024 under the NEH Scheme. Sixty farmers participated in the event. Dr. W.H. Raja and Dr. Supreetha B.G. provided guidance on the use and benefits of Pusa vegetable seed kits, while Dr. Pradeepkumara N. demonstrated planting and seed management techniques. Dr. Wasim Hasan Raja also conducted a session on training and pruning of temperate fruit crops. The program aimed to enhance vegetable cultivation, horticultural productivity, and farmer capacity through practical knowledge.

Glimpes of various programs orgnized by ICAR CITH, Regional Station Dirang

Training cum Avocado Planting Materials, Seeds & Bio-pesticides Distribution Program at Nakhu Village, Nafra, West Kameng District, Arunachal Pradesh on 5th March, 2024

Training cum Demonstration on Kiwi and Persimmon Planting Materials and Vegetable Seed, at the CITH- RS Dirang on 11th March, 2024

Training cum distribution program of vegetable seeds at KVK Papum Pare in Itanagar on 13th May 2024

Demonstration & distribution of PUSA seed kit to farmers of Celery Village on 16th March, 2024

Distribution of planting materials of Persimmon, Kiwi fruit & PUSA seed kit to farmers of Chuke Village on 17th March, 2024


Training cum Distribution Program on the Pusa Vegetable Seed Kits and IIHR Vegetable Seeds (Tomato, Chilli and Brinjal) at Kalaktang, West Kameng District, Arunachal Pradesh on 15th June, 2024


Training cum Distribution Program on the Pusa Vegetable Seed Kits and IIHR Vegetable Seeds (Tomato, Chilli and Brinjal) at Kalaktang, West Kameng District, Arunachal Pradesh on 15th June, 2024

Training cum Pusa Vegetable Seed Kits & IIHR Tomato (Arka Samrat) Seeds Distribution Program at Shergaon Village, West Kameng District, Arunachal Pradesh on June 8, 2024

Training cum Distribution Program of Pusa Vegetable Seed Kits and IIHR Vegetable Seeds (Tomato, Chilli and Brinjal) at Sangti Village, West Kameng District on 5th July, 2024

Training cum Demonstration Program for Kiwi Planting Materials & with vegetable Seedat RS Dirang on 12th March, 2024

Training cum Distribution Programme of Pusa Vegetable Seed Kits and IIHR Vegetable Seeds (Tomato, Chilli and Brinjal) at Zimthung Village, West Kameng District on 6th July, 2024

Training cum Distribution Program of Vegetable Seeds (Tomato, Chilli and Brinjal) at Yewang Village, West Kameng District on June 24, 2024

Training cum Distribution Program of Pusa Vegetable Seed Kits at Dengzi village in Kalaktang, West Kameng District on 20th July, 2024

Training cum Distribution Program of Pusa Vegetable Seed Kits and IIHR Vegetable Seed (Tomato) at Rupa, West Kameng District on July 13, 2024

Training cum Distribution Program of Vegetable Seed Kits and Bio-pesticide on

Training cum Distribution Program on Pusa Vegetable Seed Kits at Khinmey, Khrimu and Gyangkhar Village, Tawang District, Arunachal Pradesh on20th &21st November, 2024.

5th October, 2024 at Chug Village, West Kameng District, Arunachal Pradesh

5th October, 2024 at Chug Village, West Kameng District, Arunachal Pradesh

Kiwi fruit and Persimmon Planting Materials supply for demonstration, at the CITH- RS Dirang on 11th March, 2024

Training cum Distribution Program at Lish Village on 26th December, 2024

Schedule Caste Sub Plan (SCSP)

Under the SCSP scheme during 2024, ICAR-CITH conducted two awareness programs in Bageshwar district, Uttarakhand, focusing on crop diversification through horticulture and distribution of farm inputs. The programs were held on 7th March at Gahena Village and on 11th March at Odlohar-Simsyari Village. Beneficiaries received planting materials and implements to enhance farm income. Details of the programs are provided in Table 41.

Table 41. Training Programmes and farm input program organized for SC farmers of J&K under SCSP Scheme

S. No.	Date	Program	Location	No. of Participants	Organizer
1.	7th March, 2024	Crop Diversification through Horticulture and Farm input Distribution under SCSP at Gahena	Gahena	295	Arun Kishor
2	11th March,2024	FAP on "Crop Diversification through Horticulture and Farm input Distribution under SCSP at Odlohar-Simsyari, Bageshwar	Odlohar-Simsyari, Bageshwar	100	Arun Kishor
Total				**395**	


Glimpses of Farmers Awareness Program on management of horticultural crops after post monsoon cum Seed and planting material distribution on 7th March, 2024


Farmers Awareness program on Crop Diversification through Horticulture and Farm input Distribution under SCSP at Odlohar-Simsyari, Bageshwar as on 11th March, 2024

Implementation of Tribal Sub Plan (TSP)

To empower tribal farmers, ICAR-CITH, Srinagar implemented the Tribal Sub Plan in 2024 across seven districts of Jammu & Kashmir and Ladakh. Ten programs were conducted in Srinagar, Bandipora, Shopian, Poonch, Ganderbal (J&K), and Leh and Kargil (Ladakh), benefiting 435 farmers. The institute provided need-based training and distributed farm inputs such as fruit and vegetable planting materials, knapsack sprayers, and secateurs. Program details are summarized in Table 42.

Table 42. Training/farm input distribution programs organized during 2024 under TSP

S. No.	Date	One day training programme	Input material Supplied	Venue	No. of Beneficiaries	Co-ordinators
1.	11th January, 2024	Temperate horticulture for increasing the farmers income	Planting material of apple, peach, plum, apricot and pomegranate	ICAR-CITH, Srinagar	50	S U Nabi, J I Mir, Sudhakara N R, Puneet Kumar, Jyoti Priya
2.	5th February, 2024	Diversification with horticultural crops for enhancing tribal farmers income	Planting materials and agricultural input	KVK Poonch	50	Puneet Kumar, G Nabi Bhat, & Showkat Ahmad

S. No.	Date	One day training programme	Input material Supplied	Venue	No. of Beneficiaries	Co-ordinators
3	24th April, 2024	One day training / demonstration programme on Temperate fruit production	Planting material of Apricot, Plum, Peach, Nectarine, Walnut & few Apple cultivars	KVK-Gurez, district Bandipora	27	KVK-Gurez, staff & S U Nabi
4	27th May, 2024	Good Horticultural Practices for cultivation of Temperate Fruit crops for tribal farmer from Faquir Gujari distt Srinagar	Tarpaulins	ICAR-CITH, Srinagar	25	S U Nabi, J I Mir, O C Sharma & M K Verma
5	28th May, 2024	Good Horticultural Practices for cultivation of Temperate Fruit crops for tribal farmer from Babanagri distt Ganderabal	Tarpaulins	ICAR-CITH, Srinagar	30	S U Nabi, J I Mir, O C Sharma & M K Verma
6	5th June, 2024	Potato Seed Production & Distribution Programme	Potato Seed & Tarpaulin	Izmarg Station of SKUAST-Kashmir, Gurez distt. Bandipora	85	Anil Sharma & S U Nabi
7	20th August 2024	Production practices of important temperate fruit crops for tribal farmers from District Shopian	knapsack sprayer and Pruning secateurs	KVK Shopian	50	S U Nabi & M A Sheikh
8	11th September, 2024	Production practices of important Temperate fruit crops for Tribal farmers of distt Ganderbal	Registration kit, knapsack sprayer and Pruning saw	SKUAST-K, KVK Ganderbal, Shuhama	55	S U Nabi, M A Sheikh & Sachin Kumar
9	13th September, 2024	Fruit and vegetable production in Ladakh for the farmers of Distt Leh	Knapsack sprayer, secateur and vegetable seeds	ICAR-CITH, Srinagar	15	S U Nabi, O C Sharma and Sachin Kumar

S. No.	Date	One day training programme	Input material Supplied	Venue	No. of Beneficiaries	Co-ordinators
10	16th October, 2024	Technologies for quality Fruit and vegetable production in cold arid region for the farmers of Distt Kargil	Knapsack sprayer & Pruning Saw	ICAR-CITH, Srinagar	48	O C Sharma, Muneer Ahmad Sheikh & Sachin Kumar
Total					**435**	

Training cum distribution program was conducted under TSP Scheme for the tribal farmers of Fakir Gujri District Srinagar

A one-day training cum distribution program under the TSP Scheme was conducted on 11th January 2024 at Fakir Gujri, District Srinagar, with participation from 50 tribal farmers. Dr. M.K. Verma, Director ICAR-CITH, emphasized the role of temperate horticulture and outlined future plans such as on-farm demonstrations and off-season vegetable cultivation. Dr. J.I. Mir spoke on developing orchards with high-yielding varieties, and Dr. Sajad Un Nabi, TSP Nodal Officer, highlighted the importance of the program and led a farm visit. Planting materials of apple, peach, plum, apricot, and pomegranate were distributed. The event was coordinated by Sudhakar N.R., Puneet Kumar, and Jyoti Priya.

Glimpses of programme organized for the tribal farmers of Fakir Gujri District Srinagar

Training cum planting material distribution under TSP for farmers of district Poonch

A one-day training program on diversification with horticultural crops and distribution of

Agricultural input material distribution among tribal farmers of distt Poonch.

agricultural inputs was held on 5th February 2024 at KVK Poonch for tribal farmers from various villages of Poonch district. The program included an interactive session to understand farmers' challenges and provide solutions for enhancing income through crop diversification. A total of 50 tribal beneficiaries received planting materials and agricultural inputs. The event was attended by Shri Puneet Kumar, G. Nabi Bhat, and KVK Poonch staff.

Training cum planting material distribution for demonstration in Gurez on temperate fruit cultivation

A one-day training and demonstration program was organized in collaboration with KVK-Gurez at Dawar on 24th April 2024. Planting material of elite fruit crop varieties—apricot, plum, peach, nectarine, walnut, and select apple cultivars—was distributed to farmers from Bagtore and Gurez blocks for 27 demonstration units. The planting material was supplied by

Glimpses of program organized in Gurez

ICAR-CITH, Srinagar under the Tribal Sub-Plan project. KVK staff provided detailed technical guidance for planting and management.

Exposure visits cum training program for tribal farmers of District Srinagar on good horticultural practices for cultivation of temperate fruit crops.

An exposure visit cum training program on "Good Horticultural Practices for Cultivation of Temperate Fruit Crops" was organized under the Tribal Sub Plan (TSP) by ICAR-CITH, Srinagar on 27th May 2024. A total of 25 tribal farmers from Fakir Gujri participated in the program. Dr. Sajad Un Nabi, the program coordinator, emphasized the significance of the TSP initiative. Dr. Om Chand Sharma provided insights on best horticultural practices to enhance productivity, while Dr. V.K. Pandey highlighted the role of crop diversification in improving farmers' income. Director Dr. M.K. Verma encouraged the adoption of modern fruit and vegetable cultivation practices. Scientists demonstrated key techniques and technologies during a farm visit. The program concluded with the distribution of two tarpaulins and one pruning saw to each beneficiary.

Glimpses of TSP program for tribal farmers of district Srinagar

Exposure visits cum training program for tribal farmers of district Ganderbal on Good horticultural practices for cultivation of temperate fruit crops in tribal areas

An exposure visit cum training program on "Good Horticultural Practices for Cultivation of Temperate Fruit Crops" was organized under the Tribal Sub Plan (TSP) by ICAR-CITH, Srinagar on 28th May 2024 for tribal farmers from Babanagri, District Ganderbal. A total of 30 farmers participated. Dr. Sajad Un Nabi, program coordinator, emphasized the importance of TSP activities, while Dr. Om Chand Sharma guided farmers on improving productivity through good horticultural practices. Dr. M.K. Verma encouraged the adoption of modern cultivation techniques for fruits and vegetables. Scientists provided hands-on training during a farm visit, where relevant technologies were demonstrated. At the end of the program, each beneficiary received two tarpaulins, one pruning saw, and one registration kit.

Glimpses of TSP programme for tribal farmers of district Ganderbal

ICAR-CPRI, Shimla and ICAR-CITH Srinagar in collaboration with KVK Gurez organized potato Seed Distribution Programme

ICAR-CPRI, Shimla and ICAR-CITH, Srinagar, in collaboration with KVK Gurez (SKUAST-Kashmir), organized a Potato Seed Distribution Programme under the Tribal Sub Plan on 5th June 2024 at Izmarg Station, Gurez Valley. Over 85 farmers and farm women from Bagtore block participated. The program focused on sensitizing farmers about quality seed production and multiplication in potatoes. Dr. Bilal Ahmad Bhat (KVK Gurez) highlighted the potential of potato seed production in Gurez conditions, while Dr. Anil Sharma (ICAR-CPRI) emphasized the importance of ICAR-CPRI's improved potato varieties. Dr. Sajad-Un Nabi (ICAR-CITH) spoke on disease management and bio-control measures. Quality breeder potato seeds were distributed by ICAR-CPRI, along with tarpaulins by ICAR-CITH. The initiative aims to boost livelihoods through improved yields, sustainable practices, and enhanced market potential for potatoes in this Himalayan tribal region.

Glimpses of program held at Gurez on 5th June , 2024 by ICAR-CPRI Shimla & ICAR-CITH, Srinagar

One Day Training program on Production practices of important temperate fruit crops for Tribal farmers from District Shopian

To empower tribal farmers of Shopian District, ICAR-CITH Srinagar, in collaboration with KVK Shopian, organized a one-day training program on "Production Practices of Important Temperate Fruit Crops" on 20th August 2024. Fifty tribal farmers participated in the program. The event began with a welcome address by Dr. Shaiq Ahmad Ganai. Dr. Sajad Un Nabi (Scientist, Plant Pathology) and Dr. Muneer Ahmad Sheikh (STO) from ICAR-CITH briefed the farmers on various ICAR-CITH schemes and emphasized integrating stone fruits with apple farming for sustainability. They also sensitized farmers about disease management through participatory approaches. Dr. Mir Shabir Ahmad (Scientist, Animal Science) highlighted the role of KVKs in enhancing farmer knowledge and self-reliance. Registration kits, knapsack sprayers, and pruning secateurs were distributed to all beneficiaries.

