

वार्षिक प्रतिवेदन Annual Report 2025



भाकृअनुप-केन्द्रीय शुष्क बागवानी संस्थान
बीकानेर-334006 (राजस्थान)

ICAR-Central Institute for Arid Horticulture
Bikaner-334006 (Rajasthan)

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Beechwal, Bikaner-334 006 (Rajasthan)



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Preface

Arid horticulture offers tremendous potential to transform the arid and semi-arid agro-ecosystems of India by enhancing farm productivity, profitability, and resource-use efficiency, particularly per unit of water and other production inputs. The expansion of arid horticulture and related value chains can generate significant rural employment through nursery production, cultivation, processing, packaging, marketing, and export activities. As horticulture contributes nearly one-third of India's GVA, it is poised to become an even stronger driver of agricultural growth, particularly in arid and semi-arid regions. In this context, ICAR-Central Institute for Arid Horticulture (CIAH), Bikaner, Rajasthan, along with its Regional Station, Central Horticultural Experiment Station (CHES), Vejalpur, Gujarat, and Krishi Vigyan Kendra (KVK), Panchmahal, Gujarat continues to promote climate-resilient horticultural technologies and sustainable production systems.



During the year, the varieties Thar Shobha (khejri, *Prosopis cineraria*) and Thar Kasturi (kachri, *Cucumis callosus*) were notified and recommended by the SVRC, paving the way for wider adoption of improved climate-resilient crops. Similarly, Goma Yashi, an improved bael (*Aegle marmelos*) variety developed at CHES, Vejalpur, has attracted considerable interest in southern states, particularly Karnataka, with over 5,000 saplings supplied for establishing mother blocks for the first time. Several advanced technologies are also nearing large-scale deployment, including an optimized propagation protocol for Barhee date palm, identification of a rain-tolerant date palm genotype, development of climate-resilient pomegranate genotypes, propagation methods for peelu (*Salvadora oleoides*), and orange-fleshed, carotenoid-rich watermelon genotype. These innovations, along with improved crop production and post-harvest technologies, are expected to enhance horticultural expansion, climate adaptation, nutritional security, livelihoods, and employment generation. A collaborative project supported through Corporate Social Responsibility (CSR) initiatives aims to optimize technologies for large-scale adoption by farmers and solar companies, promoting simultaneous expansion of green belts and renewable energy development in the Thar Desert. Through its research, extension, and outreach programs, CIAH, Bikaner, benefited around 10,000 farmers and stakeholders, while CHES, Vejalpur, and KVK, Panchmahal, reached approximately 5,600 and 19,000 farmers, respectively, through training, demonstrations, and technology dissemination activities.

I would like to place on record our sincere appreciation to Dr. M.L. Jat, Secretary, DARE and Director General, ICAR, New Delhi, for his steadfast support, visionary leadership, and invaluable guidance in strengthening the institute's research and development initiatives. We also express our deep gratitude to Dr. S.K. Singh, DDG (Horticultural Science) and Dr. V.B. Patel, ADG (Fruits and Plantation Crops), for consistent support and valuable contributions to the institute's growth and progress.

The institute gratefully acknowledges the Chairpersons and members of various committees, including QRT, RAC, IRC, and IMC, for their invaluable guidance and support. We also thank the Central and State Government agencies for facilitating research and developmental activities. Special appreciation is extended to all staff members, particularly the Publication Committee, for their dedicated efforts in bringing out this publication within the stipulated timeframe. The research presented herein was supported by the ICAR, Department of Agricultural Research and Education, Government of India.

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February, 2026


(Jagadish Rane)
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Executive Summary

This chapter highlights the notable achievements of ICAR-CIAH during the year 2025.

Genetic Resources and Crop Improvement

ICAR-CIAH has been designated by the National Active Germplasm Site (NAGS) as a premier nodal centre for conserving and managing plant genetic resources of arid fruits and vegetables. A total of 2,793 germplasm accessions were maintained and conserved. In addition, 26 germplasm of various fruits and vegetables were collected during 2025.

During 2025, ICAR-CIAH, Bikaner focused on evaluating, characterizing and improving fruit crops for hot arid regions, identifying promising genotypes with high yield, quality and stress tolerance.

In ber, seven germplasm were evaluated and Jodhpur-1, Jodhpur-7 showed superior yield. Fourteen hybrids showed variation in growth, fruit size (14–20 g), TSS and ascorbic acid. From 106 accessions, 46 promising types were selected for drying (27–55% yield). In jharber, 164 genotypes were screened and 5 elite accessions were identified for fresh use and dehydration.

Among date palm germplasm, 40 female genotypes showed wide variation in yield (8–86 kg/plant) and TSS (20–53°B). Promising types included Dhamas (early, 40–50 kg/plant, high TSS), CIAH/DP/F1 (late, rain-tolerant) and CIAH/DP/F2 (high yielding, 75 kg/plant). Among male genotypes, CIAH/DP/M-01, M-03, M-04 and M-06 were superior, with the highest pollen production in M-01 (745 g/plant). Among ICARDA genotypes, M1N1 was superior for yield, while MHN/B excelled in fruit quality.

CIAH PG-1 and CIAH PG-4 of pomegranate were identified as elite genotypes for high aril weight (36 g/100 arils) and rind anthocyanin (909 mg/kg). CIAH PG-1 was found superior for yield (12.40 kg/plant), acidity and anardana recovery (2.23 kg/plant).

In bael, 72 seedling genotypes were screened under rainfed hot arid conditions for drought tolerance using morpho-physiological traits. Identified CIAH-AMS-39, 41 and 69 as highly tolerant types. Among citrus germplasm, identified Sathgudi as the best-performing sweet orange. The selection CIAH-SO-24/17 outperformed the check Blood Red. Acid lime accessions (CIAH-AL-01, AL-03 and AL-10) showed superior yield and quality.

Identified 6 elite genotypes of pili during exploration. High variability was observed in fruit weight (0.27–0.96 g), fruit volume and biochemical traits. Nineteen *Cordia myxa* genotypes were evaluated. Identified RP-8-1, RP-11-2, RP-20-2 and RP-12-2 as promising genotypes.

Round melon genotype, CIAH-RM-1 showed superior performance with yield potential of 143–219 q/ha and suitable for *kharif* cultivation. In muskmelon, the promising genotypes included AHMM-17, AHMM-20 and AHMM-27, while CIAH-MM-1 performed best under heat-stressed arid conditions.

Bottle gourd genotype, CIAH-LS-1 identified as a superior for early fruiting and yield (4.26–5.63 kg/plant). In drumstick genotype, CIAH-MO-1 showed early bearing (within 2 years), high yield, drought tolerance and high biomass production. Khejri genotypes (Selection 3, 4, 5 and 6) were found promising for pod size, quality and dehydration recovery.

F₆ population of watermelon exhibited considerable variability in fruit weight (2.5–3.5 kg) and TSS (11.8–5.9°B). Selected AHW/YF Sel.-1 as promising genotype with yellow flesh, oblong fruit shape and non-lobed leaf as morphological trait. Muskmelon line, AHMM/BR-52 was found promising. It produced round fruits with a reddish-brown rind marked by green sutures and greenish-white flesh.

In chilli, 114 accession were evaluated and

characterized for 45 traits which showed wide variability. Twenty-six fennel accessions were evaluated under arid conditions. Variability was induced through gamma radiation in AF-1 and GF-11.

Research at CHES, Vejalpur during 2025 focused on the evaluation, characterization and improvement of fruit and vegetable crops.

In aonla, NA-7 showed superior fruit set and retention, while CHESA-4 recorded the highest yield (75 kg/ plant) among advanced genotypes. Seedling populations showed high variability, with yield positively linked to fruit size and juice content.

In bael, 222 genotypes and 129 seedlings revealed wide variation in yield (70–182 kg/ plant). CHESB-42, 48, 59, 60, 62, 69, 71, 73, 77, 78 were identified as promising based on yield and quality traits.

Guava germplasm also showed good diversity and hybrids H-1, H-2, H-1/27 and H-2/20 were found promising for yield (25–55 kg/ tree), quality and shelf life. In acid lime, promising selections (CHESL-14, CHESL-15 and CHESL-32) exhibited high yield (55–63 kg/ plant), good juice content (48–51%) and desirable quality traits.

Among 22 jamun genotypes, identified CHESJ-30 and CHESJ-10 as superior. CHESJ-30 yielded 48 kg/ tree with 15–20 g fruits, high pulp content (91%) and vitamin C (44 mg/ 100 g). CHESJ-10 produced 45 kg/ tree with 20 g fruits, 82.5% pulp and 16.8°B TSS.

In Manila tamarind, identified CHESM-4 (46 kg/ tree, >74% pulp, 22–26°B TSS) and CHESM-27 (33 kg/ tree, >73% pulp, 24°B TSS, 120 mg/100 g vitamin C) as promising genotypes for high yield and quality parameters.

Evaluation of 12 custard apple hybrids revealed wide variability, with CAH-5 as the best performer (28–32 kg/ plant, highest TSS). CAH-1 produced the largest fruits, while CAH-3 had the lowest seed number.

Among 32 genotypes of Red Sitaphal, identified CHESRCA-05, 12 and 16 as promising for yield and pulp. In Ramphal, the genotypes CHESR-18, CHESR-14, CHESR-19 and CHESR-1 were found superior.

Evaluation of 32 tamarind genotypes highlighted CHEST-11 and CHEST-27 as promising selections. CHEST-27 produced up to 60 kg yield/ plant and high TSS (72°B). Among 30 chironji genotypes, identified CHESC-2 as a superior type having desirable quality traits and high kernel protein content (32.42%).

LS-28 × LS-20-2 (long fruited), an advance elite line of bottle gourd yielded 15.3 kg per plant under rainfed semi-arid conditions. In cucumber, the promising lines CHES C-1, CHES C-2, CHES C-3 and CHES C-4 were advanced to the sixth generation.

Biotechnological and Biochemical Studies

In date palm cv. Barhee, callus from shoot tip explants was multiplied via cell suspension culture on MS medium with 2,4-D, NAA, and BA under controlled conditions. Cultures showed variability, producing embryos (1–10 mm) within 7–30 days. Repeated subculturing yielded about 3000 cultures at various stages. Optimization with 0.1–1.0 mg 2,4-D and activated charcoal enhanced cell growth and cluster formation, leading to successful plantlet establishment.

In chilli, genome-wide analysis identified 199 heat shock protein genes with diverse structures and sizes (6.12–157.85 kDa). Most showed complex exon-intron patterns, with chromosome 1 harboring the most genes. A total of 135 stress-related cis-elements were found. Expression analysis revealed strong interactions, with seven genes significantly upregulated in heat-tolerant genotypes.

Biochemical evaluation of jamun germplasm revealed wide variability in phytochemical traits. Fruit pulp showed moderate phenolics, flavonoids, and antioxidant activity, with CHES-J-72, CHES-J-17, and Konkani Bahadoli performing best. Seeds exhibited much higher phenolic and antioxidant levels, identifying Katha, CHES-J-72, CHES-J-21, and CHES-J-117 as promising for nutraceutical use.

In mahua, fatty acid profiling of 34 germplasm indicated dominance of C18 fatty acids, especially oleic, linoleic, and stearic acids. Saturated fatty acids ranged from 40–55%, while unsaturated fatty acids constituted 45–60%, including 8–19% poly-unsaturated fatty acids, reflecting good nutritional quality.

Crop Production

In date palm, pollen source significantly affected fruit set and quality, with CIAH/DP/M-1 recording the highest fruit set (15.40%). Among cultivars, Barhee showed the maximum fruit set (15.85%). The combination Medjool $\times$ CIAH/DP/M-1 produced superior fruit size (36.58 mm length, 23.31 mm width) and TSS (52°B), while Khalas with the same pollen source recorded the highest yield (78 kg/plant). Among pollination methods, strand pollination gave the highest number of fruits per strand (17), whereas spray pollination resulted in higher bunch weight (7.89 kg) and yield (62.88 kg/plant).

In ber, the Y-shape training system proved most effective, producing higher yield, better-quality fruits and maximum economic returns. However, the espalier system improved ease of harvesting. The comparatively lower canopy temperature stress was noted in Y-shape and espalier systems.

Natural farming practices using Panchgavya, Jiwamrita, Ghan Jiwamrita, Agniastara and Tumbastra significantly improved fruit quality in aonla and ber under arid conditions. In aonla, the highest pulp weight (30.56 g) was recorded under Panchgavya + Jiwamrita, while maximum vitamin C (309 mg/100 g) was observed under Ghan Jiwamrita + Tumbastra. In ber, Ghan Jiwamrita + Agniastara + Tumbastra recorded the highest yield (56.95 kg/plant).

Under organic nutrient management of ber, vermicompost recorded the highest yield (41.8 kg/tree), while FYM + biofertilizers enhanced organic carbon (0.51%) and microbial activity. The integrated use of organic manures improved soil physical, chemical and biological properties. The highest yield was recorded under vermicompost + biofertilizers in karonda (15.3 kg/plant) and with vermicompost alone in bael (78.7 kg/plant).

In INM studies in ber, NPK (100% RDF) + 60 kg FYM + crop residue mulching recorded the highest fruit dimension (3.9 $\times$ 3.5 cm), weight (24 g) and yield (53.39 kg/tree). However, maximum TSS (20.24°B) and total sugars (9.09%) were observed under RDF + 30 kg FYM + K₂SO₄ spray. Integration of waste wool (7.5 t/ha) with FYM (15 t/ha) recorded maximum plant growth, root yield (1998 kg/ha fresh and 651 kg/ha dry), quality parameters of ashwagandha and maintained higher soil moisture.

At CHES, Vejalpur, the INM treatment grass mulch + FYM + neem cake + 50% RDF + Azotobacter + VAM in bael cv. Goma Yashi significantly improved growth, yield and fruit quality. Under high-density planting of bael cv. Goma Yashi planted during 2020-21, maximum yield per plant (17 kg) was recorded at wider spacing (8 m $\times$ 6 m), whereas highest yield per hectare (52 q/ha) was obtained at closer spacing (4 m $\times$ 4 m). Moderate spacing (6 m $\times$ 4 m) provided a balanced yield (51.75 q/ha).

Crop Protection

Azoxystrobin + Difenconazole (0.1%) was the most effective treatment for Alternaria leaf spot in date palm cv. Halawy, with the lowest PDI (14.29%) and highest disease control (49.74%). In pomegranate cv. Bhagwa, the application of clove oil (0.2%) + Bronopol (0.05%) + copper oxychloride (0.25%) recorded the lowest PDI (13.91%) and highest disease control (52.15%).

To detect the associated orthotospoviruses causing bud necrosis virus in watermelon, two sets of novel degenerate primers were designed targeting the RdRp (592 bp) and coat protein (638–860 bp) regions, enabling amplification of both WBNV and GBNV. The amplified products were sequenced to confirm primer specificity and accurate virus identification.

Lasiodiplodia theobromae, causing dieback in lasoda, was identified based on cultural and morphological characteristics. *In-vitro* evaluation revealed that the fungus was highly sensitive to Bavistin, Tebuconazole + Trifloxystrobin and Bavistin + Mancozeb.

A field survey at CHES, Vejalpur assessed the prevalence of insect pests and their natural enemies in various crops. Major pests included lemon butterfly, leaf roller and scale insects in bael; Asian weaver ant, black thrips, psyllids and lac insect in chironji; and aphids, leaf hoppers, caterpillars and bugs in vegetable cowpea and beans. The natural enemies like *Coccinella transversalis*, *Cheilomenes sexmaculata*, hover flies, lacewings and spiders were also recorded.

Post-Harvest Management and Value Addition

Optimal harvesting stages were standardized to ensure improved drying and processing quality. Tender green stages were found ideal, with harvesting

recommended at 12-15 days for ker, 8-12 days for kheemp, 10-18 days for khejri (sangri) and 12-20 days for guarphali after fruit or pod set. Blanching durations prior to drying were standardized to enhance product quality, with 5 minutes for sangri and guarphali, 7 minutes for kheemp and 25-28 minutes for lasoda. Drying yield showed wide variation, with highest recovery in bordi fruits (49.51%), followed by jharber (45.58%) and kumat seeds (43.87%).

In ker, harvesting at horticultural maturity (8-12 days after fruit set) with multiple pickings at 3-4 day intervals ensured maximum recovery of processing-grade fruits. A rapid lactic acid fermentation method was developed for acidity removal within 3 days, providing a faster and cost-effective alternative to conventional practices while maintaining fruit colour and quality. For preservation, brining with 5% salt and 120 ppm potassium metabisulphite extended shelf life up to 8-10 months, while freezing at -5°C after blanching allowed storage for 18-20 months with minimal quality loss.

Agricultural Extension

Agricultural extension studies conducted in 2025 revealed strong adoption of date palm and pomegranate in the hot arid regions of Rajasthan.

In date palm, the highest area was recorded in Bikaner (298.6 ha) with a production of 2836.7 MT. Establishment cost ranged from ₹ 3.2-4.6 lakh/ ha, with a B:C ratio of 2.8-5.7 and market prices of ₹ 4000-6000 per quintal. More than 40% of farmers reported increased awareness and adoption, along with 34-42% shifting from laggard to innovative practices.

In pomegranate, the maximum area was recorded in Jodhpur (403.2 ha), while production was highest in Pali (2661.1 MT). Establishment cost ranged from ₹ 1.20-1.42 lakh/ ha with annual maintenance of ₹ 0.90-1.22 lakh/ ha and fruit prices varied between ₹ 4500-7000 per quintal. The B:C ratio ranged from 2.6 to 4.3.

कार्यकारी सारांश

इस अध्याय में वर्ष 2025 के दौरान भा.कृ.अनु.प.-केन्द्रीय शुष्क बागवानी संस्थान की उल्लेखनीय उपलब्धियों पर प्रकाश डाला गया है।

आनुवंशिक संसाधन और फसल सुधार

राष्ट्रीय सक्रिय जननद्रव्य साइट (NAGS) द्वारा भा.कृ.अनु.प.-केन्द्रीय शुष्क बागवानी संस्थान को शुष्क क्षेत्रों के फलों और सब्जियों के पादप आनुवंशिक संसाधनों के संरक्षण और प्रबंधन के लिए एक प्रमुख नोडल केंद्र के रूप में नामित किया गया है। इसमें कुल 2,793 जननद्रव्य नमूनों का संरक्षण किया गया। इसके अतिरिक्त, 2025 के दौरान विभिन्न फलों और सब्जियों के 26 जननद्रव्य एकत्र किए गए।

2025 के दौरान, भा.कृ.अनु.प.-केन्द्रीय शुष्क बागवानी संस्थान, बीकानेर ने गर्म शुष्क क्षेत्रों के लिए फलों और सब्जियों के मूल्यांकन, लक्षण वर्णन और सुधार पर ध्यान केंद्रित किया, साथ ही उच्च उपज, गुणवत्ता और तनाव सहनशीलता वाले उन्नत जीनोटाइप की पहचान की।

बेर में सात जननद्रव्यों का मूल्यांकन किया गया और जोधपुर-1 तथा जोधपुर-7 ने बेहतर उपज प्रदर्शित की। चौदह जीनोटाइप में वृद्धि, फल के आकार (14–20 ग्राम), कुल घुलनशील ठोस और एसर्कोर्बिक एसिड में भिन्नता पाई गई। 106 जीनोटाइप में से सुखाने के लिए 46 उन्नत जीनोटाइप का चयन किया गया (27–55% उपज)। झरबेर में 164 जीनोटाइप में से ताजे उपयोग तथा सुखाने के लिए 5 श्रेष्ठ जीनोटाइप की पहचान की गई।

खजूर के जननद्रव्यों में, 40 मादा जीनोटाइप ने उपज (8–86 किग्रा/ पौधा) और कुल ठोस (20–53° ब्रिक्स) में व्यापक भिन्नता प्रदर्शित की। उन्नत किस्मों में धमास (जल्दी पकने वाली, 40–50 किग्रा/ पौधा, उच्च कुल घुलनशील ठोस), CIAH/DP/F1 (देर से पकने वाली, वर्षा-सहिष्णु) और CIAH/DP/F2 (उच्च उपज देने वाली, 75 किग्रा/ पौधा) शामिल थीं। नर जीनोटाइपों में, CIAH/DP/M-01, M-03 M-04 और M-06 श्रेष्ठ थे, जिनमें M-01 में पराग उत्पादन सबसे अधिक (745 ग्राम/ पौधा) था। ICARDA जीनोटाइपों में, M1N1 उपज के लिए श्रेष्ठ था, जबकि MHN/B फल की गुणवत्ता में उत्कृष्ट था।

अनार की CIAH PG-1 और CIAH PG-4 को उच्च

दाने के वजन (36 ग्राम/ 100 दाने) और छिलके में एंथोसायनिन की मात्रा (909 मिग्रा/ किग्रा) के लिए श्रेष्ठ जीनोटाइप के रूप में पहचाना गया। CIAH PG-1 उपज (12.40 किग्रा/ पौधा), अम्लता और अनारदाना की मात्रा (2.23 किग्रा/ पौधा) के लिए बेहतर पाई गई।

वर्षा आधारित गर्म शुष्क परिस्थितियों में बेल के 72 जीनोटाइपों का आकारिकी-शारीरिक लक्षणों के आधार पर सूखा सहनशीलता के लिए परीक्षण किया गया। CIAH-AMS-39, 41 और 69 को अत्यधिक सहनशील जीनोटाइप के रूप में पहचाना गया। नींबू वर्गीय फलों के जननद्रव्य में, सथगुड़ी को सर्वोत्तम प्रदर्शन करने वाले मीठे संतरे के रूप में पहचाना गया। CIAH-SO-24/17 जीनोटाइप ने ब्लड रेड किस्म से बेहतर प्रदर्शन किया। नींबू के जीनोटाइप (CIAH-AL-01, AL-03 और AL-10) में बेहतर उपज और गुणवत्ता पाई गई।

अन्वेषण के दौरान पीलू के 6 उत्कृष्ट जीनोटाइप की पहचान की गई। फल के वजन (0.27–0.96 ग्राम), फल के आयतन और जैव रासायनिक गुणों में उच्च भिन्नता देखी गई। लसोड़ा के उन्नीस जीनोटाइप का मूल्यांकन किया गया। जिसमें RP-8-1, RP-11-2, RP-20-2 और RP-12-2 बेहतर पाये गये।

टिंडा के CIAH-RM-1 जीनोटाइप ने 143–219 क्विंटल/ हेक्टेयर की उपज क्षमता के साथ उत्कृष्ट प्रदर्शन किया और यह खरीफ की खेती के लिए योग्य पाई गई। खरबूजों के उत्कृष्ट जीनोटाइप में AHMM-17, AHMM-20 और AHMM-27 शामिल हैं, जबकि CIAH-MM-1 ने भीषण गर्मी और शुष्क परिस्थितियों में सबसे अच्छा प्रदर्शन किया।

लौकी के जीनोटाइप CIAH-LS-1 को जल्दी फल देने और अधिक उपज (4.26–5.63 किग्रा/ पौधा) के लिए श्रेष्ठ पाया गया। सहजन के जीनोटाइप CIAH-MO-1 में जल्दी फल लगना (2 साल के भीतर), उच्च उपज, सूखा सहनशीलता और उच्च जैव द्रव्यमान उत्पादन देखा गया। खेजड़ी के जीनोटाइप (चयन 3, 4, 5 और 6) को फली के आकार, गुणवत्ता और निर्जलीकरण के लिए उत्कृष्ट पाये गये।

तरबूज की F₆ पीढ़ी में फल के वजन (2.5–3.5 किग्रा) और कुल घुलनशील ठोस (11.8–5.9° ब्रिक्स) में काफी भिन्नता देखी गई। AHW/YF Sel.-1 को पीले गूदे, फल के आकार

और बिना लोब वाली पत्तियों जैसे रूपात्मक लक्षणों के साथ उन्नत जीनोटाइप के रूप में चुना गया। खरबूजों की AHMM/BR-52 लाइन भी उन्नत पाई गई। इसमें हरे रंग की धारियों से युक्त लाल-भूरे रंग के छिलके वाले गोल फल और हरे-सफेद रंग का गूदा पाया गया।