Glimpses of training program on Production practices of important temperate fruit crops for Tribal farmers from District Shopian held at KVK Shopian on 20th August, 2024

One Day Training-cum-Awareness program on Production Practices of important temperate fruit crops for Tribal farmers from District Ganderbal

ICAR-CITH Srinagar, in collaboration with KVK Ganderbal (SKUAST-K), organized a one-day Training-cum-Awareness Program on

"Production Practices of Important Temperate Fruit Crops" under the TSP Scheme 2024–25 at Shuhama Campus on 11th September 2024. Dr. Ishfaq Abidi, Chief Scientist and Head, KVK Ganderbal, inaugurated the program and emphasized the adoption of modern horticultural technologies and entrepreneurial opportunities for tribal farmers. Dr. Sajad-Un-Nabi, TSP Nodal Officer (ICAR-CITH), highlighted the production potential of temperate fruits and assured continued support through quality inputs and technical guidance. Scientists from both institutes interacted with 55 participating tribal farmers to address their cultivation-related queries. The program concluded with the distribution of registration kits, knapsack sprayers, and pruning saws to all beneficiaries.

Glimpses of Training-cum-Awareness program on Production Practices of important temperate fruit crops for Tribal farmers from District Ganderbal at KVK Ganderbal, Shuhama on 11th September, 2024

Training program cum input distribution for the farmers of District Leh- Ladakh

A one-day training program on "Fruit and Vegetable Production in Ladakh" was organized for farmers of Leh district on 13th September 2024, with participation from 15 farmers across various villages. Dr. O.C. Sharma emphasized the importance of fruit and vegetable cultivation in Ladakh and demonstrated nursery production techniques. A field visit was conducted to showcase horticultural technologies developed by the Institute. Dr. S.U. Nabi discussed plant protection strategies for different crops. Dr. O.C. Sharma, Dr. S.U. Nabi, and Dr. Sachin Kumar facilitated the program. Knapsack sprayers, secateurs, and vegetable seeds were distributed to all participants.

Glimpses of program for farmers of district Leh on 13th September,2024

Training program cum input distribution for the farmers of District Kargil- Ladakh

A one-day training program on "Technologies for Quality Fruit and Vegetable Production in Cold Arid Regions" was held on 16th October 2024 for farmers of Kargil district, Ladakh. A total of 48 farmers from over 8 villages participated. Scientists and officers from ICAR-CITH, Srinagar shared key advancements in fruit and vegetable production suited to Ladakh's conditions. The program included technical sessions and a field visit where farmers observed practical demonstrations of improved horticultural practices. Dr. O.C. Sharma, Dr. Muneer Ahmad Sheikh, and Dr. Sachin Kumar conducted the program. Each participant received a knapsack sprayer and pruning saw. Farmers appreciated the initiative and requested more such programs in the future.

Glimpses of training program under TSP for the farmers of Kargil district of Ladakh on 16th October, 2024

Mera Gaon Mera Gaurav

ICAR-CITH RS, Mukteshwar adopted Sunkiya village under the "Mera Gaon Mera Gaurav" (MGMG) initiative. Located at 1750 meters above sea level in Dhari block, Nainital district, the village received focused support during 2024 through two farmer awareness programs, one diagnostic/field visit, and one demonstration, benefiting over 38 farmers. Farmers were also provided with technical literature on temperate fruits and vegetables and received on-demand technical guidance. Details of the programs conducted under MGMG are summarized in Table 42.

Table 42. List of programs organized under MGMG.

S. No.	Date	One day training programme	Venue	No. of Beneficiaries	Co-ordinators
1.	8th February, 2024	Farmer Awareness Programme on Management and maintenance of temperate fruit	Sunkiya	14	Arun Kishor
2	9th February,2024	Farmer Awareness Programme on Management and maintenance of temperate fruit and distribution of onion seedling	Naveen Sunkiya	20	Arun Kishor
3	1st August,2024	Diagnostics visit at farmer's field	Sunkiya	4	Arun Kishor, Rashmi E.R.& Chandni
Total				**38**	

Farmers awareness programs on Management and maintenance of temperate fruit at Sunkiya 8th February,2024 under MGMG

Farmers awareness programs on Management and maintenance of temperate fruit and distribution of onion seedling at Naveen Sunkiya on 9th February,2024 under MGMG

Diagnostic visits at farmers field on 1st August, 2024

Exhibitions

ICAR-CITH, Srinagar and its Regional Stations actively participated in various exhibitions organized by different agencies throughout 2024. The institute showcased key technologies for rapid adoption by stakeholders. In addition to hosting exhibitions at the institute level, CITH took part in seven external exhibitions during the year. A brief summary of these events is provided in Table 42.

Table. 42. List of exhibitions organized by ICAR-CITH, Srinagar & its Regional Stations

Sr No.	Date	Department/ Organization/ event	Venue	Facilitated by
1	1st to 3rd March, 2024	Three Days exhibition on "Gatisheel Jammu and Kashmir… Aatam Nirbar Bharat Ki Or" at Jammu.	Jammu	Dr. Puneet Kumar and Sh Ishtiyaq Ahmad Sheikh
2	29th to 30th May, 2024	3rd edition of National conference on "Role of Academic Driven Startups in Developing Economy of J&K (RASE-2024)	NIT, Srinagar	Dr. Puneet Kumar, Dr. Vishal Dinkar and Dr. Sachin Kumar
3	16th to 17th July, 2024	Fruit Diversity show on occasion of ICAR Foundation Day	NASC Complex New Delhi	Dr M A sheikh & M K Verma
4	3rd to 5th October, 2024	three days exhibition during "RISE in Jammu and Kashmir: A mega exhibition"	Jammu	Dr. Puneet Kumar and Sh. Ajaz Ahmad Wani
5	20th to 23rd November, 2024	four days exhibition during "National Agricultural Summit and Mela 2024	SKUAST-Jammu	Dr. Puneet Kumar and Sh. Ghulam Nabi Bhat
ICAR-CITH, Regional Stations Mukteshwar				
6	21st February, 2024	Kisan Mela at ICAR-VPKAS, Almora	Almora	Dr Arun Kishor
7	27th September, 2024	Kisan Mela at ICAR-VPKAS, Almora	Almora	Dr Arun Kishor and Shri Ankush Chaudhary


Glimpses Three Days Exhibition on "Gatisheel Jammu and Kashmir… Aatam Nirbar Bharat Ki Or" at Jammu from 1st to 3rd March, 2024


Glimpses of Two days exhibition during 3rd edition of National conference on "Role of Academic Driven Startups in Developing Economy of J&K (RASE-2024)" at NIT, Srinagar from 29th to 30th June, 2024

Glimpses of Three days exhibition during "RISE in Jammu and Kashmir: A mega exhibition" at Jammu from 3rd to 5th October, 2024

Glimpses of Four days exhibition during "National Agricultural Summit and Mela 2024" at SKUAST-J Chatha, Jammu from 20th to 23rd November, 2024

Glimpses of Four days exhibition during "National Agricultural Summit and Mela 2024" at SKUAST-J Chatha, Jammu from 20th to 23rd November, 2024

Fruit Diversity show of ICAR at NASC complex New Delhi on 16th to 17th July, 2024

Radio/ TV Talks

Scientists of ICAR-CITH, Srinagar regularly delivered need-based TV and radio talks to promote wider dissemination of horticultural technologies and enhance farmers' income. These talks proved useful for both farmers and line departments. A total of 11 such programs were delivered by the institute's scientists during the year, as detailed in Table 42.

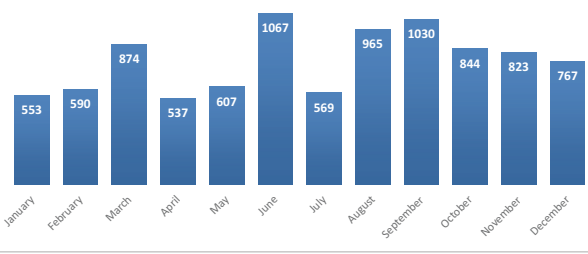
Table 42. Radio/ TV talks delivered by scientist of ICAR-CITH during 2024

Sr No	Name of Scientist	No. of talks
1	Dr W H Raja	7
2	Dr Sajad Un Nabi	4
	Total	11

Farmers/ visitors visit to ICAR-CITH, Srinagar

The well-managed orchards and crop technologies developed by ICAR-CITH, Srinagar continued to attract significant attention from farmers and visitors. In 2024, a total of 9,226 individuals visited the institute—reflecting a 20.68% increase compared to 2023. Month-wise details are shown in Fig. 18.

Fig. 18.Number of visitors/ farmers visited the Institute during 2024 (Total=9226)



6 TRAININGS AND CAPACITY BUILDING

ICAR-CITH, Srinagar is deputing its staff regularly for various need-based training programs organized time to time by various organizations for up gradation of knowledge and skill of the staff. During 2024, following officers were deputed for below mentioned trainings (online/offline) and have successfully completed the trainings.

Trainings attended by Scientific Staff

Dr O C Sharma, Principal scientist (Horticulture)

- Attended three-days Training Workshop on Introducing Exotic Orchids to Kashmir held at ICAR-CITH, Srinagar & SKUAST-K , Srinagar from 1st to 3rd August, 2024.
- Participated in Awareness programme on producing healthy planting material for vegetatively propagated fruit crops held at ICAR-Central Institute of Temperate Horticulture on 21st May, 2024.

Dr J I Mir, Principal Scientist (Plant Biotechnology)

- Attended short course training programme on Harvesting Brilliance in Next Generation Organic Farming at SKUAST-K, Srinagar from 1st to 10th March, 2024.
- Attended training on Plant Quarantine Procedures for Import and Export held at NIPHM, Hyderabad from 6th to 10th May, 2024.
- Attended training programme SRIJAN Empowering ITMUs of ICAR at NASC, New Delhi organized by IPTM, New Delhi from 13th to15th February, 2024.
- Attended training programme on Fostering Collaborative Ecosystem for Promoting Agri-Startups at i-Dea held at NAARM, Hyderabad from 18th to 20th September, 2024.
- Attended Procurement Workshop for the CPP organized by ADB, New Delhi at New Delhi on 23 December 2024.
- Attended IP awareness week organized by IP&TM, New Delhi from 8th to 14th , August, 2024.

Dr Arun Kishore, Scientist Sr Scale (Fruit Science)

- Attended virtual training on ARMS 2.0 conducted by IT unit, IASRI, New Delhi on 29th April, 2024.

Dr Geetika Malik, Scientist Sr Scale (Vegetable Science)

- Attended three-days Training Workshop on Introducing Exotic Orchids to Kashmir held at ICAR-CITH, Srinagar & SKUAST-K , Srinagar from 1st to 3rd August, 2024.
- Participated in Allium Day held at ICAR -CITH Srinagar on 22nd May, 2024

Dr W H Raja, Sceintist Sr Scale (Fruit Science)

- Attended three-days Training Workshop on Introducing Exotic Orchids to Kashmir held at ICAR-CITH, Srinagar & SKUAST-K , Srinagar from 1st to 3rd August, 2024.
- Participated in Awareness programme on producing healthy planting material for vegetatively propagated fruit crops held at ICAR-Central Institute of Temperate Horticulture on 21st May, 2024.

Dr Mohd Abas Shah, Scientist Sr Scale (Entomology)

- Attended five days training program on Fruit Fly Taxonomy at ICAR-NBAIR, Bengaluru from 8th to 12th January, 2024.
- Attended three days In-house Hands-on Training Program on Drosophila taxonomy in Dept. of Zoology, HNBGU, Srinagar (Uttrakhand) from 5th May to 7th May, 2024.

Dr Sajad Un Nabi, Scientist (Plant Pathology)

- Attended training on Plant Quarantine Procedures for Import and Export at NIPHM, Hyderabad from 6th to 10th May, 2024.
- Participated in IP Awareness Week programme (online) organized by IP&TM Unit, New Delhi in collaboration with ZTMC, ICAR-IIHR, Bengaluru from 8th to 14th August, 2024.

Dr Vishal Dinkar, Scientist (Plant Breeding & Genetics)

- Attended 21 days training on Statistical and Computational Advances for Bioinformatics Data Analysis in Agriculture: Practical Aspects' under CAFT held at ICAR-IASRI, New Delhi from 2nd to 22nd January, 2024.
- Attended three days training workshop on Exotic Orchids for Paradise on Earth – Introduction of Orchids in Kashmir jointly organized by ICAR-NRC on Orchids, ICAR-CITH, Srinagar and SKUAST(K), Kashmir from 1st August to 3rd August, 2024.
- Participated in 'IP Awareness Week' programme (online) organized by IP&TM Unit, New Delhi in collaboration with ZTMC, ICAR-IIHR, Bengaluru from 8th to 14th August, 2024.

Dr Puneet Kumar, Scientist (AS&PE)

- Attended three days' workshop on "Genomic advances in disease diagnostics and management in temperate fruit crops" held from 6th to 8th March 2024 at ICAR-CITH, Srinagar under DST-SERB, Scientific Social Responsibility (SSR) initiative.
- Participated in Awareness programme on producing healthy planting material for vegetatively propagated fruit crops held at ICAR-Central Institute of Temperate Horticulture on 21st May, 2024.

Dr Uzma Mehraj, Scientist (Floriculture and Landscaping),

- Successfully completed the Professional attachment training (PAT) at Division of Floriculture and Landscaping, ICAR-IARI, New Delhi from 19th October, 2023 to 19th January, 2024.

Dr Ronit Jaiswal, Scientist (Agricultural Statistics)

- Successfully completed 90 days Attachment training (PAT) at NIT Patna from 29th November, 2023 to 26th February, 2024.
- Attended three days' workshop on "Genomic advances in disease diagnostics and management in temperate fruit crops" held from 6th to 8th March 2024 at ICAR-CITH, Srinagar under DST-SERB, Scientific Social Responsibility (SSR) initiative.

Sh Sharath Kumar N, Scientist (Food Technology)

- Attended the PAT (Professional Attachment Training) at National Institute of Food Technology, Entrepreneurship and Management, Thanjavur (NIFTEM-T) in the Department of Food Engineering from 15th December 2023 to 15th March 2024.

Mrs Jyoti Priya, Scientist (Plant Physiology)

- Attended 21 days winter school on Genes to Proteins: Addressing Molecular Complexity of Agriculturally important traits in Crops held at Rani Lakshmi Bai Central Agricultural University, Jhansi from 19th February to 10th March, 2024

Dr Rashmi E R, Scientist (Plant Pathology)

- Successfully completed 21 Days Summer School cum Training on New Advancements in Agricultural Sciences: From the Green Revolution to Viksit Bharat 2047 (NAAS:2024) jointly organised by Agri Meet Foundation Bharat in Collaboration with ICAR-DCR Puttur Karnataka, SKLTSHU Telangana, MGUVV Durg Chattisgarh & ICAR NIBSM Raipur via Hybrid Mode from 15th August to 4th September 2024.
- Attended virtual training on ARMS 2.0 conducted by IT unit, IASRI, New Delhi on 29th April, 2024.
- Attended brainstorming session on Development of Business Module for Lettuce Cultivation in Kashmir under Public –Private Partnership held at ICAR-CITH, Srinagar on 26 April 2024.

Miss Chandni, Scientist (Vegetable Science)

- Attended online collaborative Training

Program of MANAGE & CREA on Decarbonizing Agriculture and Climate smart approaches for future sustainable farming from 12th to 14th August,2024.

- Attended 21 days winter school on Genomics and Innovative Breeding Approaches for Economically Important and Futuristic Traits in Vegetable Crops held at IARI, New Delhi from 6th to 26th March 2024.

Dr Reena Prusty, Scientist (Fruit Science)

- Successfully completed 3 months Professional attachment training program (PAT) at Division of Physiology, ICAR-IARI, New Delhi from 28th November, 2023 to 25th February, 2024.

Dr Kavitha R Scientist (Fruit Science)

- Successfully completed the Professional attachment training (PAT) at Division of Fruit Crops, ICAR-IIHR, Bengaluru from 28th November, 2023 to 22th March, 2024.
- Attended training programme for progressive orchardist and officials regarding latest technologies of introducing new grape varieties held at Ganderbal, Srinagar on 29th August, 2024
- Attended in Awareness programme on producing healthy planting material for vegetatively propagated fruit crops held at ICAR-Central Institute of Temperate Horticulture on 21st May, 2024.

Trainings attended by Administrative Staff

Sh. Fayaz Ahmad Dar, SF&AO

- Attended workshop on procurement at ADB Chanakyapuri, New Dehli on 23rd December, 2024.

Sh. Sadawarte Anand Rajesh, Administrative Officer

- Successfully completed Foundation Training Course held at ICAR-NAARM, Hyderabad from 20th March, 2024 to 19th April, 2024.
- Attended training on Domain Related to Personnel Administration at ISTM, New Delhi from 3rd to 7th June, 2024.
- Attended training on Areas Related to Procurement & Financial Management held at AJNI, Faridabad from 10th to 14th June, 2024.
- Training cum visit to SMD's at Krishi Bhawan, New Delhi from 24th to 28th June, 2024.
- Attended workshop on Procurement at ADB Chanakyapuri, New Delhi on 23rd December, 2024.

Sh. Ravi Bansal, Assistant

- Attended One Week of Module Training at ICAR-CITH, Srinagar from 11th to 17th September, 2024
- Attended 2nd Week of Module Training at ICAR-CIPHET Ludhiana from 19th to 25th October, 2024.

Sh. Lalit Gahlot, Assistant

- Attended One Week of Module Training at ICAR-CITH, Srinagar from 16th to 22nd September, 2024
- Attended 2nd Week of Module Training at ICAR-CIPHET Ludhiana from 19th to 25th October, 2024.

Sh. Subham Soni, Assistant

- Attended One Week of Module Training at ICAR-CITH, Srinagar from 9th to 15th October, 2024
- Attended 2nd Week of Module Training at ICAR-CIPHET Ludhiana from 19th to 25th October, 2024.

Miss Komal, Assistant

- Attended One Week of Module Training at ICAR-CITH, Srinagar from 12th to 18th November, 2024
- Attended 2nd Week of Module Training at ICAR-CIPHET Ludhiana from 30th December 2024 to 5th January, 2025

Sh. Rouf Ahmed, LDC

- Attended Two Week Training Program on Pre Examination Training (on line) for LDCE from the post of UDC under ICAR Headquarter from 21st August to 6th September, 2024.

Sh. Diwan Chandra, AAO

- Attended Workshop cum Training Program on eHRMS 2.0 organized by ICAR-IARI, New Delhi on 13th August , 2024
- Attended Procurement Workshop under CPP organized by ADB, New Delhi on 23rd December, 2024.

7 AWARDS/ REWARDS/ RECOGNITION

Dr Arun Kishor, Scientist SS (Fruit Science)

- Received Young Scientist Award in Fruit Science in the 9th International Conference on Current Approaches in Agricultural, Biological & Allied Sciences for Sustainable Development (CAABASSD-2024) organized by Agro Environmental Development Society (AEDS) Majhra Ghat, Rampur, Uttar Pradesh from 1st to 3rd March, 2024
- Received Young Horticulturist Award-2024 in the 6th International Conference on Cutting-Edge Solutions in Science-Agriculture, Technology, Engineering and Humanities (CSATEH-2024) at UGC-HRDC Hall, Kumaun University, Nainital, UK organized by Agricultural & Environmental Technology Developmental Society (AETDS) U.S. Nagar (Uttarakhand) from 24th to 26th August, 2024

Dr S U Nabi, Scientist-SS (Plant Pathology)

- Received Best Oral Presentation award during National Conference on Plant Health for Food Security: Threats and Promises, at ICAR-Indian Institute of Sugarcane Research (IISR), Lucknow, Uttar Pradesh from 1st to 3rd February, 2024

Dr Puneet Kumar, Scientist (AS&PE)

- Received Third Best Oral Presentation Award during 3rd edition of National Conference on Role of Academic Driven Startups in Developing Economy of J&K (RASE 2024) held at NIT, Srinagar from 29th to 30th June, 2024.
- Received 3rd Best Award in Vegetable (category: Cole crops) exhibition during "National Agricultural Summit and Mela 2024 held at SKUAST-Jammu from 20th to 23rd November, 2024.
- Received Consolation Award in Vegetable (category: Root and bulb crops) exhibition during National Agricultural Summit and Mela 2024 at SKUAST-Jammu from 20th to 23rd November, 2024.

Dr Ronit Jaiswal, Scientist (Agricultural Statistics)

- Received Young Scientist Award for outstanding contribution in the field of Agricultural Statistics by the Society for Scientific Development in Agriculture and Technology (SSDAT) on the occasion of IXth International Conference on Global Research Initiatives for Sustainable Agriculture & Allied Sciences (GRISAAS-2024) held at SKNAU-RARI, Durgapura, Jaipur, Rajasthan, India in hybrid mode from 10th to 12th December, 2024

Chandni, Scientist, (Vegetable Science)

- Received Third Prize in Oral Presentation on Advanced Prediction Models for White Mold outbreak in Temperate Beans in National Conference on Climate Smart Diseases Management for Sustainable Health Management (CDSM-2024) held at BAU, Sabour, Bhagalpur, Bihar from 10th to 12th July, 2024

Best Exhibition Stall Award

- ICAR-CITH, Srinagar Received best stall award during "RISE in Jammu and Kashmir: A mega exhibition" held at Royal Estate Banquet, Toph Sherkhanian, Jammu from 3rd to 5th October, 2024.

Plant variety protection

- CITH-W-5 (walnut variety) protected by PPV&FRA with registration number REG/2026/894 dated 22nd May, 2024

Patents granted/ Applied

- Satish Kumar, Poonam Panwar, Lakshya Partap Rana, Poonam Godara, Rupesh Sharma, Davender Singh, Javid Iqbal Mir and

Sunil Kumar received Design patent (406839-001) dated 7th February, 2024 on "Robot for real time weed and pest management in fields".

- Abhinav Dubey, Indra Mani, Suresh Mahadev Nebapure, Chandni, Roaf Ahmad Parray, Shalini Gaur Rudra, P K Sharma 2024 received patent on Polypropylene Reinforced Jute Bag Patent (No: 421978-001).

8 PUBLICATIONS

Research Papers

- Amulya S, Singh S K, Verma M K, Patel V B, Thakre M, Kumar C and Shankar K 2024. Response of selected scion and rootstock grape (*Vitis* spp.) genotypes to induced drought stress. *Journal of Horticultural Sciences* 19(1): 1-9.
- Bishnoi P, Thakre M, Maurya P, Jagga S, Gangappa N D, Nagaraja A, Verma M K, Krishnan S G, Varghese E and Mithra Sevanthi A 2024. Pulp colour and pigment composition have no genetic correlation with seed hardness in guava (*Psidium guajava* L.). *The Journal of Horticultural Science and Biotechnology*, 1-14. doi.org/10.1080/14620316.2024.2392090.
- Choudhary K, Jha G K, Jaiswal R, and Kumar R R 2024. Decomposition-based long short-term memory model for price forecasting of agricultural commodities. *Iran Journal of Computer Science* 7 (4): 1-13. DOI:10.1007/s42044-024-00203-x
- Demiwal P, Nabi S U, Mir J I, Verma M K, Yadav S R, Roy Partha and Sircar D 2024. Methyl jasmonate improves resistance in scab-susceptible Red Delicious apple by altering ROS homeostasis and enhancing phenylpropanoid biosynthesis. *Plant Physiology and Biochemistry* 207: 108371. https://doi.org/10.1016/j.plaphy.2024.108371
- Demiwal P, Mir J I and Sircar D 2024. A non-invasive method for phenotyping scab-tolerant apple plants using volatile organic compounds Ph*ysiologia Plantarum.* 176(3) e14377
- Dhakad A, Patel V, Singh S, Verma M K, Mishra G P, Mhetre V, Kumar C, Singh R, Rajkumar S and Gaikwad K., 2024. Pollen biology and metaxenic studies on early maturing grape (*Vitis vinifera*) genotypes. *The Indian Journal of Agricultural Sciences* 94(10): 1094-1099.
- Dinkar V, Jha S K, Niranjana M, Mallick N, Agarwal P and Sharma J B 2024. Molecular mapping of *Triticum monococcum* derived leaf rust resistance gene in durum wheat. *Physiological and Molecular Plant Pathology* 134, p.102467.
- Dubey A, Mani I, Chandni, Routray W, Nebapure S M and Parray R A 2024. Evaluating bag storage technologies for physical characteristics, loss reduction, and economic viability in pulses. *Journal of Stored Products Research*, 107, 102339. https://doi.org/10.1016/j.jspr.2024.102339
- Fayaz U, Hussain S Z, Naseer B, Mahdi S S, Mir J I, Ghosh A, Jana A Wani Z R, Jabeen A, Wani F J and Manzoor S. **2024**. Flavor profiling and gene expression studies of indigenous aromatic rice variety (Mushk Budiji) grown at different altitudes of Highland Himalayan regions. *Scientific Reports* **14**: 1010.
- Gul N , Ashraf J , Nowshehri, Mir M A , Wani S , Mir J I and Bhat M A 2024. MicroRNA: A novel micromachineries to target crop plants for tolerance to temperature stress plant. *Molecular Biology Reporter*. 42:48–56
- Hasan M, Tripathi K, Harun M, Krishnan V, Kaushik R, Chawla G, Shakil N A, Verma M K, Dahuja A, Sachdev A and Lorezo J M 2024. Unravelling the effect of extraction on anthocyanin functionality and prebiotic potential. *Heliyon*. 10(11): 11e31780.
- Hongal D A, Munshi A D, Talukdar A, Das A, Pradeepkumara N, Manjunath K K, Kumari J, Chinnusamy, V, Ranjan J K, Behera T K and Dey SS 2024. Role of important physiological traits and development of heat tolerance index in a large set of diverse cucumber germplasm. *Acta Physiol Plant* 46, 112
- Indrabi S A, Malik A, Malik G, Hussain K,

Shikari A, Mir J I, Park Ji Eun, Tuan Anh, Mansoor S and Masoodi K Z 2024. Phenotypic, biochemical and genetic diversity of pepper (*Capsicum* spp.) germplasm reflects selection for cultivar types and spatial distribution. *Plant Biotechnology Reports* 18: 341–360. https://doi.org/10.1007/s11816-024-00904-6.