मिर्च में, 114 जीनोटाइप का मूल्यांकन किया गया और 45 लक्षणों के लिए उनका लक्षण वर्णन किया गया, जिनमें व्यापक भिन्नता पाई गई। सौंफ की छब्बीस किस्मों का मूल्यांकन शुष्क परिस्थितियों में किया गया। AF-1 और GF-11 में गामा विकिरण के माध्यम से भिन्नता उत्पन्न की गई।

2025 के दौरान वेजलपुर स्थित केन्द्रीय बागवानी प्रायोगिक केन्द्र में किए गए अनुसंधान का मुख्य उद्देश्य फल और सब्जी फसलों का मूल्यांकन, लक्षण वर्णन और उन्नयन करना था।

आंवला की NA-7 किस्म में बेहतर फल लगने और फल के टिके रहने की दर देखी गई, जबकि अग्रिम पंक्तियों में CHESA-4 ने सबसे अधिक उपज (75 किग्रा/ पौधा) दर्ज की गई। पौधों की विभिन्न किस्मों में काफी भिन्नता पाई गई तथा उपज का सीधा संबंध फल के आकार और रस की मात्रा में पाया गया।

बेल में, 222 जीनोटाइप और 129 बीज-व्युत्पन्न जननद्रव्यों में उपज में व्यापक भिन्नता (70–182 किग्रा/ पौधा) देखी गई। उपज और गुणवत्ता के आधार पर CHESB-42, 48, 59, 60, 62, 69, 71, 73, 77 और 78 जीनोटाइप को श्रेष्ठ पाया गया।

अमरूद के जननद्रव्यों में भी व्यापक विविधता देखी गई और संकर जीनोटाइप H-1, H-2, H-1/27 और H-2/20 उपज (25–55 किग्रा/ पौधे), गुणवत्ता और भण्डारण अवधि के लिए उत्तम पाए गए। कागजी नींबू के जीनोटाइप (CHESL-14, CHESL-15 और CHESL-32) ने उच्च उपज (55–63 किग्रा/ पौधे), अधिक रस मात्रा (48–51%) और वांछनीय गुणवत्ता पाई गई।

जामुन के 22 जीनोटाइप में से, CHESJ-30 और CHESJ-10 को श्रेष्ठ पाया गया। CHESJ-30 से प्रति वृक्ष 48 किलोग्राम उपज प्राप्त हुई, जिसमें 15–20 ग्राम के फल, उच्च गूदा (91%) और विटामिन-सी (44 मिग्रा/ 100 ग्राम) की मात्रा पाई गई। वहीं, CHESJ-10 से प्रति वृक्ष 45 किलोग्राम उपज प्राप्त हुई, जिसमें 20 ग्राम के फल, 82.5% गूदा और 16.8° ब्रिक्स कुल घुलनशील ठोस पाया गया।

जंगल जलेबी में, CHESM-4 (प्रति वृक्ष 46 किलोग्राम, 74 प्रतिशत से अधिक गूदा, 22–26° ब्रिक्स कुल घुलनशील ठोस) और CHESM-27 (प्रति वृक्ष 33 किग्रा उपज, 73 प्रतिशत से अधिक गूदा, 24° ब्रिक्स कुल घुलनशील ठोस,

120 मिग्रा 100 ग्राम विटामिन सी) को उच्च उपज और गुणवत्ता मानकों के लिए श्रेष्ठ चिन्हित किया गया।

सीताफल के 12 हाइब्रिड जीनोटाइप मूल्यांकन से व्यापक भिन्नता का पता चला, जिसमें CAH-5 सर्वश्रेष्ठ प्रदर्शन करने वाला (28–32 किग्रा/ पौधा, उच्चतम कुल घुलनशील ठोस) रहा। CAH-1 ने सबसे बड़े फल दिये, जबकि CAH-3 में बीजों की संख्या सबसे कम थी।

लाल सीताफल के 32 जीनोटाइप में से, CHESRCA-05, 12 और 16 को उपज और गूदे के लिए उत्कृष्ट पाया गया। रामफल में, CHESR-18, CHESR-14, CHESR-19 और CHESR-1 जीनोटाइप श्रेष्ठ पाए गए।

इमली के 32 जीनोटाइप के मूल्यांकन में CHEST-11 और CHEST-27 को उत्कृष्ट जीनोटाइप के रूप में पहचाना गया। CHEST-27 ने प्रति पौधा 60 किलोग्राम तक उपज और उच्च कुल घुलनशील ठोस (72° ब्रिक्स का उत्पादन किया। चिरौंजी के 30 जीनोटाइप में से, CHESC-2 को वांछनीय गुणवत्ता लक्षणों और उच्च गिरी प्रोटीन सामग्री (32.42%) वाले एक श्रेष्ठ जीनोटाइप के रूप में पहचाना गया।

लौकी की अग्रिम पंक्ति LS-28 × LS-20-2 (लम्बे फल) ने वर्षा आधारित अर्ध-शुष्क परिस्थितियों में प्रति पौधा 15.3 किग्रा उपज दी। खीरे में CHES C-1, CHES C-2, CHES C-3 और CHES C-4 को श्रेष्ठ पाया गया तथा F₆ पीढ़ी तक विकसित किया गया।

जैव प्रौद्योगिकी एवं जैव रासायनिक अध्ययन

खजूर की किस्म बरही में, शूट टिप एक्सप्लांट से प्राप्त कैलस को नियंत्रित परिस्थितियों में 2,4-D, NAA, और BA, युक्त MS माध्यम पर सेल सस्पेंशन कल्चर द्वारा गुणनित किया गया। कल्चर में विभिन्नता देखी गई और 7–30 दिनों के भीतर भ्रूण (1–10 मिमी) उत्पन्न हुए। बार-बार सबकल्चरिंग करने पर विभिन्न चरणों में लगभग 3000 कल्चर प्राप्त हुए। 0.1–1.0 मिलीग्राम 2,4-D और सक्रिय चारकोल के साथ अनुकूलन करने से कोशिका और क्लस्टर निर्माण में वृद्धि हुई, जिससे सफल पौध स्थापना हुई।

मिर्च में, जीनोम-व्यापी विश्लेषण से विविध संरचनाओं और आकारों (6.12 – 157.85 kDa) वाले 199 हीट शॉक प्रोटीन जीन की पहचान की गई। इनमें से अधिकांश में जटिल एक्सॉन-इंट्रॉन पैटर्न पाए गए, जिनमें से गुणसूत्र 1 में सबसे अधिक जीन मौजूद थे। कुल 135 तनाव-संबंधित cis-elements पाए गए। अभिव्यक्ति विश्लेषण से मजबूत अंतःक्रियाओं का पता चला, जिसमें गर्मी सहनशील जीनोटाइप में सात जीन महत्वपूर्ण रूप से अपग्रेड पाए गए।

जामुन जननद्रव्यों के जैव रासायनिक मूल्यांकन से फाइटोकेमिकल गुणों में व्यापक विविधता का पता चला। फल

के गूदे में फेनोलिक्स, फ्लेवोनोइड्स और एंटीऑक्सीडेंट गतिविधि मध्यम स्तर की पाई गई, जिसमें CHES-J-72, CHES-J-17 और कोंकणी बहादोली का प्रदर्शन सर्वोत्तम रहा। बीजों में फेनोलिक और एंटीऑक्सीडेंट का स्तर काफी अधिक था, जिससे कथा, CHES-J-72, CHES-J-21 और CHES-J-117 जीनोटाइप को पोषक तत्वों के उपयोग के लिए उन्नत माना गया।

महुआ में, 34 जननद्रव्यों के फैटी एसिड प्रोफाइलिंग से C18 फैटी एसिड, विशेष रूप से ओलिक, लिनोलिक और स्टीयरिक एसिड की प्रधानता का पता चला। संतृप्त फैटी एसिड 40–55% तक थे, जबकि असंतृप्त फैटी एसिड 45–60% थे, जिनमें 8–19% पॉलीअनसैचुरेटेड फैटी एसिड शामिल थे, जो अच्छी पोषण गुणवत्ता को दर्शाते हैं।

फसल उत्पादन

खजूर में पराग स्रोत का फल लगने और उसकी गुणवत्ता पर महत्वपूर्ण प्रभाव पड़ा, जिसमें CIAH/DP/M-1 जीनोटाइप के परागण से सबसे अधिक फल (15.40%) लगे। विभिन्न किस्मों में, बरही किस्म में सबसे अधिक फल (15.85%) लगे। मेडजूल × CIAH/DP/M-1 के संयोजन से बेहतर फल का आकार (36.58 मिमी लंबाई, 23.31 मिमी चौड़ाई) और कुल घुलनशील ठोस (52° ब्रिक्स) प्राप्त हुआ, जबकि इसी पराग स्रोत से प्राप्त खलास किस्म की उपज सबसे अधिक (78 किग्रा/ पौधा) रही। परागण विधियों में, लड़ परागण से प्रति लड़ फलों की संख्या सबसे अधिक (17) रही, जबकि स्प्रे परागण से गुच्छे का वजन (7.89 किग्रा) और उपज (62.88 किग्रा/ पौधा) अधिक रही।

बेर की खेती में, 'Y'- आकार की सधाई प्रणाली सबसे प्रभावी साबित हुई, जिससे अधिक उपज, बेहतर गुणवत्ता वाले फल और अधिकतम आर्थिक लाभ प्राप्त हुए। हालांकि, एस्पेलियर प्रणाली से कटाई में आसानी हुई। 'Y'- आकार और एस्पेलियर प्रणालियों में कैनोपी का तापमान अपेक्षाकृत कम पाया गया।

पंचगव्य, जीवामृत, घन जीवामृत, अग्निअस्त्र और तुम्बास्त्रा जैसी प्राकृतिक कृषि पद्धतियों से शुष्क परिस्थितियों में आंवला और बेर के फलों की गुणवत्ता में उल्लेखनीय सुधार हुआ। आंवला में पंचगव्य + जीवामृत के संयोजन से सबसे अधिक गूदे का वजन (30.56 ग्राम) दर्ज किया गया, जबकि घन जीवामृत + तुम्बास्त्रा के संयोजन से अधिकतम विटामिन सी (309 मिग्रा 100 ग्राम) प्राप्त हुआ। बेर में, घन जीवामृत तथा अग्निस्त्रा + तुम्बास्त्रा के संयोजन से सबसे अधिक उपज (56.95 किग्रा/ पौधा) प्राप्त हुई।

बेर की जैविक पोषक तत्व प्रबंधन पद्धति के अंतर्गत, वर्मीकम्पोस्ट से उच्चतम उपज (41.8 किग्रा/ वृक्ष) प्राप्त हुई,

जबकि गोबर की खाद और जैव उर्वरकों के संयोजन से ऑर्गेनिक कार्बन (0.51%) और सूक्ष्मजीवीय गतिविधि में वृद्धि हुई। जैविक खादों के एकीकृत उपयोग से मृदा के भौतिक, रासायनिक और जैविक गुणों में सुधार हुआ। करोंदा में वर्मीकम्पोस्ट और जैव उर्वरकों के संयोजन से उच्चतम उपज (15.3 किग्रा/ वृक्ष) प्राप्त हुई, जबकि बेल में केवल वर्मीकम्पोस्ट से उच्चतम उपज (78.7 किग्रा/ वृक्ष) प्राप्त हुई।

बेर के समन्वित पोषक तत्व प्रबंधन अध्ययन में, एनपीके (100% आरडीएफ) + 60 किलोग्राम गोबर की खाद + फसल अवशेष मल्लिचंग से फल का आकार (3.9 x 3.5 सेमी), वजन (24 ग्राम) और उपज (53.39 किग्रा/ वृक्ष) उच्चतम पाई गई। हालांकि, आरडीएफ 30 किलोग्राम + गोबर की खाद + पोटैशियम सल्फेट के स्प्रे से अधिकतम कुल घुलनशील ठोस (20.24° ब्रिक्स) और कुल शर्करा (9.09%) पाई गई। अश्वगंधा में अपशिष्ट ऊन (7.5 टन/ हेक्टेयर) को गोबर की खाद (15 टन/हेक्टेयर) के साथ एकीकृत करने से पौधों की अधिकतम वृद्धि, जड़ की उपज (1998 किग्रा/ हेक्टेयर ताजा और 651 किग्रा/ हेक्टेयर सूखी जड़), गुणवत्ता मापदंड और मिट्टी की उच्च नमी बनाए रखने में सफलता मिली।