- Jabeen A, Mir J I, Malik G, Yasmeen S, Ganie S A, Rasool R and Hakeem K R 2024. Biotechnological interventions of improvement in cabbage (*Brassica oleracea* var. *capitata* L.) *Scientia Horticulturae* 329 (2024) 112966.
- Jadhav A K, Singh S K, Srivastav M, Verma M K, Solanke A U, Kumar C and Singh N 2024. Standardizing ovule age for *in ovulo* embryo rescue in seedless grape (*Vitis vinifera*) breeding under the subtropical region. *Indian Journal of Agricultural Sciences*, *94*(6): 658-664.
- Khan Z A, Sharma S K, Gupta N, Diksha D, Thapa P, Shimray M Y, Prajapati M R,Nabi S U, Watpade s, Verma M K and Baranwal V 2024. Assessing the *de novo* assemblers: a metaviromic study of apple and first report of citrus concave gum-associated virus, apple rubbery wood virus 1 and 2 infecting apple in India. *BMC Genomics 25:* 1057. https://doi.org/10.1186/s12864-024-10968-x
- Khan Z A, Thapa P, Diksha D, Milem Y S, Sharma S K, Nabi S U, Wani S S , Mehraj D, Verma M K and Barnwal V K 2024. Virome analysis deciphered the infection of American plum line pattern virus, little cherry virus 1 and plum bark necrosis stem pitting-associated virus in plum from India. *European Journal of Plant Pathology, 171 (3) : 341-357*
- Kishor A, Debnath S, Das B, Narayan R, Attri B L, Kumar A, Chandni, Rashmi E R, Prasad R, Verma M K and Arunachalam A 2024. Integrated nutrient management in apple-based horti-olericulture system enhances yield of apple and intercrops and improves soil health in Kumaon region of Himalaya, Uttarakhand. *Indian Journal of Agroforestry*, Special Issue, 2024: 42-49.
- Kumar A, Adhikari S, Joshi A, Singh N K, Bharati A, Rohit R, Prasad B, Dinkar V and Singh A 2024. Study of co-localization of QTL for drought tolerance of morphological traits in teosinte introgressed maize population. *Cereal Research Communications*, 1-12.
- Kumar P, Kumar R, Shah M A, Singh R K, Sharma A K, Sharma A, Sharma J, Singh B and Kumar R 2024. Optimization of vine killing date for maximum seed-tuber yield and minimum exposure to late-season aphid vectors in potato. *Heliyon* 10(19) https://doi.org/10.1016/j.heliyon.2024.e38639.
- Kumawat K L, Raina S K, Kumar D, Verma M K, Singh D B, Mir J I, Sultan S M and Sharma O C 2024. Association of reproductive phenology with air temperature in almond (*Prunus dulcis* [Mill.] D.A. Webb) cultivars under Northwestern Himalayan conditions. *Applied Fruit Science* 66 : 581–588. https://doi.org/10.1007/s10341-023-00991-9
- Kumawat K L, Raja W H and Nabi S U 2024. Quality of nursery trees is critical for optimal growth and inducing precocity in apple. *Applied Fruit Science* 66: 2135–2143. https://doi.org/10.1007/s10341-024-01202-9
- Kumawat K L, Verma M K, Kumar D, Singh D B, Lal S, Mir J I, Sharma O C, Raja W H and Chand L 2024. Fatty acid profiling of almond germpalsm grown in the Western Himalayan region of India. *Journal of Environmental Biology* 45 (1) :106-116 DOI: http://doi.org/10.22438/jeb/45/1/MRN-5168
- Lone A, Jeelani S, Yasmin S, Irfan M, Dinkar V, Verma M K, Nabi S U and Malik G and Mir J I 2024. Morphological diversity in different almond varieties based on DUS descriptor. *Indian Journal of Horticulture* 81(4): 343–350.
- Malik G, Asma J, Mir J I, Shah R A, Shah M A, Dinkar V, Sheikh M A, Kumar R, Sharma O C and Verma M K 2024. Genetic diversity, population structure and marker-trait associations in Indian kale (*Brassica oleracea* L. gp. acephala) using cross-species microsatellite markers *Heliyon* 10 (8) https://doi.org/10.1016/j.heliyon.2024.e29521.
- Malik G, Shah R A, Shabir A, Dinkar V , Mir J I and Sharma O C 2024. Evaluation of long-day onion (*Allium cepa* L.) genotypes for yield

and quality traits under temperate conditions of Kashmir Valley in India. *Indian Journal of Plant Genetic Resources.* 37(2): 232-245. DOI: 10.61949/0976-1926.2024.v37i02.06.

- Manzoor S, Nabi S U, Raja W H, Mir J I, Mir R R, Jeelani F, Parveen S and Mansoor S 2024. Comparative biochemical and physiological responses to the virus-induced mosaic disease in apple (*Malus domestica*). *J Plant Dis Prot* 131 (3): 1945–1958 . https://doi.org/10.1007/s41348-024-00974-2
- Mehraj U, Singh K P, Kumar G, Panwar S, Pattanayak D and Mallick N 2024. Characterization of doubled haploids obtained by in vitro androgenesis in African marigold (*Tagetes erecta* L.) *Plant Cell, Tissue and Organ Culture,* 159. No. 1. 1
- Mir J I, Raina S K, Sharma O C, Raja W H, Nabi S U, Yasmeen S and Sultan S M 2024. Transcriptomic analysis of almond cultivars with differential flowering time. *Indian J. Genet. Plant Breed.* 84(1): 114-120
- Nabi S U, Verma M K, Mir J I, Raja W H, Shah M A, Parveen S Sharma O C and Baranwal V K 2024. Transmission efficiency protocol of two ilarviruses (ApMV and ApNMV) associated with mosaic disease of apple (*Malus* x *domestica*) through cleft grafting and T-budding. *Indian Phytopathology* 77: 433–439. https://doi.org/10.1007/s42360-024-00739-9
- Nabi Z, Manzoor S, Nabi, S U, Gulzar H, Rther M F, Arya V M, Baloch F S, Carmen V, Simona M P and Mansoor S 2024.Pattern-Triggered Immunity and Effector-Triggered Immunity: crosstalk and cooperation of PRR and NLR-mediated plant defense pathways during host–pathogen interactions. *Physiol Mol Biol Plants* 30, 587–604 .https://doi.org/10.1007/s12298-024-01452-7
- Nandi L, Pradeepkumara N, Suresh P, Munshi A D, Sharma, P K, Boopalakrishnan G and Dey S S 2024. Elucidating the genetics of post-harvest shelf-life of cucumber fruits and identification of associated QTLs and candidate genes. *Scientia Horticulturae* 327, 112800.
- Nisa Q, Gulzar G, Dar M S, Shahnaz E, Banday S, Bhat Z, El Sheikh M A,Nabi S U, Arya V M, Anwar Ali and Mansoor S 2024. New reports of pathogen spectrum associated with bulb rot and their interactions during the development of rot in tulip. *BMC Genom Data* 25: 40 . https://doi.org/10.1186/s12863-024-01218-w
- Pradeepkumara N, Parkash C, Bhatia R, Munshi A D, Rao M, Subhasmita S, Behera T K and Dey S S 2024. An efficient and easy-to-use protocol for induction of haploids in cucumber through parthenogenic embryo development. *Botanical Studies* 65(1): 1-17.
- Rane P, Thakre M, Verma M K, Kumar C, Prakash J, Srivastava V, Shashank P R, Murukan N, Chawla G, Mandal P K and Kumar H,Jadhav A K, Varghese E, Patel V B and Singh S K 2024. Studies on pollen micro-morphology, pollen storage methods, and cross-compatibility among grape (*Vitis* spp.) genotypes. *Frontiers in Plant Science*, *21:15:1353808. doi:10.3389/fpls.2024.1353808.*
- Rashmi E R , Mondal K K, Ghoshal T and Lakshmi M A 2024. Comparative gene expression of OsSWEETs from various rice genotypes during the development of bacterial blight as induced by the most virulent Race 4 of Xanthomonas oryzae pv. oryzae. *Australasian Plant Pathology* **53 (1):** 401-412.DOI:10.1007/s13313-024-00990-8
- Sreenayana B, Mondal K K, Kumar S, Mathiyalagan N, Reddy M S, Nagaranai Shanmugam K, Rashmi E R and Mani C 2024. Virulence profiling of emerging Indian strains of *Burkholderia glumae* causing panicle blight of rice. *Journal of Phytopathology* 172(2) , p.e13277
- Srivastava S, Pandey V K, Dar A H, Shams R, Dash K K, Rafiq S M, Zahoor I and Kumar S 2024. Effect of microencapsulation techniques on the different properties of bioactives, vitamins and minerals. *Food Science and Biotechnology* 33(14): 3181-3198.
- Supreetha B G, Prakasha D P, Kulapati Hipparagi, Prabhulinga G. Gurumurthy S B, Ratnakar Manjunath Shet and Ashok 2024 Efficient Micropropagation Techniques for

Finger Lime Cultivation with Emphasis on Shoot Tip Explants. *Eco. Env. & Cons.* 30 (3) : 1143-1148

- Supreetha B G, Singh, N P, Sharma S, Sharda R and Sharma A 2025. Comparison of fruit colour development and biochemical attributes under different mulching regimes in strawberry. *Acta Physiologiae Plantarum* 47(1), 1-13.
- Verma M K, Sharma O C, Mir J I, Raja W H and Nabi S U 2024. Current status and potential of temperate fruit crops for livelihood and nutritional security in India. *Indian J. Plant Genet. Resources*. 37(3): 387-403. DOI: 10.61949/0976-1926.2024.v37i03.01
- Zaffar A, Shafi S, Fatima S, Nabi S U *et al.*2024. Unveiling biochemical dynamics in common bean-*Pseudocercospora* Pathosystem under angular leaf spot pressure in Western Himalayan Kashmir. *Journal of Crop Health* 76 : 1343–1356. https://doi.org/10.1007/s10343-024-01035-2

Review Papers

- Ankad H, Dhillon A, Thakre M, Senapati R, Kumar R, Nayan Deepak G, Arumugam N, Verma M K, Krishnan S G and Mithra A 2024. Breeding for pulp colour in Guava: current status and opportunities. *The Journal of Horticultural Science and Biotechnology*, *99*(2): 130-145. doi.org/10.1080/14620316.2023.2251995.
- Dinkar V, Pandey S, Kumar A, Shiv A, Lal D, Bharati A, Joshi A, Adhikari S, Singh A, Pandey P K and Chandra A K 2024. Epigenetic regulations under plant stress: a cereals perspective. *Environmental and Experimental Botany* 220, p.105688.
- Dinkar V, Sarkarb S, Pandey S and Antred S H 2024. Plant stress phenotyping: Current status and future prospects. *Advances in Agronomy* 188, p.247.
- Kumar N S, Dar A H, Dash K K, Kaur B, Pandey V K, Singh A, Fayaz U, Shams R and Shaikh A M 2024. Recent advances in Cold Plasma Technology for modifications of proteins: A comprehensive review. *Journal of Agriculture and Food Research 16 (4) :* 101177 DOI:10.1016/j.jafr.2024.101177
- Kumar S N, Dar A H, Srivastava S, Dash K K & Pandey V K 2024. Carotenoids based Smart Packaging: A comprehensive review. *Measurement: Food*, 100190.
- Manzoor S, Nabi S U, Rather T R, Gani G, Mir Z A, Wani A W, Ali S, Tyagi A and Manzar N 2024. Advancing crop disease resistance through genome editing: a promising approach for enhancing agricultural production. *Front. Genome Ed.* 6:1399051. doi: 10.3389/fgeed.2024.1399051
- Nabi Z, Manzoor S, Nabi S U, Wani T A, Gulzar H, Farooq M, Arya V M, Baloch F S, Vladulescu C, Popescu S M and Mansoor S 2024. Pattern-triggered immunity and effector-triggered immunity: crosstalk and cooperation of PRR and NLR-mediated plant defense pathways during host–pathogen interactions. *Physiol Mol Biol Plants* 30: 587–604). https://doi.org/10.1007/s12298-024-01452-7
- Prusty R, Nayak S L, Priya J and Dinkar V 2024. Pomegranate fruit cracking: causes and control measures. *Food and Scientific Reports* 5(10): 23-27.

Book

- Geetika Malik, Asma Jabeen, Mhd Irfan Rather, J I Mir and M K Verma 2024. Exotic Vegetables of India-Their Cultivation and Pest Management. New Delhi, Astral International publisher, 118p.

Book Chapters

- Babu Ramesh, Santhiya, Chandni, Vinay N D, Pal Saheb and Hudedamani Umesh 2024. Organic Vegetable production: Recent advances and way forward. *In* : Research and Technology Advancement in Agriculture.
- Barman D, Yadav P, Priya J, Divya Bharathi R, Khan F N, Nagar S, Yadava P, Watts A, Ray S, Chinnusamy C 2024. Combating plant diseases through CRISPR -based genome editing approaches**.** *In*: Applied and Strategic Approaches for Management of Plant Diseases in 21st Century. CRC Press
- Bharati A, Kumar A, Chandra A K, Phogat

S, Poudel A, Adhikari S, Dinkar V and Choudhury S 2024. Breeding and Molecular Approaches for Heat-Resilient Crops. *In*: Climate-Resilient Agriculture *(Edited by Singh A and Pandey S)*. Apple Academic Press, pp. 193-226.