केंद्रीय बागवानी प्रयोग स्टेशन, वेजलपुर में, बेल की गोमा यशी किस्म में घास की मल्ल, नीम की खली, 50% आरडीएफ, एजोटोबैक्टर, VAM (वेसिकुलर आर्बस्कुलर माइकोराइजा) के समन्वित पोषक तत्व प्रबंधन से वृद्धि, उपज और फल की गुणवत्ता में उल्लेखनीय सुधार हुआ। 2020–21 के दौरान उच्च घनत्व में रोपित बेल की गोमा यशी किस्म में प्रति पौधा अधिकतम उपज (17 किग्रा) अधिक दूरी (8 मी. × 6 मी.) पर दर्ज की गई, जबकि प्रति हेक्टेयर उच्चतम उपज (52 क्विंटल/ हेक्टेयर) कम दूरी (4 मी. × 4 मी.) पर प्राप्त हुई। मध्यम दूरी (6 मी. × 4 मी.) पर संतुलित उपज (51.75 क्विंटल/ हेक्टेयर) प्राप्त हुई।

फसल सुरक्षा

खजूर की हलावी किस्म में अल्टरनेरिया लीफ स्पॉट के उपचार में एजोक्सीस्ट्रोबिन + डिफिनोकोनाजोल (0.1%) सबसे प्रभावी पाया गया, जिसमें सबसे कम पीडीआई (14.29%) और उच्चतम रोग नियंत्रण (49.74%) हुआ। अनार की भगवा किस्म में लॉंग का तेल (0.2%) + ब्रोनोपोल (0.05%) + कॉपर ऑक्सीक्लोराइड (0.25%) के प्रयोग से सबसे कम पीडीआई (13.91%) और उच्चतम रोग नियंत्रण (52.15%) दर्ज किया गया।

तरबूज में बड नेक्रोसिस वायरस (बीएनवी) उत्पन्न करने वाले संबंधित ऑर्थोटोस्पोवायरस का पता लगाने के लिए RdRp (592 bp) और coat protein (638–860 बीपी) क्षेत्रों को

लक्षित करते हुए दो नए **degenerate primers** तैयार किए गए, जिससे डब्ल्यूबीएनवी और जीबीएनवी दोनों का प्रवर्धन संभव हुआ। प्रवर्धित उत्पादों का अनुक्रमण करके प्राइमर की विशिष्टता और सटीक वायरस पहचान की पुष्टि की गई।

लसोड़ा में रोग उत्पन्न करने वाले लासियोडिप्लोडिया थियोब्रोमे की पहचान संवर्धन और आकारिकी विशेषताओं के आधार पहचान पर की गई। *In-vitro* मूल्यांकन से पता चला कि यह कवक बाविस्टिन, टेबुकोनाजोल + ट्राइफ्लोक्सीस्ट्रोबिन और बैविस्टिन + मैनकोजेब के प्रति अत्यधिक संवेदनशील था।

वेजलपुर स्थित केन्द्रीय बागवानी प्रायोगिक केन्द्र, में किए गए एक क्षेत्रीय सर्वेक्षण में विभिन्न फसलों में कीटों और उनके प्राकृतिक शत्रुओं की व्यापकता का आकलन किया गया। बेल में पाए जाने वाले प्रमुख कीटों में पैपिलियो डेमोलियस, लीफ रोलर और स्केल कीट शामिल थे। चिरौंजी में एशियाई वीवर चींटी, ब्लैक थ्रिप्स, साइलिड और लाख कीट शामिल थे तथा लोबिया और बीन्स में एफिड्स, लीफ हॉपर्स, कैटरपिलर और बग शामिल थे। कोकिनेला ट्रान्सवर्सलिस, चीलोमेनेस सेक्समैकुलाटा, हॉवर फ्लाई, लेसविंग्स और मकड़ियों जैसे प्राकृतिक शत्रुओं को भी दर्ज किया गया।

फसलों परांत प्रबंधन और मूल्यवर्धन

सुखाने और प्रसंस्करण की गुणवत्ता में सुधार सुनिश्चित करने के लिए कटाई के इष्टतम चरणों को मानकीकृत किया गया। केर में फल लगने के 12–15 दिन बाद, खीम्प में 8–12 दिन, खेजड़ी (सांगरी) के लिए 10–18 दिन बाद और ग्वारफली के लिए 12–20 दिन बाद कोमल व हरी अवस्था में तुड़ाई करने की सिफारिश की गई। उत्पाद की गुणवत्ता बढ़ाने के लिए सुखाने से पहले ब्लांचिंग की अवधि को मानकीकृत किया गया, जिसमें सांगरी और ग्वारफली के लिए 5 मिनट, खीम्प के लिए 7 मिनट और लसोड़ा के लिए 25–28 मिनट अवधि निर्धारित की गयी। सूखे फलों की उपज में व्यापक भिन्नता देखी गई, जिसमें बोर्डी फलों में सबसे अधिक (49.51%), उसके बाद झड़बेर (45.58%) और कुमट के बीजों में

(43.87%) उपज प्राप्त हुई।

केर में, बागवानी परिपक्वता (फल लगने के 8–12 दिन बाद) पर कटाई और 3–4 दिन के अंतराल पर कई बार तुड़ाई करने से प्रसंस्करण योग्य फलों की अधिकतम प्राप्ति सुनिश्चित हुई। तीन दिनों के भीतर तीखापन दूर करने के लिए एक तीव्र लैक्टिक एसिड किण्वन विधि विकसित की गई, जो फलों के रंग और गुणवत्ता को बनाए रखते हुए पारंपरिक विधियों का जल्दी और लागत प्रभावी विकल्प प्रदान करती है। संरक्षण के लिए 5% नमक और 120 पीपीएम पोटेशियम मेटाबाइसल्फाइड के साथ ब्राइनिंग करने से भंडारण अवधि 8–10 महीने तक बढ़ जाता है जबकि ब्लांचिंग के बाद -5°C पर फ्रीज करने से न्यूनतम गुणवत्ता हानि के साथ 18–20 महीने तक भंडारण संभव हो जाता है।

कृषि विस्तार

2025 में किए गए कृषि विस्तार अध्ययनों से पता चला कि राजस्थान के गर्म शुष्क क्षेत्रों में खजूर और अनार की खेती में व्यापक वृद्धि हुई है। खजूर की खेती में सबसे अधिक क्षेत्रफल बीकानेर (298.6 हेक्टेयर) में दर्ज किया गया, जहाँ उत्पादन 2836.7 मीट्रिक टन रहा। स्थापना लागत ₹ 3.2–4.6 लाख प्रति हेक्टेयर रही। लाभ:लागत अनुपात 2.8–5.7 रहा और बाजार मूल्य ₹ 4000–6000 प्रति क्विंटल रहा। 40 प्रतिशत से अधिक किसानों ने जागरूकता और खेती को अपनाने में वृद्धि की सूचना दी तथा 34–42 प्रतिशत किसान पुरानी पद्धतियों से नई पद्धतियों की ओर अग्रसर हुए।

अनार की खेती में अधिकतम क्षेत्रफल जोधपुर (403.2 हेक्टेयर) में दर्ज किया गया, जबकि उत्पादन पाली (2661.1 मीट्रिक टन) में सबसे अधिक रहा। स्थापना लागत ₹ 1.20–1.42 लाख प्रति हेक्टेयर थी। वार्षिक रखरखाव लागत ₹ 0.90–1.22 लाख प्रति हेक्टेयर थी और फलों की कीमतें ₹ 4500–7000 प्रति क्विंटल के बीच थीं। लाभ:लागत अनुपात 2.6 से 4.3 के बीच था।

1. Introduction

The ICAR-Central Institute for Arid Horticulture conducts basic, strategic, anticipatory and applied research on all aspects of arid and semi-arid fruits and vegetables. The arid and semi-arid ecosystem has ample strengths such as plenty of sunshine, vast land, human labour, wide bio-diversity, low humidity and low incidences of insect-pests and diseases for the production of quality fruits and vegetables. Realizing the potential of horticultural crops of arid zones, the compatibility of these crops to the arid zone ecosystem and the need to achieve nutritional and income security for the people, The Indian Planning Commission approved establishment of National Research Center for Arid Horticulture (NRCAH) during VII Five Year Plan. As a result, the NRCAH came into existence on 01st April 1993. Dr. O.P. Pareek was the founder Director, whose vision and dynamism helped the Centre grow rapidly. It was later upgraded to Central Institute for Arid Horticulture on 27th September 2000 and Central Horticultural Research Station (CHES), Vejalpur, Godhra (earlier Regional Station of IIHR, Bengaluru) was merged as its Regional Station on 01st October, 2000. The Krishi Vigyan Kendra (KVK) at Panchmahal was also established on 01 October 2005 by the ICAR under the administrative control of ICAR-CIAH, Bikaner. This KVK is located at Vejalpur, Godhra-Vadodara Highway about 16 km away from the District Headquarter Panchmahal (Godhra). The institute houses the Project Coordinating Unit of the ICAR-All India Coordinated Research Project on Arid Zone Fruits at its main campus.

Vision

To achieve nutrition and income security for the people of arid and semi-arid regions, suitable horticultural production technologies, multi-location collaborative research.

Mandate

- Basic, strategic and applied research to

enhance sustainable productivity, quality and utilization of horticultural crops of arid and semi-arid regions.

- Repository of genetic resources and scientific information on horticultural crops of arid and semi-arid regions.
- Transfer of technology, capacity building and impact assessment of technologies.
- Coordinate research and validation of technologies on fruit crops of arid and semi-arid regions.

Mission

To undertake basic and strategic studies for developing technologies to enhance productivity and utilization of arid horticultural crops, multistorey horticulture based sustainable cropping system under arid environment, coordinate network research with State Agricultural Universities and line departments, to provide consultancy in research and development of arid horticulture.

Objectives

- To introduce, collect, characterize, conserve and evaluate the biodiversity of horticultural crops under arid and semi-arid environment.
- To utilize the available bio-diversity and improve the target fruits such as ber, pomegranate, aonla, date palm, bael, jamun sapota, custard apple, tamarind, fig, cucurbitaceous, leguminous and solanaceous vegetables to develop high quality and productive types having tolerance to biotic and abiotic stresses.
- To study the factors related to rapid multiplication of propagules in case of established as well as new crops and the problems related to their growth and fruit development.

- To standardize agro-techniques with respect to efficient use of soil, water and nutrients for increased horticultural productivity involving water harvesting and conservation techniques under rainfed conditions, efficient use of the scarce irrigation water and nutrient management.
- To study the eco-physiological parameters of cropping system models for utilization of high temperature and radiation resources.
- To develop post-harvest technology package for extended use of the horticultural produce of arid region.
- To develop integrated pest and disease management technologies for horticultural crops under arid environment.
- To transfer the innovative technologies generated on the above aspects to farmer's field for effective horticultural development and socio-economic upliftment of the farmers.
- To carry out the impact assessment of the technologies and constraint analysis.
- To serve as a repository of information related to arid and semi-arid horticulture.
- To collaborate with relevant national and international agencies for achieving the above.

Priorities and Programmes

Keeping in view the mandate and objectives, the Institute has following research priorities:

Germplasm Evaluation and Improvement

- Collection of germplasm of mandate crops and their use for breeding climate resilient and pest tolerant varieties.
- Development of rootstocks of different crops to induce dwarfism, resistance to abiotic stresses (*eg.* drought and frost) and obtain favourable tree architecture for high density orcharding.
- Research on lesser-known edible fruits such as - lasora, ker, pilu, khirni and minor tropical fruits.

Agro-techniques

- Plant architecture/canopy management for different purposes by using different

approaches including pruning and training systems.

- Development of propagation technologies with focus on date palm by enhancing offshoots per palm in addition to micro-propagation.
- Research on planting systems for improving input use efficiency.
- Microbial intervention for efficient growth promotion and nutrient management.
- Development of climate resilient technology for crops such as ber, bael, tamarind, jamun, lasora and aonla.

Water and Nutrient Management

- Development of rainfed farming models for commercial production of fruits and vegetables at Bikaner and Godhra with minimum irrigation.
- Research on micro irrigation using pressurized irrigation system at Bikaner.
- Studies on adaptation mechanism in arid horticultural crops for drought, heat and salinity stress.
- Studies on identifying the critical stages of fruits and vegetables crops for irrigation.

Post Harvest Technology

- Work on different aspects of pre and post-harvest management such as-maturity indices, harvesting, precooling, grading, packaging and storage on shelf life of fruits.
- Work on dehydration of arid horticultural produce for value addition.
- Development of nutraceuticals and functional foods.

IPM and IDM

- IPM and IDM with minimal use of pesticides/insecticides for important pests and diseases of arid/semi-arid fruit and vegetable crops.
- Epidemiology of different economically important diseases and pests and disease/pest-forecasting models.
- Prophylactic use of biopesticides to control the insects and plant pathogens.

Agriculture Extension

- Strengthening of facilities for training to

trainers and farmers.

- Impact analysis and constraints in adoption of technologies.
- Evaluation and validation of technologies on farmers' field.
- Development of data base on market intelligence.

Main Station, Beechwal, Bikaner

The main station is located at Beechwal on National Highway No. 15 (Bikaner-Sri Ganganagar Road) 10 km away from the Bikaner city. The Institute houses administrative block cum laboratories, experimental farms, tissue culture laboratory, library building, scientist home, trainees home and staff quarters located at the Beechwal campus spread over 124.58 ha land.

Central Horticultural Experiment Station (CHES), Vejalpur, Godhra, Gujarat

The station was merged in CIAH on 27 September 2000 to cater the research and developmental needs in horticulture for the tribal belt of Gujarat and the adjoining semi-arid region. It is located 15 km from Godhra town on Godhra-Vadodara Highway. The station is spread over an area of 372 ha housing a full-fledged laboratory and office building and the experimental farm.

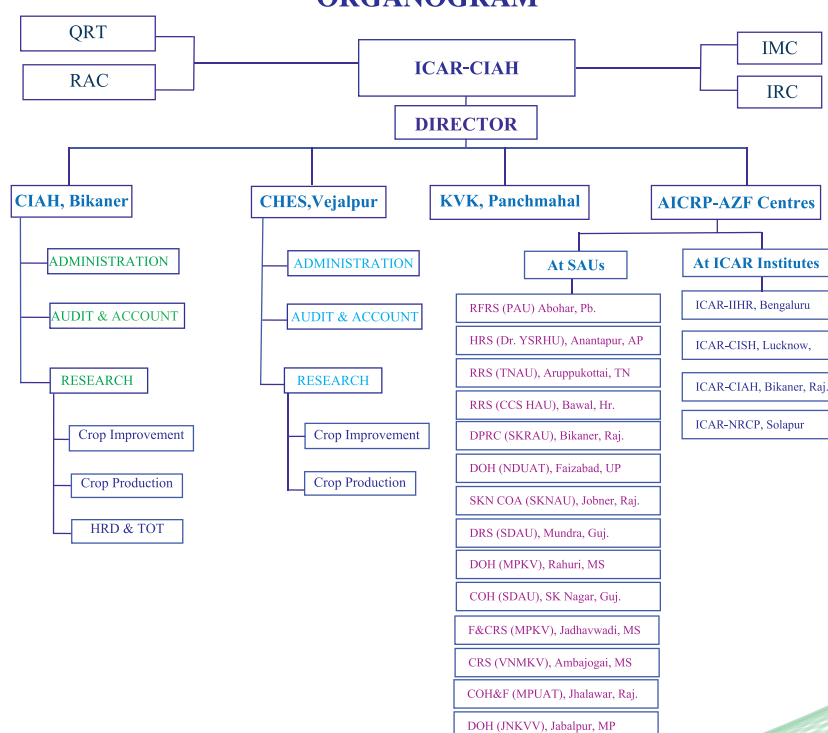
Krishi Vigyan Kendra (KVK), Panchmahal, Gujarat

KVK, Panchmahal was established in the year 2005 occupying an area of 20 ha. It is located at Vejalpur, Godhra-Vadodara Highway about 16 km away from the Panchmahal. Apart from the activities of a KVK, it has taken up activities of popularization of ICAR-CIAH and CHES developed technologies, varieties, distribution of seeds and planting material.

ICAR-AICRP on Arid Zone Fruits

The institute houses the Project Coordinating Cell of All India Coordinated Research Project (AICRP) on Arid Zone Fruits. The project has objective of collection, conservation and evaluation of germplasm, along with standardization of production technologies, viz., rootstocks, population density, nutrition and water management, integrated insect-pest and disease management practices under different agro-climatic conditions in *ber*, pomegranate, *aonla*, date palm, bael, lasoda, jamun, tamarind, custard apple, fig and some other under exploited fruit crops. At present, the project has 18 centres spread over 11 states of the country *i.e.* four in Rajasthan, four in Madhya Pradesh, two in Gujarat, two in Uttar Pradesh and one each in Punjab, Haryana, Madhya Pradesh, Andhra Pradesh, Tamil Nadu and Karnataka.

ORGANOGRAM



2. Research Achievements

2.1 Plant Genetic Resources

At ICAR-CIAH, Bikaner

Fruit crops	Germplasm collected during 2025	Total viable germplasm as on 31.12.2025	No. of germplasm maintained during 2025
Ber (<i>Ziziphus</i> spp.)	-	350	350
Date palm (<i>Phoenix dactylifera</i>)	-	64	64
Pomegranate (<i>Punica granatum</i>)	-	107	107
Citrus spp.	06	88	88
Gondi (<i>Cordia gharaf</i>)	-	04	04
Lasoda (<i>Cordia myxa</i>)	-	67	67
Phalsa (<i>Grewia subinaequalis</i>)	-	04	04
Ker (<i>Capparis decidua</i>)	-	09	09
Karonda (<i>Carissa carandas</i>)	-	05	05
Mulberry (<i>Morus</i> spp.)	-	12	12
Manila tamarind (<i>Pithecellobium dulce</i>)	-	02	02
Wood apple (<i>Feronia limonia</i>)	-	03	03
Marula nut (<i>Sclerocarya birrea</i>)	-	01	01
Argon (<i>Argania spinosa</i>)	-	01	01
Bael (<i>Aegle marmelos</i>)	02	21	21
Date palm (<i>Phoenix sylvestris</i>)	-	01	01
Olive (<i>Olea europaea</i>)	-	05	05
Total	08	744	744

Five citrus germplasm were collected from PAU RRS, Abohar, while one acid lime was collected from Suratgarh (Rajasthan). Bael genotypes were collected from Jaipur.

Vegetable crops	Total viable germplasm as on 31.12.2025	No. of germplasm maintained during 2025
Melons	280	280
Gourds	60	60
Chilli (<i>Capsicum annuum</i>)	45	45
Tomato (<i>Solanum lycopersicum</i>)	14	14
Brinjal (<i>Solanum melongena</i>)	30	30
Cowpea and beans	35	35
Muskmelon (<i>Cucumis melo</i>)	60	40
Watermelon (<i>Citrullus lanatus</i>)	46	30
Sponge gourd (<i>Luffa cylindrica</i>)	16	16
Ridge gourd (<i>Luffa acutangula</i>)	20	20
Total	606	570

At CHES, Vejalpur, Godhra

Fruit crops	Germplasm collected during 2025	Area explored/ Source Institute	Total viable germplasm as on 31.12.2025	No. of germplasm maintained during 2025
Bael (<i>Aegle marmelos</i>)	-	-	222	222
Aonla (<i>Emblica officinalis</i>)			28	28
Guava (<i>Psidium guajava</i>)	01	Bharuch	130	130
Lime (<i>Citrus aurantifolia</i>)	03	Nagpur	39	39
Pomegranate (<i>Punica granatum</i>)	-	-	38	38
Jamun (<i>Syzygium cumini</i>)	02	Bharuch	74	74
Khirni (<i>Manilkara hexandra</i>)	-	-	30	30
Manila tamarind (<i>Pithecellobium dulce</i>)	02	Bharadiya	32	32
Indian dates	02	Panchmahal	03	03
Mahua (<i>Bassia latifolia</i>)	-	-	34	34
Phalsa (<i>Grewia subinaequalis</i>)	-	-	25	25
Custard apple (<i>Annona squamosa</i>)	-	-	74	74
Wood apple (<i>Feronia limonia</i>)	-	-	62	62
Tamarind (<i>Tamarindus indica</i>)	-	-	32	32
Chironji (<i>Buchanania lanzan</i>)	-	-	30	30
Karonda (<i>Carissa carandas</i>)	-	-	62	62
Tendu (<i>Diospyros melanoxylon</i>)	05	Karada, Bakrol, Kharsaliya village of Panchmahal, Gujarat	09	09
Palmyra palm (<i>Borassus sp.</i>)	-	-	05	05
Ramphal (<i>Annona reticulata</i> L.)	-	-	23	23
Red Sitaphal (<i>Annona squamosa</i> L.)	-	-	32	32
Total	15		984	984

Vegetable crops	Germplasm collected during 2025	Area explored/ Source Institute	Total viable germplasm as on 31.12.2025	No. of germplasm maintained during 2025
Dolichos bean (<i>Lablab purpureus</i> var. <i>typicus</i>)	-	-	60	60
Vegetable cowpea (<i>Vigna unguiculata</i>)	-	-	181	181
Cluster bean (<i>Cyamopsis tetragonoloba</i>)	-	-	62	62
Ivy gourd (<i>Coccinia indica</i>)	-	-	29	29
Spine gourd (<i>Momordica dioica</i>)	-	-	25	25
Bottle gourd (<i>Lagenaria siceraria</i>)	-	-	08	08
Tomato (<i>Solanum lycopersicum</i>)	-	-	03	03
Pumpkin (<i>Cucurbita moschata</i>)	01	-	05	05
Cucumber (<i>Cucumis sativus</i>)	01	-	10	10
Okra (<i>Abelmoschus esculentus</i>)	-	-	40	40
Chilli (<i>Capsicum annuum</i>)	-	-	17	17
Drumstick (<i>Moringa oleifera</i>)	01	-	55	55
Total	03		495	495

2.2 Improvement in Fruit Crops

At ICAR-CIAH, Bikaner

Evaluation and characterization of ber germplasm

During 2025 seven ber germplasm were characterized and evaluated for plant growth, fruiting and yield related traits. Among these Jodhpur-1 and Jodhpur-7 were found promising in terms of yield related traits.



Jodhpur-1



Jodhpur-2



Jodhpur-4



Jodhpur-5



Jodhpur-6



Jodhpur-7

Evaluation of ber hybrids

Fourteen hybrid progenies derived from the crosses Tikadi $\times$ Thar Sevika, BS-1 $\times$ Thar Sevika, Gola $\times$ Thar Sevika and BS-1 $\times$ Gola were evaluated for morphometric and fruit quality traits. Among the hybrid progenies, CIAH GM H-F1P1 exhibited an erect growth habit, while CIAH GM H-F1P3 showed round-shaped leaves. Fruit weight ranged from 14 to 20 g, with fruit shape varying from long to oblong and size ranging from 23.2 $\times$ 11.4 mm to 32.5 $\times$ 27.1 mm. Seed weight varied between 0.48 and 1.32 g. Quality traits included acidity (0.35-0.41 %), TSS (16-18 %) and ascorbic acid content (95-101 mg/100 g).



F1P11

F1P9



F1P13

F1P14

Fruits of evaluated ber hybrids

Screening of ber germplasm for drying purpose

A total of 106 ber germplasm accessions were screened for drying suitability based on sensory attributes, edible portion and storage stability. Fruits harvested at full maturity were sun-dried, stored at room temperature and evaluated for sensory quality after three months. Taste, texture and edible portion percentage were considered key selection criteria. Accessions scoring ≥ 6.5 on a 9-point scale were shortlisted. Based on these criteria, 46 accessions were selected for detailed evaluation. Drying yield among the screened accessions ranged from 26.87% to 55.22%. The ber germplasm categories based on dried fruit sensory scores are presented below.