- Chandni and Thingujam Victor 2024. Agroforestry Multitrophic Interactions: An Overview. *In*: Multitrophic Interactions in Agroforestry for Sustainable Plant Protection. Apple Academic Press, [CRC Press, a Taylor & Francis Group].
- Chandni, Anu B C, Kiran Jaya, Dubey Abhinav and Kishor Arun 2024. Advances in Biofortification of Vegetables to Combat Malnutrition. Enhancing Crop Resilience: Advances in Climate Smart Crop Production Technologies. Biotica Publication, Tripura, pp 177-193.
- Dinkar V, Kushwaha A K, Singh A K, Sahu K P, Sarkar S, Bharati A, Kumar A and Singh B 2024. Recent advances in CRISPR/Cas9 for climate-resilient agriculture in vegetable crops. *In*: Climate-Resilient Agriculture (Singh, A. and Pandey, S. (eds). Apple Academic Press, pp. 373-414.
- Garai S, Vinayaka, Barman S, Udgata A R, Paul N C, Jaiswal R, Ramasubramaniam, Dhandapani A and Yashvanth B S 2024. Statistical modelling aspects of climate-resilient agriculture. *In* **:Research** and Technological Advances for Climate Resilient Agriculture ICAR-National Academy of Agricultural Research and Management, Hyderabad, India,pp 245-272.
- Kumar A, Bharati A, Chandra A K, Adhikari S, Joshi A, Kumar L, Dinkar V, Singh A and Kencharaddi HG 2024. Breeding and Molecular Mechanism of Drought Stress in Maize. *In*: Climate-Resilient Agriculture Agriculture *(Edited by Singh A and Pandey S)*. Apple Academic Press, pp. 481-508.
- Kumar N N, Kumar N S, BG Supreetha, R Kavitha, Prusty Reena, Huddedamani Umesh 2024. Processing and Value addition to alleviate Post harvest losses in fruits. *In*: Research and Technological Advances for Climate Resilient Agriculture edited by Srinivasarao C H, Vijay Avinashilingam, N A, Yashavanth B S, ICAR-National Academy of Agricultural Research and Management, Hyderabad, India,pp 245-272.
- Kumar N S, Kumar P and Verma M K 2024. Maturity indices, harvesting, grading and waxing of fruits. *In* : Post-harvest management of fruits and plantation crops (Vol. 2: Applied concepts). New Delhi,NIPA Genx Electronic resources & solutions P. LTD , pp. 27-60.
- Kumar S N 2024. Human Auditory System. *In* :Sensory Science Applications for Food Production, IGI Global, pp. 158-175.
- Kumar S N and Ranganathan T V 2024. Circular Models and Strategies to Reduce and Reuse Food Waste. *In*: Novel Approach to Sustainable Temperate Horticulture CRC Press, p 212-228.
- Kumar S N and Ranganathan T V 2024. Circular Models and Strategies to Reduce and Reuse Food Waste. *In* : Novel Approach to Sustainable Temperate Horticulture CRC Press, pp. 212-228.
- Manik Suryakant, Haritha Mohan M, Patel Asharani, Rashmi E R, Mythra R , Sharma Susheel Kumar 2024. Current scenario of impact of climate changes on plant diseases and their management strategies. ICAR-NAARM, Hyderabad, India. Pages 85-108
- Manzoor S, Mir Z A, Wani T A, Gulzar H, Nabi Zarka, Parveen S, Rather T R and Nabi S U 2024.Recent advances in diagnostic approaches for plant pathogen detection, Futuristic Trends in Biotechnology. IIP Series, Volume 3, 2024, p17-41, e-ISBN: 978-93-6252-428-7 , DOI/Link: https://www.doi.org/10.58532/V3BFBT3P1CH2
- Mhetre V B, Dinkar V, Vittal H, Sirasapalli B K, Jain S, Chaithra T S and Patil M S 2025. Gene Pyramiding to Increase the Sustainability of Crops Under Biotic and Abiotic Stresses. *In*: Plant Breeding Technology: Future Trends and Challenges (edited by Khan Z), CABI, pp. 49-83.
- Nabi S U, Parveen S, Raja W H, Shah M A and Sharma O C 2024. Potential strategies for plant disease management in hortipastoral systems under climate change. *In*:: Recent trends in

live stock and crop production technologies vis-a-vis climate change. Dilpreet publishers and distributors ,Vishnu Garden New Delhi, pp 371-382

- Nandha Kumar N, Sharath Kumar N, Supreetha B G, Kavitha R, Reena Prusty and Umesh Hudedamani . 2024. Processing and Value Addition to Alleviate Post Harvest Losses in Fruits. *In*: Research and technological advances for resilient agriculture, pp 245-272
- Panwar S, Namita, Panigrahi S, Girish P M,Uzma Mehraj and kumari P 2024. *Chrysanthemum morifolium*. *In*: Edible flowers. Health benefits, nutrition, processing and applications, pp 65-85
- Pathaw N,Sharma S K, Gupta N, Singh S, Sharma D, Sharma P, Nabi S U, Sanasam J, Devi K S, Wangkhem B, Devi O P, Singh T S, Maibam A, Monteshori S, Chandrajini H, Keisham M, Yumkhaibam T, Chanu W T and Roy S S 2024. Recent advances in the detection of plant viruses and viroids in field crops. *In*: Diseases of Field Crops: Diagnostics and Management. Edited by Singh V K, Akhtar J, Singh K P. Singapore, Springer,. https://doi.org/10.1007/978-981-97-6160-9_3
- Pradeepkumara N, Bhargav Kiran, Supreetha B G, Subhashree Subhasmita, Swagat Ranjan Behera 2024. Digital Agriculture: Technologies and Innovations, Modern Horizons in Agricultural Sciences. ISBN: 978-93-48091-98-7.
- Prakash O, Kumar P, Kaukab S, and Deo M M 2024. Postharvest technological aspects in pigeonpea. *In* : Pigeonpea in a Nutshell . New Delhi, AkiNik Publication, pp. 311-332.
- Rashmi E R, Prusty R, Priya J, Kavitha R and Supreetha B G 2024. Applications of Versatile CRISPR Technology for the Detection of Targeted Plant Pathogens. *In*: Conventional to Emerging Advances in Plant Disease Diagnosis and Pathogen Detection . CRC Press, pp 230-246.

Popular articles/pamphlet/folders/ Practical Manuals/ Technical Bulletins

- Atufa Regu, Mehraj Uzma, Kumar Ankit, Kumar Sandeep, Rout Rahul Kumar and Mallick Sonali 2024 Fostering agricultural development through corporate social responsibility. *Agri Articles* 4(4):330-344
- Chandni, Anu B C and Kishor Arun 2024. Uttarakhand's Floral Symphony: *Rosa banksiae*. *Agri India Today* 4(7):90-93.
- Chandni, Dubey Abhinav and Kishor Arun 2024. Production Technology of *Meetha Karela* (*Cyclanthera pedata*) in Kumaon Region of Uttarakhand. *The Agriculture Magazine* 4(3):20-22.
- Chandni, Kishor Arun and Rashmi E R 2024. Green Harvest, Golden Future: Underutilized Vegetables for Nutrition and Income in Uttarakhand's Hills. *The Agriculture Magazine* 3(8):53-55.
- Dubey A, Rout A S, Chandni, Nishani S, & Urhe S B 2024. Improving the quality and shelf life of flowers through modified atmospheric packaging (MAP). *The Agriculture Times* 4(2), October. E-ISSN: 2583-1755.
- Kumar P, Lalita and Kumar N S 2024. Biosensors: A rapid sensing technology for food processing Industry. *Agri Articles* 4(4): 706-709.
- Lalita, Kumar P, Sudhakara N R and Dinkar V 2024)Biodegradable packaging materials: Recent innovations in packaging materials. *Food and Scientific Reports*, 5(3): 28-32.
- Malik Ajaz Ahmed and Malik Geetika 2024 The Art and Science of Vegetable Breeding. New Delhi, EPH publishers,
- Malik Ajaz Ahmed and Malik Geetika 2024. Unveiling the Secrets of Vegetables. New Delhi, EPH publishers,
- Mhetre V B, Verma M K, Drakpa D, Bam G and Sudhakara NR. 2024. Potential and prospects of saffron cultivation in Arunachal Pradesh. *Food and Scientific Reports* 5(10): 41-47. E-ISSN 2582-5437.
- Parveen Shugufta, Nabi Sajad Un, Rashid Bisma and Verma Mahendra K 2024 Technologies for Pesticide residue elimination in temperate fruits. *Agri Tech Today*: 60-63
- Pradeepkumara N, Manisha R, Chouhan Ravindra, Murmu Dipak and Mani Arghya

2024. *Bacillus velezensis* -A Potential Bio-Control Agent. *Agriculture and Food*, 43, 23-26. *Published: 18-09-2024.*

- Prusty R, Nayak S L, Priya J and Dinkar V 2024. Pomegranate Fruit Cracking: Causes and Control Measures. *Food and Scientific Reports* 5(10): 23-27.
- Raja W H., Mhetre V, Supreetha BG, Verma M K, Sharma O C, Mir J I, Nabi S U, Shah M A Sudhakara N R, Kumar P and Drakpa D 2024. Scientific Cultivation of Kiwi Fruit for NEH. Published by Director, ICAR-CITH, Srinagar, 23p.
- Rashid Bisma, Sudhakara N, Nabi Sajad Un, Parveen Shugufta and Verma Mahendra K 2024. Plant Microbiome Engineering: A sustainable management approach for plant growth and disease management in temperate fruits. *Agri Tech Today:* 175-178
- Rashmi E R , Kishor A, and Chandni 2024. Burr knots in apple trees: Causes, environmental factors, and management. *Indian Horticulture* 69(4), 20-21.
- Rashmi E R, Kishor Arun and Chandni 2024. Deciphering the complexity of peach leaf curl: causes, environmental influences and effective management. *The Agriculture Magazine* 3(8): 252-255.
- Rasool Sheezana, Rasool Bushra, Ayaz Aadil, Manzoor Subaya, Parveen Shugufta and Nabi Sajad Un 2024. Endophytes and their role in enhancing horticultural productivity. *Agri Tech Today,* 2, (6): 32-34
- कुमार पु, नबी स उ, ललिता 2024 खाद्य सुरक्षा एवं पौधों की बीमाररयों पर जलवायु पररवर्नि का प्रभाव. *एग्री आर्टिकल्स* 4(4): 131-134.

9 PARTICIPATION IN WORKSHOPS/ CONFERENCE/ MEETING

Dr M. K. Verma, Director

- 20th SAC Meeting of the KVK Ganderbal on 20th May, 2024.
- IMC Meeting of ICAR-CISH Lucknow on 21st May, 2024.
- Stakeholders Consultation Meet on Nano-Fertilizers for Next Generation Agriculture organized by ICAR-ATARI Ludhiana, ICAR-CSSRI Karnal and SKUAST-K held at SKUAST-K, Srinagar on 24th July, 2024.
- Kashmir Science Vision 2024 Summit held at SKUAST-K, Srinagar on 22nd August, 2024.
- Stakeholders Meeting on Management and Post Harvest Technology of Apricot held at Krishi Bhawan, New Delhi on 25th October, 2024.

Dr O. C. Sharma, Principal Scientist (Horticulture)

- National Conference on Development of Horticulture in Indian Trans Himalayan Region through Cooperatives and Collectives organized by World Cooperation Economic Forum in collaboration with ICAR-Central Institute of Temperate Horticulture (CITH), Srinagar, Confederation of NGOs of Rural India (CNRI), National Cooperative Union of India (NCUI) held at SKUAST-K, Shalimar, Srinagar from 14th to 15th March, 2024
- Brain Storming Session on the Development of Business Modules for the Cultivation of Lettuce under the Temperate Region through Public Private Partnership on 26th April 2024 at ICAR-CITH Srinagar.
- One day Workshop on Agri-Food Systems in the Indian Himalayan Region (IHR) on 3rd June, 2024 at ICAR- Central Institute of Temperate Horticulture.
- Workshop on Introducing Exotic Orchids to Kashmir held at ICAR-CITH, Srinagar & SKUAST-K, Srinagar from 1st to 3rd August, 2024
- 15th Annual Group Meeting (AGM) of All India Network Research Project on Onion & Garlic (AINRPO & G) organized by ICAR-Central Institute of Temperate Horticulture, Srinagar and ICAR-Directorate of Onion & Garlic Research, Pune at ICAR-CITH Srinagar from 29th to 31st August 2024.

Dr J. I. Mir, Principal Scientist (Plant Biotechnology)

- Two days National Conference on Development of Horticulture in Indian Trans Himalayan Region through Cooperatives and Collectives organized by World Cooperation Economic Forum in collaboration with ICAR-Central Institute of Temperate Horticulture (CITH), Srinagar, Confederation of NGOs of Rural India (CNRI), National Cooperative Union of India (NCUI) from 14 to 15th March, 2024 at SKUAST-K, Shalimar, Srinagar.
- Brain Storming Session on the Development of Business Modules for the Cultivation of Lettuce under the Temperate Region through Public Private Partnership on 26th April 2024 at ICAR-CITH Srinagar.
- Awareness programme on producing healthy planting material for vegetatively propagated fruit crops held at ICAR-Central Institute of Temperate Horticulture CITH on 21st May, 2024.
- One day Workshop on Agri-Food Systems in the Indian Himalayan Region (IHR) on 3rd June, 2024 at the Central Institute of Temperate Horticulture.
- 15th Annual Group Meeting (AGM) of All India Network Research Project on Onion & Garlic (AINRPO&G) organized by ICAR-Central Institute of Temperate Horticulture, Srinagar and ICAR-Directorate of Onion &

Garlic Research, Pune at ICAR-CITH Srinagar from 29th to 31st August 2024.

- 55th REAC meeting (Kharif 2024) of SKUAST, K, Srinagar on 18th July, 20-24.

Dr Arun Kishore, Scientist SS (Fruit Science)

- Review Meeting of ICAR institutes through virtual made on 5th January, 2024 organized by DG ICAR New Delhi.
- Stakeholder meet at ICAR-VPKAS Almora on 30th January,2024.
- ITMU meeting through virtual mode on 2nd February, 2024 organized by ICAR-VPKAS Almora.
- SLEC Meeting on 19th February, 2024 as Member of SLEC Committee of HMNEH and DOHFP, Directorate of Horticulture & Food Processing, Uttarakhand.
- 9th International Conference on Current Approaches in Agricultural, Biological & Allied Sciences for Sustainable Development (CAABASSD-2024) organized by Agro Environmental Development Society (AEDS) Majhra Ghat, Rampur, Uttar Pradesh, India from 1st to 3rd March, 2024.
- Brain Storming Session on the Development of Business Modules for the Cultivation of Lettuce under the Temperate Region through Public Private Partnership on 26th April 2024 at ICAR-CITH Srinagar.
- Workshop on Agri-food system in Himalayan regions on 3rd June, 2024 through virtual mode organized by ICAR-CITH Srinagar.
- SAC Meeting of KVK, Kafligare, Bageshwar on 8th August, 2024 organized by KVK, Kafligare, Bageshwar.
- 6th International Conference on Cutting-edge Solutions in Science-Agriculture, Technology, Engineering and Humanities (CSATEH-2024) at UGC-HRDC Hall, Kumaon University, Nainital, UK, organized by Agricultural & environmental technology developmental Society (AETDS) U.S. Nagar (Uttarakhand) from 24th to 26th August, 2024.
- 18th RCM-I meeting through virtual mode on 22nd November organized by ICAR-CPRI Shimla.
- CPP meeting through virtual mode on 22nd November, 2024 organized by NHB.

Dr Geetika Malik, Scientist SS (Vegetable Science)

- 14th Annual Group Meeting of AINRPOG held from 11th to 13th January, 2024 at JNKVV, Jabalpur, Madhya Pradesh
- 42nd Annual Group Meeting of AICRP-Vegetable Crops on 22nd to 24th February, 2024 at ANDUAT, Ayodhya, Uttar Pradesh.
- Two days National Conference on Development of Horticulture in Indian Trans Himalayan Region through Cooperatives and Collectives organized by World Cooperation Economic Forum in collaboration with ICAR-Central Institute of Temperate Horticulture (CITH), Srinagar, Confederation of NGOs of Rural India (CNRI), National Cooperative Union of India (NCUI) from 14th to 15th March, 2024 at SKUAST-K, Shalimar, Srinagar.
- Brain Storming Session on the Development of Business Modules for the Cultivation of Lettuce under the Temperate Region through Public Private Partnership on 26th April 2024 at ICAR-CITH Srinagar.
- One Day Workshop on Agri-Food Systems in the Indian Himalayan Region (IHR) held at the Central Institute of Temperate Horticulture on 3rd June, 2024.
- 15th Annual Group Meeting (AGM) of All India Network Research Project on Onion & Garlic (AINRP O&G) organized by ICAR-Central Institute of Temperate Horticulture, Srinagar and ICAR-Directorate of Onion & Garlic Research, Pune at ICAR-CITH Srinagar from 29th to 31st August 2024.

Dr W H Raja, Scientist SS (Fruit Science)

- Two Days National Conference on Development of Horticulture in Indian Trans Himalayan Region through Cooperatives and Collectives organized by World Cooperation Economic Forum in collaboration with ICAR-Central Institute of Temperate Horticulture Srinagar, Confederation of NGOs of Rural India (CNRI), National Cooperative Union of India (NCUI) from 14th to 15th March, 2024 at SKUAST-K, Shalimar, Srinagar.

- One Day Workshop on Agri-Food Systems in the Indian Himalayan Region (IHR) on 3rd June, 2024 at the ICAR- Central Institute of Temperate Horticulture, Srinagar.
- Regional Level Workshop on High Altitude Temperate Horticulture: Challenges and Opportunities in Arunachal Pradesh and Sikkim organized by ICAR – ATARI, Zone -IV Guwahati, Assam held at Anini, Arunachal Pradesh on 19th December 2024.

Dr Mohd Abas Shah, Scientist SS (Entomology)

- National Conference on Development of Horticulture in Indian Trans Himalayan Region through Cooperatives and Collectives organized by World Cooperation Economic Forum in collaboration with ICAR-Central Institute of Temperate Horticulture (CITH), Srinagar, Confederation of NGOs of Rural India (CNRI), National Cooperative Union of India (NCUI) from 14 to 15th March, 2024 at SKUAST-K, Shalimar, Srinagar.
- Brain Storming Session on the Development of Business Modules for the Cultivation of Lettuce under the Temperate Region through Public Private Partnership on 26th April 2024 at ICAR-CITH Srinagar.
- Awareness programme on producing healthy planting material for vegetatively propagated fruit crops held at ICAR-Central Institute of Temperate Horticulture CITH on 21st May, 2024.
- One Day Workshop on Agri-Food Systems in the Indian Himalayan Region (IHR) on 3rd June, 2024 at the Central Institute of Temperate Horticulture.
- 15th Annual Group Meeting (AGM) of All India Network Research Project on Onion & Garlic (AINRPO&G) organized by ICAR-Central Institute of Temperate Horticulture, Srinagar and ICAR-Directorate of Onion & Garlic Research, Pune at ICAR-CITH Srinagar from 29th to 31st August 2024.

Dr Sajad Un Nabi, SS (Plant Pathology)

- National Conference on Plant Health for Food Security: Threats and Promises, at ICAR-Indian Institute of Sugarcane Research (IISR), Lucknow, Uttar Pradesh from 1st to 3rd February, 2024.
- Two Days National Conference on "Development of Horticulture in Indian Trans Himalayan Region through Cooperatives and Collectives", organized by World Cooperation Economic Forum in collaboration with ICAR-Central Institute of Temperate Horticulture (CITH), Srinagar, Confederation of NGOs of Rural India (CNRI), National Cooperative Union of India (NCUI) from 14th to 15th March, 2024 at SKUAST-K, Shalimar, Srinagar.
- Brain Storming Session on the Development of Business Modules for the Cultivation of Lettuce under the Temperate Region through Public Private Partnership on 26th April 2024 at ICAR-CITH Srinagar.
- Awareness Programme on Producing Healthy Planting material for Vegetatively Propagated Fruit Crops held at ICAR-Central Institute of Temperate Horticulture on 21st May, 2024.
- One Day Workshop on Agri-Food Systems in the Indian Himalayan Region (IHR) on 3rd June, 2024 at ICAR- Central Institute of Temperate Horticulture, Srinagar.
- National Symposium on Multidisciplinary Perspectives for Pest and Disease Management in Sustainable Production of Crops at SKUAST-K Shalimar, Srinagar, J&K from 28th to 30th August, 2024.
- 15th Annual Group Meeting (AGM) of All India Network Research Project on Onion & Garlic (AINRPO&G) organized by ICAR-Central Institute of Temperate Horticulture, Srinagar and ICAR-Directorate of Onion & Garlic Research, Pune at ICAR-CITH Srinagar from 29th to 31st August 2024.

Dr Vishal Dinkar, Scientist (Plant Breeding and Genetics)

- National Conference on Seed Spices and Allied Crops & Institute Industry Meet-2024' held at ICAR-NRC on Seed Spices, Tabiji, Ajmer from 13th to 15th March, 2024.
- 3rd Edition of Nation Conference on 'Role of Academic Driven Startups in Developing Economy of J&K (RASE-2024) held from 29th to 30th June, 2024 at NIT, Srinagar.

Dr Puneet Kumar, Scientist (AS&PE)

- National Conference on Development of Horticulture in Indian Trans Himalayan Region through Cooperatives and Collectives", organized by World Cooperation Economic Forum in collaboration with ICAR-Central Institute of Temperate Horticulture (CITH), Srinagar, Confederation of NGOs of Rural India (CNRI), National Cooperative Union of India (NCUI) from 14th to 15th March, 2024 at SKUAST-K, Shalimar, Srinagar.
- Brain Storming Session on the Development of Business Modules for the Cultivation of Lettuce under the Temperate Region through Public Private Partnership on 26th April 2024 at ICAR-CITH Srinagar.
- Awareness Programme on Producing Healthy Planting Material for Vegetatively Propagated Fruit Crops held at ICAR-Central Institute of Temperate Horticulture, Srinagar on 21st May, 2024.
- One Day Workshop on Agri-Food Systems in the Indian Himalayan Region (IHR) on 3rd June, 2024 at ICAR- Central Institute of Temperate Horticulture.
- 3rd Edition of Nation Conference on Role of Academic Driven Startups in Developing Economy of J&K (RASE-2024) held at NIT, Srinagar from 29th to 30th June, 2024
- 15th Annual Group Meeting (AGM) of All India Network Research Project on Onion & Garlic (AINRPO&G) organized by ICAR-Central Institute of Temperate Horticulture, Srinagar and ICAR-Directorate of Onion & Garlic Research, Pune at ICAR-CITH Srinagar from 29th to 31st August 2024.
- Workshop on Genomic Advances in Disease Diagnostics and Management in Temperate Fruit Crops held from 6th to 8th March 2024 at ICAR-CITH, Srinagar under DST-SERB, Scientific Social Responsibility (SSR) initiative.
- Regional Stakeholder Meeting for Potential Entrepreneurs organized by ICAR-Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora, Uttarakhand from 30th to 31st January, 2024.

Dr Uzma Mehraj, Scientist (Floriculture and Landscaping)

- National Conference on Recent Trends and Future Prospects of Floriculture in India organized by ICAR-IIHR, Bengaluru from 9th to 11th January, 2024
- Workshop on Generative AI Tools for Agriculture organized by ICAR-NAARM, Hyderabad from 26th to 28th June 2024.
- IP Awareness Week organized by IP and TM unit, New Delhi, in collaboration with ZTMC, ICAR-IIHR, Bengaluru (online) from 8th to 14th August, 2024
- Workshop on Introducing Exotic Orchids to Kashmir held at ICAR-CITH, Srinagar & SKUAST-K, Srinagar from 1st to 3rd August, 2024.
- 15th Annual Group Meeting (AGM) of All India Network Research Project on Onion & Garlic (AINRPO&G) organized by ICAR-Central Institute of Temperate Horticulture, Srinagar and ICAR-Directorate of Onion & Garlic Research, Pune at ICAR-CITH Srinagar from 29th to 31st August 2024.
- One Day Workshop on Agri-Food Systems in the Indian Himalayan Region (IHR) on 3rd June, 2024 at ICAR- Central Institute of Temperate Horticulture.
- Brain Storming Session on the Development of Business Modules for the Cultivation of Lettuce under the Temperate Region through Public Private Partnership on 26th April 2024 at ICAR-CITH Srinagar.

Dr. Ronit Jaiswal, Scientist (Agricultural Statistics)

- Brain Storming Session on the Development of Business Modules for the cultivation of Lettuce under the Temperate Region through Public Private Partnership on 26th April, 2024 at ICAR-CITH Srinagar.
- Awareness Programme on Producing Healthy Planting Material for Vegetatively Propagated Fruit Crops held at ICAR-Central Institute of Temperate Horticulture, Srinagar on 21st May, 2024.
- One Day Workshop on Agri-Food Systems

in the Indian Himalayan Region (IHR) on 3rd June, 2024 at ICAR- Central Institute of Temperate Horticulture, Srinagar.

- 15th Annual Group Meeting (AGM) of All India Network Research Project on Onion & Garlic (AINRPO&G) organized by ICAR-Central Institute of Temperate Horticulture, Srinagar and ICAR-Directorate of Onion & Garlic Research, Pune at ICAR-CITH Srinagar from 29th to 31st August 2024.

Sh. Sharath Kumar N, Scientist (Food Technology)

- Brain Storming Session on the Development of Business Modules for the Cultivation of Lettuce under the Temperate Region through Public Private Partnership on 26th April 2024 at ICAR-CITH Srinagar.
- One Day workshop on Agri-Food Systems in the Indian Himalayan Region (IHR) on 3rd June, 2024 at ICAR- Central Institute of Temperate Horticulture.
- Training Workshop on Introducing Exotic Orchids to Kashmir at ICAR-CITH, Srinagar & SKUAST-K, Srinagar from 1st to 3rd August, 2024.

Reena Prusty, Scientist (Fruit Science)

- National Conference on Development of Horticulture in Indian Trans Himalayan Region through Cooperatives and Collectives organized by World Cooperation Economic Forum in collaboration with ICAR-Central Institute of Temperate Horticulture (CITH), Srinagar, Confederation of NGOs of Rural India (CNRI), National Cooperative Union of India (NCUI) held at SKUAST-K, Shalimar, Srinagar from 14th to 15th March, 2024
- Brain Storming Session on the Development of Business Modules for the Cultivation of Lettuce under the Temperate Region through Public Private Partnership on 26th April 2024 at ICAR-CITH Srinagar.
- One day Workshop on Agri-Food Systems in the Indian Himalayan Region (IHR) on 3rd June, 2024 at ICAR- Central Institute of Temperate Horticulture.
- Workshop on Introducing Exotic Orchids to Kashmir held at ICAR-CITH, Srinagar & SKUAST-K, Srinagar from 1st to 3rd August, 2024
- 15th Annual Group Meeting (AGM) of All India Network Research Project on Onion & Garlic (AINRPO & G) organized by ICAR-Central Institute of Temperate Horticulture, Srinagar and ICAR-Directorate of Onion & Garlic Research, Pune at ICAR-CITH Srinagar from 29th to 31st August 2024.
- IP Awareness Week organised by IP&TM Unit, New Delhi, in collaboration with ZTMC, ICAR-IIHR, Bengaluru from 8th to 14th August 2024.

Dr. Kavitha R, Scientist (Fruit Science)

- Workshop on Package of Practices for Kharif Crops held at Experimental Farm, Hawalbagh, Almora in Hybrid mode organised by ICAR-VPKS, Almora from 29th to 30th July,2024.
- Workshop on Introducing Exotic Orchids to Kashmir held at ICAR-CITH, Srinagar & SKUAST-K, Srinagar from 1st to 3rd August, 2024.
- Brain Storming Session on the Development of Business Modules for the Cultivation of Lettuce under the Temperate Region through Public Private Partnership on 26th April 2024 at ICAR-CITH Srinagar.
- One Day workshop on Agri-Food Systems in the Indian Himalayan Region (IHR) on 3rd June, 2024 at ICAR- Central Institute of Temperate Horticulture.