Sensory score (6.5 to 7.5): Thar Sevika, Kismis, BS-75-1, Jodhpur-6, Mehrun, Gorfa, Jobner NRCAH-5, Kharkhi No.1, Suveda, Chirana, Akhrota, Villaiti, Chirana-4, *Ziziphus* spp. USA, NRCAH-13, Katha

Bombay, Sanour-5, Nehru Mandal, NRCAH-2, BS-75-3, Badami, NRCAH-3, Sanour-4, Pholiso Alwari, Mundiya, Jodhpur-3, Jogiya, Laddu, Lakhan, CIAH ZR-1, Gola, Seo, Mirchiya, Manukhi, Banarasi Kadaka, Goma Kirti, Kathaphal, Jodhpur-4 and Jodhpur-5.

Sensory score (> 7.5 to 9): Chhuhara, Aliganj, NRCAH-14, Supari, Sanaur-6, Kala Gola and Gularvasi.

Evaluation, characterization and documentation of jharber

Fifteen-year-old seed-derived jharber genotypes (164 plants) were evaluated using 18 grouped traits, including morphological, phenological and biochemical characteristics. The genotypes were further assessed for their suitability for fresh consumption and drying. Based on this evaluation, 44 genotypes were selected to capture maximum variability for developing extended guidelines and conservation. IC numbers were obtained for five promising accessions. Genotypes CIAH-ZN1 (IC657783), CIAH-ZN3 (IC657785) and CIAH-ZN5 (IC657787) were found to be suitable for fresh consumption, while CIAH-ZN2 (IC657784) and CIAH-ZN4 (IC657786) were identified as suitable for dehydration.

Evaluation of female date palm genotypes

Sixty-eight date palm genotypes are being conserved and maintained in a field repository. Among them, 40 genotypes were evaluated for plant morphology, yield attributes and quality traits. Considerable variation were observed in fruit yield (8-86 kg/ plant) and TSS (20-53°B). The promising female genotypes are described as under-

Dhamas: It is early-ripening type, maturing in the month of June, with about 90% soft fruits produced before the onset of the monsoon. The average yield per plant ranges from 40-50 kg. Key fruit and bunch characteristics include an average fruit weight of 11.5 g, fruit size of 45.7 mm $\times$ 20.5 mm and approximately 10.3 bunches per plant. The stalk length and bunch length were recorded as 56.1 cm and 16.67 cm, respectively, with an average of 51.7 strands per bunch. The pulp-to-stone ratio was 5.6 and TSS reached upto 50°B.

CIAH/DP/F1 (IC-624544) : A late-maturing, rain-

tolerant having red colour fruits. The genotype is well suited to address fruit ripening issues caused by monsoon season in arid region. It yields 45–50 kg per plant and allows harvesting at the *doka* stage by late August.

CIAH/DP/F2: An early to mid-season (second week of July) ripening genotype was identified with dark red and crunchy fruits, suitable for fresh consumption at the *doka* stage. The genotype recorded an average bunch weight of 6.5 kg, 11 bunches per plant, 67 strands per bunch and 14.2 fruits per strand. Fruits weighed 7.5 g with dimensions of 32.5×21.5 mm, TSS of 26°B and an average yield of 75 kg/ plant.



Fruiting in CIAH/DP/F2

CIAH/DP/F3: A late-maturing, rain-tolerant seedling genotype with light red berries was identified. Fruits are medium-sized, attractive and have good texture, ripening from the last week of August to the first week of September. The genotype recorded a fruit weight of 10.11 g, size of 31.5×23.8 mm, TSS of 33°B and a yield of 30 kg per plant (third harvest). It is suitable for fresh consumption as well as processing.

Evaluation of male date palms genotypes

Nine elite male date palm genotypes, namely CIAH/DP/M-01, CIAH/DP/M-02, CIAH/DP/M-03, CIAH/DP/M-04, CIAH/DP/M-05, CIAH/DP/M-06, CIAH/DP/M-07, CIAH/DP/M-08 and Ghanami, were evaluated for morphological traits and flowering characteristics. Based on observations across various traits, particularly pollen grain production attributes, the genotypes CIAH/DP/M-01, CIAH/DP/M-03, CIAH/DP/M-04 and CIAH/DP/M-06 were found to be superior under hot arid ecosystem conditions. The promising male genotype is described as follows:

CIAH/DP/M-01: Flowering begins in the first week of

January with spathe cracking in February, taking the longest duration (40 days) among the genotypes. It exhibited superior morphological and flowering traits, including larger spathe size, higher spadix and inflorescence weight, more strands and flowers and higher pollen production, with a pollen yield of 745 g per plant.

CIAH/DP/M-03: Spathe emergence occurs from the second week of February to the second week of March, with a shorter duration from flower emergence to spathe cracking (21 days). It exhibited desirable traits, including moderate spathe size, higher number of spadices per plant (23), good pollen weight per spathe (19.8 g) and a pollen yield of 445 g per plant.

CIAH/DP/M-04: Flower emergence from the second week of February to the second week of March and spathe cracking occurring after 24 days. The pollen is very fine and hygroscopic in nature, requiring careful handling after harvest and before use in pollination. It recorded moderate morphological and flowering traits, including spathe size, spadix weight (0.923 kg), 15 spadices per plant, pollen weight per spathe (15.6 g) and a pollen yield of 236 g per plant.

CIAH/DP/M-06: Flower emergence occurs from the last week of January to the third week of February, with spathe cracking taking 21 days. It exhibited desirable traits, including spathe length (71.6 cm), spadix weight (1.262 kg), 25 spadices per plant, pollen weight per spathe (21 g) and a pollen yield of 529 g per plant, along with a high number of flowers per inflorescence (8,151).

Evaluation of date palm genotypes received from ICARDA, Jordan

Three genotypes (MRKS, MHN/B and M1N1) were evaluated for various horticultural traits. Among the evaluated genotypes, M1N1 showed superior yield traits with higher bunch number (6.2 per plant), bunch weight (3.95 kg) and yield (20 kg/ plant). In contrast, MHN/B recorded better fruit quality with higher fruit weight (12.8 g), size (37.29×23.70 mm) and TSS (44.74°B).

Evaluation of promising pomegranate genotypes

Elite pomegranate genotypes, CIAH PG-1 and CIAH PG-4 were evaluated along with commercial check varieties for rind and aril quality traits. Rind anthocyanin content was highest in CIAH PG-4 (909

mg/ kg), followed by Mridula (513 mg/ kg) and lowest in Jalore Seedless (43 mg/kg). Juice anthocyanin content was maximum in Mridula (305 mg/ kg), followed by CIAH PG-1 (288 mg/ kg) and minimum in Ganesh (69 mg/ kg). CIAH PG-1 recorded the boldest arils with the highest 100-aril weight (35.78 g), while the lowest was observed in CIAH PG-4 (26.40 g). TSS ranged from 13.15°B (CIAH PG-4) to 17.13°B (Jalore Seedless) and acidity varied from 0.47% (Jalore Seedless) to 3.76% (CIAH PG-1). Rind colour ranged from light red (CIAH PG-1), purple (CIAH PG-4), red (Bhagwa) and dark red (Mridula) to yellow with red tinge (Jalore Seedless and Ganesh). Aril colour varied from light pink (Jalore Seedless and Ganesh) to blood red (CIAH PG-1 and Mridula) and dark purple (CIAH PG-4).

CIAH PG-1 (IC-633374) is a vigorous, evergreen, semi-spreading genotype with an average fruit weight of 275 g. Fruits are reddish with bold, blood-red arils. It recorded fruit dimensions of 8.49 cm (length) and 8.34 cm (diameter), with a 100-aril weight of 35.78 g. The genotype showed TSS of 15.19°B, acidity of 3.76% and a yield of 22.96 kg/ plant. It is highly suitable for anardana production due to high acidity and recovery (2.30 kg/ plant). Juice anthocyanin content was 288 mg/ kg. CIAH PG-4 (IC-633376) is also a vigorous, semi-spreading, deciduous genotype with an average fruit weight of 137 g. Fruits are dark purple with light purple, slightly sweet and hard arils. It is a promising parent for improvement of fruit colour. Rind anthocyanin content was high (909 mg/ kg). Leaves exhibit purple midrib coloration, which intensifies with maturity.

Breeding for improvement of pomegranate under hot arid region

During 2025, a total of 143 crosses involving Jalore Seedless, Bhagwa, Mridula, Gul-e-Shah Rose Pink and CIAH PG-4 were attempted to develop pomegranate hybrids with improved fruit quality, cracking tolerance and adaptability to hot arid conditions. All parental combinations were found cross-compatible. Fruit set ranged from 18.18% to 45.71% across different crosses, with the highest in cross B (45.71%) and the lowest in cross D (18.18%). Mature fruits were harvested and seeds were sown in potting mixture under polyhouse conditions. The hybrid seedling population is being raised under

polyhouse conditions.

Field establishment of pomegranate hybrid progeny for evaluation

A total of 150 hybrid progeny plants were transplanted under field conditions for evaluation of growth and fruit quality traits. During severe winter (December-January), plants were covered with polythene to protect against frost. Additionally, about 210 hybrid seedlings are being raised under polyhouse conditions for further evaluation.

Evaluation of pomegranate germplasm

Sixty pomegranate germplasm accessions were evaluated for nutraceutical traits, revealing significant variation in bioactive compounds. Phenolic content ranged from 0.84 to 4.76 mg GAE/g, with the maximum value observed in CIAH PG A-12. Flavonoid content varied from 0.011 to 0.058 mg GAE/g, with KS-1 showing the maximum. Anthocyanin content ranged from 9.67 to 319.76 mg/L, with the highest in Mridula. Total antioxidant activity ranged from 1.08 to 11.17 mg AAE/g, with the maximum observed in KS-1.

Evaluation of sour-type pomegranate genotypes

Thirty-one sour-type pomegranate genotypes were evaluated under hot arid conditions for yield, physico-chemical traits and anardana quality. CIAH PG-1 recorded the highest fruit number (46.92 fruits/ plant), fruit yield (12.40 kg/ plant), fruit weight (263.84 g) and aril content (67.71%). It was followed by Gul-e-Shah Rose Pink and Tujetis EC-104347 for yield traits. Maximum juice acidity was observed in Tujetis EC-104347 (3.57%), which was statistically at par with CIAH PG-1 (3.50%). The lowest dehydration ratio was recorded in CIAH PG-A-3 (2.23). Maximum anardana recovery was obtained in CIAH PG-1 (2.23 kg/ plant), followed by Tujetis EC-104347 and Gul-e-Shah Rose Pink. Anardana acidity ranged from 4.63 to 7.99%, with several genotypes exceeding 7% (AHPG H-2, Tujetis EC-104347, CIAH PG-1, Khog, Gul-e-Shah, IC-318712 and Tabest). Overall, CIAH PG-1 was found superior for anardana recovery, quality and sensory attributes, while Tujetis EC-104347 and Gul-e-Shah Rose Pink were also suitable for processing and breeding.

Evaluation of bael germplasm

A population of seed-origin bael genotypes

was initially evaluated under natural rainfed conditions of hot arid environment. A total of 72 genotypes were assessed based on morpho-physiological indicators. Observations were recorded during the post-monsoon period (October-November) and after winter. The genotypes were classified into six categories based on their response. Highly sensitive genotypes (CIAH-AMS-1, 7, 13, 17 and 67) showed severe leaf wilting, loss of greenness and scorching at leaf margin with no leaf drop. Sensitive genotypes (CIAH-AMS-40, 42, 45, 48, 53 and 57) exhibited severe leaf wilting and loss of greenness with no leaf drop. Moderately sensitive genotypes (CIAH-AMS-10, 12, 14, 16, 18, 22, 27, 28, 32, 34, 36, 38, 43, 44, 49, 52, 54, 55, 56, 60, 61, 63, 64, 65 and 71) showed moderate leaf wilting and loss of greenness, but no leaf drop. Moderately tolerant genotypes (CIAH-AMS-2, 3, 4, 5, 9, 15, 19, 20, 21, 23, 24, 29, 30, 33, 46, 50, 51, 58, 59, 62, 66, 68, 70 and 73) had healthy leaves without growth cessation at shoot tips; partial leaf senescence followed by leaf drop, without leaf rolling or wilting and post-monsoon senescence indicates partial drought avoidance. Tolerant genotypes (CIAH-AMS-6, 8, 25, 26, 31, 35, 47 and 72) showed healthy green to light green leaves with growth cessation at the tips of current season's shoots. Highly tolerant genotypes (CIAH-AMS-39, 41 and 69) showed healthy dark green leaves without growth cessation at the tips of current season's shoot.

Further, twenty-six seed-origin bael genotypes, along with varieties Goma Yashi, NB-9 and NB-5, were evaluated for 21 fruit and pulp traits. Half sib-population of eighteen seedling progenies were evaluated for rootstock purposes.

Evaluation of citrus germplasm

Eleven sweet orange cultivars, namely Hamlin, Jaffa, Mosambi, Sathgudi, Early Gold, Blood Red, Pusa Round, Pineapple, Valencia Late, Lane Late and Washington Navel, along with three selections (CIAH-SO-24/17, CIAH-SO-21/09 and CIAH-SO-22/15), were evaluated on Rough Lemon rootstock under hot arid conditions. Among the cultivars, Sathgudi was found superior for most yield and quality attributes and exhibited an extended harvesting period. Among the selections, CIAH-SO-24/17 performed better than the standard check, Blood Red.

Among mandarins and interspecific hybrids, Fremont, Daisy, Oree, Kinnow, Murcott and Fairchild Tangelo

were evaluated for their performance under arid conditions. Based on maturity, Fremont was classified as early maturing, Daisy as mid-season, Oree and Murcott as mid-late and Kinnow as late maturing.

Three grapefruit cultivars i.e., Duncan, Ruby Red and Red Blush were also evaluated. In addition, seven acid lime accessions were evaluated along with the national check, Balaji. Among these, the accessions CIAH-AL-01, CIAH-AL-03 and CIAH-AL-10 were found promising in terms of fruit size, quality and yield potential under hot arid conditions. Furthermore, one acid lime genotype collected from a homestead garden in the Suratgarh area exhibited field tolerance to citrus canker. The plants have been established in nursery for further evaluation.

Hybridization in citrus

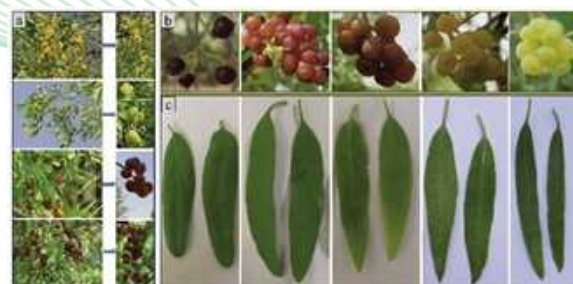
Interspecific hybridization viz., Kinnow × Daisy, Daisy × Kinnow, Daisy × Fremont, Acid Lime × Grapefruit and Rangpur Lime × Rough Lemon were attempted to develop specific citrus hybrids. Mature fruits obtained from these crosses were harvested and putative F_1 populations were raised. A putative hybrid population (290 seedling) are currently being maintained and the populations developed during the previous year have been established in the field.

Germplasm exploration and survey of pilu

To identify elite germplasm of pilu (*Salvadora oleoides*), an exploration and survey programme was conducted in the Balotra, Jalore, Santhore, Sirohi, Pali and Jodhpur districts of Rajasthan during the peak fruiting season to assess its natural diversity and select superior plants with desirable horticultural traits. A total of six elite genotypes were identified from the desert ecology of Rajasthan, including three from Jalore and one each from Balotra, Santhore and Pali. The selected trees were marked in the field and their morphological traits, including tree height, canopy spread, trunk circumference and canopy density were recorded. Leaf and fruit samples were collected from these trees to assess qualitative and quantitative traits. Cuttings from the identified trees were also collected for propagation and further evaluation.

The descriptive statistics revealed significant variability among the pilu genotypes for multiple traits. Fruit weight exhibited wide variation (0.27-0.96 g; CV

= 36.95%), whereas polar and equatorial diameters and geometric mean diameter showed moderate variability (CV = 14-15%). Fruit volume and surface area exhibited relatively higher variability (CV = 27-37%). Most size-related traits showed negative skewness with near-normal to moderately leptokurtic distributions. Shape traits (sphericity, aspect ratio and shape index) and edible portion exhibited low variability (CV = 2.75-4.14%). Seed traits showed low to moderate variation (CV = 8.7-19%) with negative skewness. Among biochemical traits, total soluble solids varied moderately (CV = 9.58%), acidity showed low variation, while ascorbic acid exhibited higher variability (CV = 25.87%). Anthocyanin (in red-fruited types) and β -carotenoids showed very high variability. Leaf traits such as blade length, thickness, petiole length and petiole diameter showed low to moderate variability (CV = 7-17%), whereas leaf width exhibited relatively higher variation (CV = 24.98%). Considerable variability was also observed in bearing habit, fruit colour and leaf shape.



(a) Bearing habit, (b) Fruit colour, (c) Leaf shape
Variability in natural populations of *S. oleoides*

Evaluation of lasoda germplasm

During 2025, a total of 19 genotypes of *Cordia myxa* were evaluated for various fruit traits at two stages, namely horticultural maturity and the ripe fruit stage. At horticultural maturity, fruit dimensional attributes exhibited low variability, with polar diameter ranging from 20.90 to 25.64 mm (mean = 23.29 mm, CV = 4.64%) and equatorial diameter from 18.67 to 23.10 mm (mean = 21.08 mm, CV = 5.24%). The shape index varied between 80.83 and 98.27 (mean = 90.62, CV = 4.83%), while sphericity ranged from 86.75 to 98.83% (mean = 93.58%, CV = 3.21%). Fruit weight showed comparatively higher variability, ranging from 4.23 to 7.34 g (mean = 5.79 g, CV = 12.64%), whereas the edible portion remained highly uniform (89.95-93.84%, mean = 92.13%, CV = 1.03%).

At the ripe stage, polar diameter ranged from 20.16 to 24.50 mm (mean = 22.32 mm, CV = 4.60%) and equatorial diameter from 19.34 to 24.95 mm (mean = 22.46 mm, CV = 5.12%). The shape index ranged from 90.63 to 107.61 (mean = 100.72, CV = 4.30%), while sphericity varied from 93.64 to 105.00% (mean = 100.44%, CV = 2.87%). Fruit weight exhibited moderate variability (4.62-9.06 g, mean = 6.91 g, CV = 14.12%), whereas the edible portion remained highly uniform (91.32-94.79%, mean = 93.37%, CV = 1.16%). Overall, dimensional traits exhibited a high degree of uniformity, while weight-related traits showed relatively greater variability at both maturity stages.

From horticultural maturity to the ripe stage, notable changes were observed in fruit physical attributes. Mean polar diameter decreased by 4.2% (23.29 to 22.32 mm), while equatorial diameter increased by 6.5% (21.08 to 22.46 mm), resulting in an 11.2% increase in shape index and 7.3% increase in



CIAH-SO-21

CIAH-SO-22



CIAH-SO-23

CIAH-SO-24



CIAH-SO-23

CIAH-SO-24

Fruits of selected elite genotypes of *S. oleoides*

sphericity. Geometric mean diameter and surface area increased by 2.9% and 6.0%, respectively. Mean fruit weight showed a substantial increase of 19.3% (5.79 to 6.91 g), whereas seed weight remained unchanged.



RP-8-1

RP-11-2



RP-20-2

RP-12-2

Promising lasoda genotypes

At CHES, Vejalpur, Godhra

Evaluation of aonla germplasm

During 2025, a total of 77 aonla germplasm accessions were evaluated, including 14 released varieties (Chakaiya, Banarasi, Francis, Krishna, Kanchan, NA-10, Anand-1, Anand-2, NA-7, NA-6, Goma Aishwarya, BSR-1, Laxmi-52, BSR-2), 16 advance genotypes (CHESA-1 to CHESA-16) and 47 seedling genotypes for morphometric traits, yield performance and fruit quality.

Evaluation of aonla varieties

The results revealed significant variation among the evaluated aonla varieties for fruit set, fruit physical characteristics and fruit retention. Fruit set ranged from 14.20% (Banarasi) to 25.12% (NA-7). Fruit weight ranged from 13.15 g (BSR-1) to 37.10 g (Banarasi). Fruit length varied from 3.44 cm to 4.10 cm, with the longest fruits in Banarasi and shorted in NA-7. Fruit breadth ranged from 1.82 cm to 4.02 cm, with the maximum in Banarasi whereas the minimum in BSR-1. Fruit retention percentage was highest in NA-7 (11.11%), followed by Goma Aishwarya

(10.98%) and Krishna (9.22%), while lowest in Banarasi (8.00%) and Laxmi-52 (7.20%).

Evaluation of advance genotypes of aonla

Among the 16 genotypes, flowering and fruiting were observed in 14 genotypes. The highest plant height was recorded in CHESA-4 (5.10 m), followed by CHESA-7 (4.57 m), while the minimum was observed in CHESA-1 (4.31 m) and CHESA-2 (4.35 m). Yield per plant was highest in CHESA-4 (75 kg). Tree growth habit varied among the genotypes: semi-spreading in CHESA-1, CHESA-2 and CHESA-10; tall upright in CHESA-7, CHESA-8 and CHESA-11; tall spreading in CHESA-5 and CHESA-6; and semi-drooping in CHESA-4. Foliage density ranged from dense to sparse.

Evaluation of aonla seedlings genotypes

Analysis of variance revealed highly significant ($p < 0.05$) genotypic differences across nearly all traits. High F-values were observed for plant height, fruit weight, pulp weight, juice percentage, TSS, acidity and yield. Remarkably high variation was noted in vitamin C and phenolic content. Correlation analysis showed strong positive associations of yield per plant with fruit weight ($r = 0.83$), fruit length ($r = 0.86$), pulp weight ($r = 0.85$) and juice content ($r = 0.86$), while negative correlations with vitamin C ($r = -0.66$) and TSS ($r = -0.75$). Network analysis delineated three distinct trait modules including a core cluster of interrelated fruit and yield parameters. PCA indicated that the first two components explained 65% of total variance mainly influenced by fruit size, pulp weight and quality traits.

Evaluation of bael germplasm

During the year 2025, all 222 established genotypes (CHESB-1 to CHESB-222), along with 8 varieties maintained in the field repository, exhibited flowering and fruiting. Additionally, 129 seedling germplasm (CHESBS-1 to CHESBS-129) were maintained, out of which 69 were evaluated for their morphological, qualitative and quantitative traits. A wide range of variability was observed in leaf, flower, yield, quality attributes and maturity period. Yield per plant ranged from 70-182 kg, fruit weight from 0.52-2.67 kg, fruit length from 7.2-22.9 cm and circumference from 22.1-53.2 cm. Variations were also recorded in shell thickness (1.47-3.28 mm), seeds

per fruit (69-290), number of seed sacs (10-18), seed weight (0.10-0.16 g), shell weight (115-455 g) and pulp weight (0.3-2.2 kg). Chemical composition showed variation with pulp TSS (35-43°B), mucilage TSS (43-57°B), acidity (0.3-0.7%), vitamin C (14-25 mg/100 g), total phenols (1725-2970 mg/100 g) and total sugar (13-19%). Fruit composition also varied in pulp (42-75%), shell (13-27%), fibre (3.4-8.9%), mucilage (9-16%) and seed content (1.98-5.27%). Ripening period ranged from February to June. Based on fruiting pattern and quality traits, genotypes CHESB-42, CHESB-48, CHESB-59, CHESB-60, CHESB-62, CHESB-69, CHESB-71, CHESB-73, CHESB-77 and CHESB-78 were found promising. The selected elite bael genotypes are described below.