Mrs. Jyoti Priya, Scientist (Plant Physiology)

- International Workshop-Cum-Webinar on "CRISPR Genome Editing: Basics to advanced application in agriculture, pharma and health sectors" from 22nd to 26th July, 2024.
- Brain Storming Session on the Development of Business Modules for the cultivation of Lettuce under the Temperate Region through Public Private Partnership on 26th April, 2024 at ICAR-CITH Srinagar.
- One day Workshop on Agri-Food Systems in the Indian Himalayan Region (IHR) on 3rd June, 2024 at ICAR- Central Institute of Temperate Horticulture.

- 15th Annual Group Meeting (AGM) of All India Network Research Project on Onion & Garlic (AINRPO&G) organized by ICAR-Central Institute of Temperate Horticulture, Srinagar and ICAR-Directorate of Onion & Garlic Research, Pune at ICAR-CITH Srinagar from 29th to 31st August 2024.

Dr Rashmi E R, Scientist (Plant Pathology)

- 1st International Workshop-cum-Webinar on CRISPR Genome Editing" held from 22nd to 26th July, 2024.
- International Conference on Plant Protection in Horticulture (ICPPH-2024) held at ICAR-Indian Institute of Horticultural Research, Bangalore, Karnataka from 25thto 27th September 2024
- XVth Annual Group Meeting of All India Network Research Project on Onion and Garlic held at ICAR-CITH, Srinagar from 29th to 31st August 2024.

Mrs Chandni, Scientist, (Vegetable Science)

- National Conference on Climate Smart Diseases Management for Sustainable Health Management (CDSM-2024) held at BAU, Sabour, Bhagalpur, Bihar from 10th to 12th July, 2024
- 6th International Conference on Cutting-Edge Solutions in Science-Agriculture, Technology, Engineering and Humanities (CSATEH-2024) at Kumaon University, Nainital, UK, organized by Agricultural & Environmental Technology Developmental Society (AETDS) U.S. Nagar (Uttarakhand) from 24th to 26th August, 2024.

Dr Supretha B G, Scientist (Fruit Science)

- Regional Level Workshop on Supply chain management of high-altitude horticulture and livestock: opportunities and challenges held organized by ICAR – ATARI, Zone -IV Guwahati, Assam at Dirang, Arunachal Pradesh on 3rd March. 2025.
- National Conference on Managing Agro-Biodiversity in North Eastern India (NCMAN-2024) held at ICAR-Research Complex for NEH Region from 22nd to 25th October,2024.
- Regional Level Workshop on High Altitude Temperate Horticulture: Challenges and Opportunities in Arunachal Pradesh and Sikkim organized by ICAR – ATARI, Zone -IV Guwahati, Assam at Anini, Arunachal Pradesh from 19th December 2024.

Dr Pradeepkumara N, Scientist (Vegetable Science)

- National Conference on Managing Agro-Biodiversity in North Eastern India (NCMAN-2024) held at ICAR-Research Complex for NEH Region from 22nd to 25th October,2024.
- Attended National Conference on Hill-Agro Ecosystem; Challenges and Opportunities for Achieving Sustainable Development Goals" at ICAR Nagaland Centre, Jharnapani, Medziphema from 29th to 30th November 2024.
- Attended Regional Level Workshop on High Altitude Temperate Horticulture: Challenges and Opportunities in Arunachal Pradesh and Sikkim organized by ICAR – ATARI, Zone -IV Guwahati, Assam at Anini, Arunachal Pradesh from 19th December 2024.

Dr Muneer Ahmad Sheikh, Senior Technical Officer (T-6)

- National Conference on Plant Health for Food Security: Threats and Promises", at ICAR-Indian Institute of Sugarcane Research (IISR), Lucknow, Uttar Pradesh from 1st to 3rd February, 2024.

Dr Sachin Kumar, Senior Technical Officer (T-6)

- 3rd Edition of Nation Conference on Role of Academic Driven Startups in Developing Economy of J&K (RASE-2024) held at NIT, Srinagar from 29th to 30th June, 2024

10 LIST OF ONGOING PROJECTS

I. Institute Research Projects	
A. Project: Crop improvement and Biotechnology Sub projects	
1.	Survey, collection, characterization and documentation of temperate horticultural crops
2.	Breeding for development of superior varieties/hybrids in solanaceous vegetables
3.	Development of superior cultivars/ hybrids in temperate fruits through conventional and non conventional methods
4.	Characterization and diversity analysis of flowering related gene/ genes in almond
5.	Development of CMS lines in long day onion [*Allium cepa* L]
6.	Rootstock breeding in apple (*Malus* x *domestica*)
B. Project: Crop Production and Propagation Sub projects	
1.	Assessment of soil carbon dynamics and carbon sequestration potential of selected temperate fruit crops of Arunachal Pradesh
2.	Impact of combined application of phosphorous and silicon on apple rootstock performance under various soil moisture regimes
3.	Development and evaluation of integrated nutrient management module for high-quality temperate vegetable production
4.	Development of almond based saffron inter cropping system
5.	Canopy management and plant architectural engineering in temperate fruits
6.	Development of different techniques for enhancing the multiplication rate of temperate fruits under protected/open conditions
7.	Standardization of integrated nutrient management of vegetables as intercrop in apple orchard
8.	Development of Efficient Organic Production Practices of Persimmon (*Diospyros kaki* L.) for North-Eastern Region
9.	Diseases and Pest Identification Models for Various Temperate Horticultural Crops using Deep learning Techniques
C. Project: Crop Protection Sub projects	
1.	Diagnosis, transmission and management of virus/virus like diseases of temperate fruit crops
2.	Elucidating the diversity, species spectrum and screening of germplasm against *Alternaria* spp. infecting temperate fruits
3.	Bionomics, modeling and management of sucking pest complex of temperate fruits

4.	Bioprospecting of Rhizo-cum-endospheric Microbiome/Microbiota of temperate fruit Rootstocks for management of soil and foliar diseases
5.	Biology, ecology and management of fruit flies infesting temperate fruits
	D. Project: Post Harvest Management Sub projects:
1.	Synthesis of nanocellulose from horticultural waste material and development of packaging film by incorporating biodegradable polymer
2.	Upcycling of Temperate Fruit and Vegetable Derived Pomace into a Sustainable Carotenoid Avenue for Functional Food Product Development
3.	Rosehip Seed Oil-Based Oleogels as Sustainable Fat Substitute in Food Applications
	E. Ongoing externally funded projects Sub projects
1.	Network project on onion and garlic (co-operation centre)
2.	All India coordinated research project (Vegetable Crops)
3.	National Agriculture Innovation Fund/ Intellectual Property Management and Transfer/Commercialization of Agriculture Technology
4.	DUS Centre for temperate fruits and nuts
5.	Walnut propagation for production of quality planting material for walnut promotion in Uttrakhand
6.	DUS centre for olive
7.	Development and validation of DUS guidelines in Kale under Indian conditions
8.	Development of DUS guidelines for Pran
9.	Augmentation of plant genetic resources and capacity building of researchers in India and Uzbekistan
10.	Production of quality planting material of elite walnut cultivars and demonstration of improved agro technology for walnut orchards in Kashmir and Arunachal Pradesh
11.	Augmentation of plant genetic resources and capacity building of researchers in India and Uzbekistan
12.	Characterizing diversity, genome profile and development of robust diagnostics for *Diplodia* spp. associated with canker disease of apple (*Malus domestica* Borkh.) in north western Himalayan region of India (DST-SERB)
13.	Development of infectious clone, point-of-care diagnostics and transcriptome profiling for apple (*Malus domestica*) exhibiting mosaic disease associated with apple necrotic mosaic virus in Northwestern Himalayan region of India
14.	Artificial Intelligence enabled Biotic & Abiotic Stress Detection and Advisory Mobile Application for Crops
15.	Bioprospecting of Rhizo-cum-endospheric Microbiota of Apple Rootstocks for management of soil borne diseases of temperate fruit crops
16.	Hazard Analysis in pome fruit crops under Clean Plant Programme
17.	Capacity building for improving skill and efficiency in transfer of technologies in farmers field under J & K State
18.	A comparative metabolomics approach for the analyses of scab-disease resistance in apple and development of a metabolite-based non-invasive sensor for early scab-disease diagnosis.
19.	Development of PEQ facilities at Srinagar, Mukteshwar & Dirang" for temperate fruits and nuts
20.	Appraisal of the dual ecosystem services of syrphid flies in apple orchards: pollinators and bioagents
21.	Development of edible coating with enriched antimicrobial bioactive compounds for various stone fruits
22.	Development and evaluation of integrated nutrient management module for producing high quality long day onions and its impact on soil quality

23.	All India Network Project on Vertebrate Pest management
24.	Genome editing using CRISPR Cas-9 for inducing precocity in apple
25.	Development of Decision Support System for Monitoring and Management of Emerging Aphid Pests in Apple Orchards
26.	Agri-Drone Project (ADP): Central Sector Scheme of DA&FW, Sub-Mission on Agricultural Mechanization, Component 1 – Drone Technology Demonstration
27.	Development and Evaluation of Stem Banding Technique for the Management of Woolly Apple Aphid, *Eriosoma lanigerum* (Hausmann, 1802) in Apple Orchards (Contract Research)

11 RESEARCH REVIEW AND MANAGEMENT COMMITTEES

Research Advisory Committee of ICAR-CITH, Srinagar (17th December, 2024 to 16th December, 2027)

1.	**Dr B. C. Deka** Vice Chancellor, AAU Johrat, Assam	**Chairman**
2.	**Dr S. Rajan** Former Director, ICAR- CISH, Lucknow	Member
3.	**Dr Raj Kumar** Former Head, ICAR- IARI, Rgional Station Katrain, Kullu (Himachal Pradesh)	Member
4.	**Dr K. K. Anjaneyulu** Former Head, ICAR-IIHR, Bengaluru	Member
5.	**Dr Ambika Baldev** Principal Scientist, ICAR-NBPGR, New Delhi	Member
5.	**Dr Vikramaditya Pandey** Principal Scientist, Horticultural Science Division ICAR, New Delhi-110 012	Member
6.	**Shri Abdul Jabbar Parey** S/O Sh Mohd Jamal Parrey, R/O Yorekhoshipora, Qazigund, Distt. Kulgam (J&K)	Non-Official Member
7	**Shri ChheringAngchok** 34 Tyapa, Sakara, Leh, Ladakh, 194 101	Non-Official Member
8.	**Dr V. B. Patel** Asstt. Director General (F&PC) Horticultural Science Division ICAR, KAB-II, Pusa, New Delhi-110012	Ex – Officio Member
9.	**Dr Mahendra Kumar Verma** Director, ICAR-CITH, Srinagar	Ex – Officio Member
10.	**Dr Javid Iqbal Mir** Principal Scientist & Head ICAR-CITH, Srinagar	**Member Secretary**

Institute Management Committee (IMC)

1.	**Dr Mahendra Kumar Verma** **Director** ICAR-CITH, Srinagar	**Chairman**
2.	Director Horticulture, Kashmir Govt. of J&K, Raj Bagh, Srinagar	Member

3.	**Director** Horticulture & Food Processing, Deharadun, Uttarakhand	Member
4.	**Vice Chancellor Nominee** SKUAST-K, Srinagar	Member
5.	**Dr. O P Awashti** Head, Division of Fruit and Horticulture Technology, ICAR- IARI, New Delhi.	Member
6.	**Dr Anil Sharma** Head, ICAR-CPRI, Regional Station Jalandhar	Member
7.	**Dr Dinesh Kumar** Principal Scientist, Crop Production CISH, Lucknow	Member
8.	**Dr Suresh Kumar Upadhaya** Professor, Horticulture,CSKHPKV Palampur	Member
9.	**Shri Abdul Jabbar.Parey** S/O Sh Mohd Jamal Parrey, R/O Yorekhoshipora, Qazigund, Distt. Kulgam (J&K	Member / Progressive Farmer
10.	**Shri ChheringAngchok** 34 Tyapa, Sakara, Leh, Ladakh, 194101	Member / Progressive Farmer
11.	**Dr V B Patel** Asstt. Director General (F&PC) Horticultural Science Division ICAR, KAB-II, Pusa, New Delhi-110012	Member/Council representative
12.	**Sr Amitabh Singh** Sr F&AO. ICAR Headquarter Amitabh	Member
13.	**Administrative Officer** ICAR-CITH, Srinagar (J&K)	**Member Secretary**

12 DISTINGUISHED VISITORS

- Dr Himanshu Pathak, Secretary, DARE and Director General, ICAR, visited ICAR-CITH, Srinagar on 5th November 2024. During his visit, he was briefed on the ongoing research activities at the Institute. He interacted with the staff and provided valuable suggestions for further improvement. Dr. Pathak also inaugurated the Farmers-cum-Trainees' Hostel and visited various laboratories and experimental fields. He appreciated the efforts of the Director and scientists in advancing temperate horticulture research and development.

Glimpses of visit by Dr Himanshu Pathak, Secretary DARE and Director General ICAR to ICAR-CITH, Srinagar

- Dr Trilochan Mohapatra, Chairman, PPV&FRA, New Delhi, and former Secretary, DARE and Director General, ICAR, visited ICAR–Central Institute of Temperate Horticulture, Srinagar on 30th September 2024. During his interaction with the scientists, Dr. Mohapatra emphasized the need to focus on key areas such as rootstock breeding, value addition in fruits and vegetables, exploration of minor fruit crops, and the medicinal potential of various horticultural crops.

Glimpses of visit by Dr Trilochan Mohapatra Chairman, PPV&FRA, New Delhi, former Secretary DARE and Director General (DG), ICAR, New Delhi to ICAR-CITH, Srinagar

- Dr Mangala Rai, former Secretary, DARE and Director General, ICAR, New Delhi, visited ICAR–Central Institute of Temperate Horticulture, Srinagar on 6th August 2024. During his visit, he interacted with the staff and shared his insights on shaping the future course of research at the Institute.

- Shri Sardar Chetan Singh, Hon'ble Horticulture Minister, Government of Punjab, along with a team of state officials, visited ICAR–Central Institute of Temperate Horticulture (ICAR-CITH), Srinagar on 28th June 2024. During the visit, the Hon'ble Minister was apprised of the ongoing research activities at the Institute. Dr. M. K. Verma, Director, ICAR-CITH, highlighted the potential of various temperate fruit crops in Punjab, with particular emphasis on pear, plum, peach, and low-chill apple, as well as the importance of canopy management. The Minister underscored the need for collaborative research between ICAR-CITH and the Government of Punjab, focusing on canopy management and varietal evaluation under Punjab's agro-climatic conditions. He also visited the exhibition showcasing the technologies and varieties developed by the Institute.

Glimpses of visit and discussion with Shri S Chetan Singh, Honourable Horticulture Minister, Govt of Punjab during his visit to ICAR-CITH, Srinagar

- Dr (Prof) Nazeer Ahmed Ganai, Vice Chancellor SKUAST-K visited ICAR-CITH, Srinagar on 5th November 2024 and was apprised about various research activities going on at the Institute.
- Dr S K Chaudhari, DDG (NRM), ICAR KAB II, Pusa New Delhi visited ICAR-CITH Srinagar on 3rd June, 2024. He was briefed about various research activities going on at the Institute for the benefit of farmers.
- Dr (Prof) Nazeer Ahmed Ganai, Vice Chancellor, SKUAS-K visited ICAR-CITH Srinagar on 3rd June, 2024 and was briefed about the research priorities of the Institute.

Felicitation of Dr S K Chaudhari, DDG (NRM) ICAR KAB II, Pusa New Delhi and Dr (Prof) Nazeer Ahmed Ganai, Vice Chancellor, SKUAS-K during their visit to ICAR-CITH, Srinagar

- Dr B N Tripathi, Vice Chancellor, SKUAST-J visited ICAR-CITH Srinagar on 21st May, 2024.

Dr B N Tripathi, Vice Chancellor, SKUAS J during his visit to ICAR-CITH, Srinagar

- Dr P.L. Gautam, Ex Vice Chancellor (GBPUAT, Pant Nagar) and Ex Chairman, PPV & FRA, New Delhi visited ICAR-Central Institute of Temperate Horticulture, Srinagar on 30th September, 2024. Dr P L Gautam stressed upon more collaborations with other R& D institutes of hill regions, and focused on varietal release which institute has developed.
- Dr J. P. Sharma, Former Vice Chancellor, SKUAS J visited ICAR-CITH Srinagar on 20th May, 2024.

Dr J. P. Sharma, Former Vice Chancellor, SKUAST- J during his visit to ICAR-CITH, Srinagar

- Prof. (Dr) Indra Mani Mishra, Vice-Chancellor, VNMKV-Parbhani visited ICAR-CITH Srinagar on 9th June, 2024.

Visit of Prof. (Dr) Indra Mani Mishra, Vice-Chancellor, VNMKV-Parbhani

- Dr H P Singh, Ex DDG (Hort) visited ICAR-CITH, Srinagar on 16th October, 2024 and apprised with various research activities going on at the Institute.

Staff interaction with Dr H P Singh, Ex DDG (Hort) during his visit to ICAR-CITH, Srinagar

- Sh. Saurabh Bhagat (IAS), Commissioner/ Secretary to Govt. of J&K, Department of Science & Technology visited institute on 22nd June, 2024 and lauded the research work being carried out by ICAR-CITH Srinagar. He visited the various germplasm blocks, laboratories and appreciated the work being done both on basic and applied research fronts by the institute.

Visit of Sh. Saurabh Bhagat (IAS), Commissioner/Secretary to Govt. of J&K, Department of Science & Technology

Visit of Dr V B Patel ADG Horticulture-ICAR-New Delhi to ICAR-CITH Srinagar on 29th April &4th October,2024

- Dr H. S. Gupta, Chairman, Assam Agri Commission, Ex DG Borlaug Institute for South Asia (BISA), Ex Director ICAR-IARI visited ICAR-CITH Srinagar on 17th May, 2024.
- Dr Rasappa Viswanathan, Director, ICAR-IISR, Lucknow visited ICAR-CITH Srinagar on 28th March, 2024.
- Dr G. P. Singh, Director, ICAR-NBPGR, New Delhi visited ICAR-CITH Srinagar on 30th April, 2024
- Dr Nachiket Kotwaliwala, Director ICAR-CIPHET, Ludhiana visited ICAR-CITH Srinagar on 24th May, 2024.
- Dr R. Dinesh, Director ICAR-IISR, Calicut, Kerala visited ICAR-CITH Srinagar on 12th June, 2024.
- Dr. V. B. Patel, Assistant Director General (Horticulture–Fruits & Plantation Crops), ICAR, New Delhi, visited ICAR–Central Institute of Temperate Horticulture, Srinagar on 29th April 2024. During his visit, he was briefed on the ongoing research and institutional activities. Dr. Patel also inaugurated the Plant Virology Laboratory in the presence of Dr. M. K. Verma, Director, ICAR-CITH; Dr. Sajad Un Nabi, Scientist (Plant Pathology) and Lab In-charge; along with other scientific staff of the Institute.
- Dr V.B. Patel, ADG Horticulture-ICAR-New Delhi visited Central institute of Temperate Horticulture, Srinagar on 4th October, 2024. The visit was in connection with the Clean Plant Program (CPP) and in order to review the ongoing research activities of the institute.
- Dr Sridevi Annapurna Singh, Director CSIR-CFTRI, Mysuru visited ICAR-CITH, Srinagar on 17th November, 2024.
- Dr M Maheswari, Director, CSR&T Pampore visited ICAR-CITH, Srinagar on 11th October, 2024.
- Sh. Mahmood Ah Shah, Director Handicraft and Handloom, Kashmir visited ICAR-CITH Srinagar on 15th January, 2024.
- Sh. Raja Babu Singh, IPS, IG, Trg BSF Hqrt visited ICAR-CITH Srinagar on 20th June, 2024.

13 PERSONNEL

(As on 31st December, 2024)

ICAR-CITH Head Quarter, Srinagar

RMP

- Dr. M K Verma, Director

Scientific

- Dr O C Sharma, Principal Scientist (Horticulture)
- Dr. J.I. Mir, Principal Scientist (Agricultural Biotechnology)
- Dr. Geetika Malik, Scientist SS (Vegetable Science)
- Dr. Wasim Hassan Raja, Scientist SS (Fruit Science)
- Dr. Mohd. Abas Shah, Scientist SS (Agriculture Entomology)
- Dr. Sajad Un Nabi Naingroo, Scientist SS(Plant Pathology)
- Dr. Sudhakara N R, Scientist (Soil Science)
- Dr. Puneet Kumar, Scientist (AS&PE)
- Dr Uzma Mehraj Scientist (Floriculture)
- Dr Reena Prusty, Scientist (Fruit Science)
- Dr. Kavitha R, Scientist (Fruit Science)
- Dr. Ronit Jaiswal, Scientist (Agricultural Statistics)
- Sh Sharath Kumar N, Scientist (Food Technology)
- Mrs Jyoti Priya, Scientist (Plant Physiology)

Administrative

- Shri. Fayaz Ahmad Dar, Sr F&AO
- Shri Sadawarte Anand Rajesh, Administrative Officer
- Smt. Shahida Rafiq, P S to Director
- Shri. Showkat Ahmad Mir, AAO
- Shri. Reyaz Ahmad Mir, AAO
- Shri Tariq Ahmad Mir, P A to Director
- Shri. Mehraj-ud-Din Meer, Assistant
- Shri Ravi Bansal, Assistant
- Shri Shubham Soni, Assistant
- Miss Komal, Assistant
- Shri Lalit Ghalot, Assistant
- Shri Rouf Ahmad Sheikh, LDC
- Shri Khushi Ram, LDC

Technical

- Sh. Eshan Ahad, Sr.Technical Officer (T-6)
- Dr. Muneer Ahmad Sheikh, Senior Technical Officer (T-6)
- Dr Sachin Kumar, Senior Technical Officer (T-6)
- Sh. Mehraj-ud-Din Bhat, Sr. Technical Assistant (T-4)/Driver
- Sh. Farman Ali, Technical Officer (T-5)/ Driver)
- Smt. Mubeena, Technical Assistant (T-3)
- Sh Ishtiyaq Ahmad Sheikh, Sr.Technician (T-2)/ Field

Skilled Supporting Staff

- Sh. Ajaz Ahmad Wani, SSS
- Sh. Bashir Ahmad Dar, SSS
- Sh. Showkat Ahmad Dar, SSS
- Sh. Abdul Rashid Bhat, SSS
- Sh. Bashir Ahmad Ganai, SSS
- Sh. Zubair Ahmad Swathi, SSS
- Sh. Madan Lal, SSS
- Sh. Ghulam Nabi Bhat, SSS
- Sh. Shabir Ahmad Mir, SSS

ICAR-CITH, Regional Station, Mukteshwar (Uttarakhand)

Scientific Staff

- Dr. Arun Kishor, Scientist SS (Fruit Science)
- Miss Rashmi E R, Scientist (Plant Pathology)
- Miss Chandni, Scientist (Vegetable Science)

Administrative

- Sh. Diwan Chandra, AAO
- Sh. Pushpendra Kumar,UDC

Technical Staff

- Sh. Vinod Chandra, Sr. Technical Officer (T-6)
- Sh Ankush Chaudhary, Technician (T-I)

Skilled Supporting Staff

- Sh. Narayan Singh, SSS
- Sh. Govind Giri, SSS

ICAR-CITH, Regional Station Dirang (Arunachal Pradesh)

Scientific Staff

- Dr Supretha B G, Scientist (Fruit Science)
- Sh Pradeepkumara N, Scientist (Vegetable Science)

14
NEW JOINING/ TRANSFERS/ RESIGNATION/ DEMISE

New Joining/ Transfers/ Resignation/ Demise

New Joining

- Dr Uzma Mehraj, joined as Scientist (Floriculture) at ICAR-CITH, Srinagar on 29th January, 2024 after transfer from ICAR-DFR, Pune.
- Sh Pradeepkumara N., joined as Scientist (Vegetable Science) at ICAR-CITH, RS Dirang (Arunachal Pradesh) on 19th February, 2024.
- Sh. Sadawarte Anand Rajesh, joined as Administrative Officer at ICAR-CITH, Srinagar on 20th April, 2024.
- Dr Sajad Ahmad Sheikh, joined as Subject Matter Specialist (Animal Science) at ICAR-CITH, KVK, Baramulla on 21st May, 2024.
- Dr Sachin Kumar joined as Senior Technical Officer (T-6) at ICAR-CITH, Srinagar on 27th May, 2024.
- Sh. Vishal Vihan, joined as Subject Matter Specialist (Agriculture Extension) at ICAR-CITH, KVK Baramulla on 29th May, 2024.
- Dr Anjali Gairola, joined as Subject Matter Specialist (Home Science) at ICAR-CITH, KVK, Baramulla on 3rd June, 2024
- Dr Neeraj, joined as Subject Matter Specialist (Plant Protection) at ICAR-CITH KVK, Baramulla on 5th June, 2024 (A/N).
- Sh. Ravi Bansal, joined as Assistant at ICAR-CITH, Srinagar on 11th September, 2024.
- Shri Lalit Ghalot, joined as Assistant at ICAR-CITH, Srinagar on 16th September, 2024.
- Sh. Shubham Soni, joined as Assistant at ICAR-CITH, Srinagar on 9th October, 2024 (A/N).
- Miss Komal, joined as Assistant at ICAR-CITH, Srinagar on 12th November, 2024.
- Miss Sapna, joined as Technician (T-I) at ICAR-CITH, Srinagar on 8th May, 2024.
- Sh. Ankush Chaudhary, joined as Technician (T-I) at ICAR-CITH, Regional Station Mukteshwar on 22nd April, 2024.

Transfers

- Sh. K.R. Vashisht, Lower Division Clerk joined ICAR-CITH, Srinagar on 2nd February, 2024 after his transfer from ICAR-CITH, Regional Station, Dirang (Arunachal Pradesh).
- Dr Manoj Kumar, Programme Coordinator & Head, ICAR-CITH, KVK Baramulla was relieved from ICAR-CITH, Srinagar on 19th June, 2024 (A/N) to join as Head, ICAR-CAZRI, KVK Pali (Rajasthan).
- Sh. Mohd Muzafer, Lower Division Clerk has been relieved from ICAR-CITH, Srinagar on 20th August, 2024 (A/N) to enable him to join at ICAR-CPRI, Shimla.
- Dr Vishal Dinkar, Scientist (Genetics & Plant Breeding) is relieved from ICAR-CITH, Srinagar on 9th December, 2024 after his transfer to ICAR-IIPR, Kanpur.

Resignation

- Sh. Mhetre Vishal Balasaheb, Sr. Technical Officer has been relieved from ICAR-CITH, Regional Station, Dirang (Arunachal Pradesh) on 12th July, 2024 after his resignation.
- Miss Sapna has been relieved from ICAR-CITH, Srinagar on 31st August, 2024 after her resignation.

Demise

- Sh. Puran Chandra, Technical Assistant (T-1-3) at ICAR-CITH, Regional Station Mukteshwar expired on 7th August, 2024.