CHESB-31: Collected from Nimadi, Jaipur (2012-13). Average yield: 127 kg/ plant (13th year). Average fruit weight: 1.45 kg; size: 12 × 18 cm; shell thickness: 0.2 cm; seeds: 91; seed weight: 21 g; fibre: 45 g; shell weight: 240 g; locules: 15-17. TSS pulp: 37.5°B; mucilage: 52°B; acidity: 0.3%; vitamin C: 22 mg/100 g. Suitable for *sharbat*, *murabba*, powder and ayurvedic uses. Ripening period from flowering: 300 days. Distinct for peripheral locules arrangement and flattened lemon-coloured fruit.

CHESB-42: Collected from Nimadi, Jaipur (2012-13). Yield: 101 kg/ plant (12th year). Average fruit weight: 1.53 kg; size: 19 × 16 cm; shell thickness: 1.8 mm; shell weight: 220 g; pulp: 1.15 kg. Locules: 13-15; seeds: 150-169; fibre: 66 g. TSS pulp: 38°B; mucilage: 50°B; sugar: 21%; acidity: 0.5%; phenolic content: 19 mg/g fresh weight and vitamin C: 20 mg/100 g.

CHESB-48: Collected from Gir, Somnath (2013). Yield: 110 kg/ plant (12th year). Average fruit weight: 1.43 kg; Shell weight: 266 g; thickness: 2.2 mm; pulp: 1.25 kg. Locules: 14-16; seeds: 140; fibre: 27.8 g. TSS pulp: 38°B; mucilage: 48°B; sugar: 21%; acidity: 0.65%; phenolic content: 27 mg/g fresh weight and vitamin C: 18 mg/100 g.

CHESB-59: Collected from Khijalpur, Kheda (2012). Yield: 105 kg/ plant (13th year). Fruit weight: 1.1 kg; size: 14 × 13 cm; shell weight: 206 g; shell thickness: 2.2 mm; pulp: 0.98 kg. Locules: 12-14; seeds: 180; fibre: 25 g. TSS pulp: 43°B; mucilage: 57°B; sugar: 20%; acidity: 0.45%; phenolic content: 21 mg/g fresh weight and vitamin C: 17 mg/100 g.

CHESB-60: Collected from Pratapgarh, Uttar Pradesh. Yield: 86 kg/ plant. Fruit weight: 1.62 kg; shell weight: 280 g; thickness: 2.85 mm; pulp: 1.30 kg. Locules: 16-18; seeds: 62.88; fibre: 34.6 g. TSS pulp: 37°B; mucilage: 47°B; sugar: 21%; acidity: 0.4%; phenolic content: 28 mg/g fresh weight and vitamin C: 15 mg/100 g.

CHESB-69: Collected from Keshod, Junagarh (2012). Yield: 86 kg/ plant (13th year). Fruit weight: 0.97 kg; size: 15 × 12 cm, shell weight: 187 g; shell thickness: 2.52 mm; pulp: 0.88 kg. Locules: 15-17; seeds: 120; fibre: 20 g. TSS pulp: 45°B; mucilage: 49°B; sugar: 18%; acidity: 0.4%; phenolic content: 22 mg/g fresh weight and vitamin C: 19 mg/100 g.

Characterization and evaluation of guava germplasm

A total of 126 guava germplasm, comprising 65 red-fleshed and 61 white-fleshed genotypes, were characterized based on 35 morphometric traits. The Shannon diversity index showed moderate to high phenotypic diversity among the genotypes for most qualitative and quantitative traits. Higher diversity was observed for fruit-related attributes such as fruit weight, size, pulp thickness and biochemical traits. In contrast, relatively lower diversity was recorded for certain canopy and leaf morphological descriptors. Hierarchical cluster analysis classified the 126 genotypes into five clusters, comprising 32, 34, 20, 24, and 16 genotypes in clusters I through V, respectively. Principal component analysis showed that the first two components captured a significant proportion of total variability and separated genotypes based on fruit quality and yield-related traits. Quality traits (TSS, sugars, acidity and antioxidant attributes) were closely associated and largely separated from yield attributing traits. Genotypes were grouped into quality-dominant, yield-dominant and intermediate categories. The characteristics of promising guava hybrids are described as under:

H-1 (CHESG-15 × VL): Plants are moderately vigorous and prolific bearers, yielding about 55 kg/ tree in the 7th year. Fruits are round, medium to large (240-260 g) with smooth yellowish-green peel and red pulp. It has high TSS (14°B), acidity (0.6%) and ascorbic acid (280 mg/100 g). Suitable for both table use and processing. Fruits have good keeping quality (6-7 days at ambient conditions).

H-2 (CHESG-15 × VL): Plants exhibit an upright growth habit and are prolific bearers (52 kg/ tree in the 7th year). Fruits are round, medium to large (230-250 g) with smooth yellowish-green peel and red pulp. It has a good blend of TSS (11.5°B) and acidity (0.45%), with ascorbic acid above 200 mg/100 g. Suitable for table purpose with good shelf life (4-5 days at ambient conditions).

H-1/27 (BL × SP): Plants have an upright growth habit and are heavy bearers. Fruits are roundish, weighing 180-220 g, with whitish yellow-green peel and orange-pink pulp. At mature ripened stage, pulp is firm with fewer small soft seeds, pleasant aroma, good taste and good shelf life (5-6 days).

H-2/20 (VL × SP): Plants are comparatively dwarf and prolific bearers (25 kg/ tree in the 4th year). Fruits are round, medium to large (250-280 g) with smooth yellowish-green peel and orange-pink pulp. It has high TSS (12°B), acidity (0.48%) and ascorbic acid (184 mg/100 g). Suitable for table purpose with good keeping quality (6-7 days at ambient conditions).



H-1

H-2



H-1/27

H-2/20

Promising guava hybrids

Characterization and evaluation of acid lime germplasm

A total of 27 acid lime genotypes were characterized and evaluated based on various morphometric traits. Substantial phenotypic variability was observed among the acid lime genotypes across vegetative, fruit and biochemical traits. Leaf length ranged from 5.5 to 9.8 cm and leaf width from 2.9 to 5.2 cm, while petiole length (0.8-2.0 cm) and spine

length (2-11mm) also showed variation. Fruit and yield traits showed wide variation, including fruit length (30.91-49.20 mm), fruit width (28.92-50.45 mm), number of segments (8-13), number of seeds (4-16), fruit weight (27.74-52.61 g) and yield per tree (17.50-56.72 kg). Juice percentage ranged from 36.54 to 55.75%. Biochemical traits also varied, with TSS ranging from 6.55 to 9.62°B, acidity from 5.25 to 8.71% and ascorbic acid from 23.60 to 42.14 mg/100 g. Mean values with standard deviations indicated consistent performance across genotypes, while coefficients of variation were generally low, except for number of seeds (26.34%).

Genotype effects were highly significant ($P < 0.001$) for most traits, including leaf length ($F = 89.86$), leaf width ($F = 23.80$), petiole length ($F = 11.13$), spine length ($F = 11.57$), fruit length ($F = 9.04$), fruit width ($F = 16.25$), number of segments ($F = 10.68$), fruit weight ($F = 4.60$), yield per tree ($F = 95.59$), juice percentage ($F = 8.26$), TSS ($F = 17.47$), acidity ($F = 25.09$) and ascorbic acid ($F = 12.67$), whereas number of seeds were non-significant.

Ward's hierarchical clustering grouped the acid lime genotypes into four distinct clusters based on fruit quality, yield and biochemical traits. Cluster I comprised CHESL-32, CHESL-13, CHESL-29, CHESL-10, CHESL-11 and CHESL-22, which grouped at relatively low Ward's distances. These genotypes were associated with moderate fruit size and intermediate quality traits. Cluster II included CHESL-3, CHESL-12, CHESL-15, CHESL-21 and CHESL-5. These genotypes were associated with superior fruit physical traits and higher yield. Cluster III, the largest group, consisted of CHESL-17, CHESL-14, CHESL-31, CHESL-8, CHESL-9, Sai Sarbati, CHESL-7, Pramalini, Vikram, CHESL-33, CHESL-23, CHESL-20 and CHESL-6. These genotypes were associated with variable combinations of quality, nutritional and yield traits. Cluster IV comprised Ganganagar1, CHESL-24 and CHESL-35, which were separated at the highest Ward's distance. These genotypes were associated with distinct biochemical and fruit quality traits.

The heatmap differentiated genotypes based on fruit size and yield (CHESL-15, CHESL-21, Vikram) and those with superior quality and nutritional traits (Ganganagar1, Sai Sarbati, CHESL-5, CHESL-32).

The promising acid lime selection is characterized as follows:

CHESL-14: Dwarf plant with drooping canopy and low thorn density. Fruits are round, medium-sized with prominent green vesicles. It is a cluster bearer with average fruit weight of 30-35 g and size of 46.47 × 41.33 mm. Average yield is 55 kg/ plant at 8th year. Juice content is 48% with TSS 8.19°B, acidity 7.86% and ascorbic acid 34 mg/100 ml. Fruits have good keeping quality under ambient conditions.



CHESL-14

CHESL-15: Plant has a spreading growth habit and fruits are almost free from citrus canker. Average yield is 63 kg/ plant at 8th year, with fruit weight above 40 g and fewer seeds (8-9 per fruit). Juice content is high (51%) with acidity 6.87% and ascorbic acid 38 mg/100 ml. Fruits have good keeping quality (8-10 days) with attractive smooth yellow peel.



CHESL-15

CHESL-32: A high-yielding genotype with larger fruits and high juice content (49%). Average yield is 59 kg/ plant at 8th year, with fruit weight around 40 g. Juice has TSS 9°B, acidity 8.15% and ascorbic acid 30 mg/100 ml.



CHESL-32

Characterization and evaluation of jamun germplasm

A total of 22 jamun genotypes were characterized and evaluated based on various morphological, yield, biochemical traits. Mean comparison analysis (LSD, $P \leq 0.05$) revealed significant differences among jamun genotypes for all studied traits. Tree canopy volume ranged from 61.90 (CJ-27) to 107.20 (CJ-42). Fruit weight was highest in CHESJ-36 (17.93 g) followed by CHESJ-30 (17.23 g), Goma Priyanka (17.12 g) and CISHJ-37 (17.10 g). Yield per tree ranged widely, with CHESJ-30 recording the highest yield (51.65 kg), followed by Goma Priyanka (45.44 kg) and CISHJ-37 (40.69 kg). TSS ranged from 10.83°B (CHESJ-34) to 18.93°B (Gokak-1), while acidity varied from 0.39% (CHESJ-29, CHESJ-35) to 0.97% (CHESJ-45). Ascorbic acid content was highest in CHESJ-30 (44.17 mg/100 g) followed by CHESJ-42 (42.50 mg/100 g) and CHESJ-45 (42.19 mg/100 g).

Based on mean performance, CHESJ-30 and CHESJ-10 were identified as superior genotypes. Correlation analysis showed associations among fruit size, yield and biochemical traits. Hierarchical clustering grouped genotypes into distinct clusters. The promising jamun accession is detailed as follows:

CHESJ-10: Ripens in the 3rd week of June, with harvesting extending to the 2nd week of July. It produces about 45 kg fruits/ tree (10th year), with an average fruit weight of 20 g, pulp content of 82.5% and TSS of 16.8°B.



CHESJ-10

CHESJ-30: A regular and prolific bearer, with fruit ripening beginning in the 3rd week of June and harvesting completed by last week of June, helping it escapes fruit and seed borer and seed weevil attacks. It produces around 48 kg of fruits/ tree, with high pulp content (91%). Fruits weigh 15-20 g, are rich in vitamin C (44 mg/100 g) and total sugars (11.94%). Fruits are elliptic in shape and purple-red in colour.



CHESJ-30

Characterization and evaluation of Manila tamarind germplasm

A total of 22 Manila tamarind genotypes were characterized and evaluated based on various morphological, yield, biochemical traits. Mean comparison revealed clear differentiation among

Manila tamarind genotypes. Pod weight varied significantly, with CHESM-7 and CHESM-6 recording the highest mean values, followed by CHESM-24, CHESM-32, CHESM-27 and CHESM-4. These genotypes also exhibited higher pulp and aril weights. TSS, total sugars and sweetness were relatively higher in CHESM-32, CHESM-20, CHESM-7 and CHESM-4, while acidity remained low to moderate. Ascorbic acid content differed significantly, with higher values observed in CHESM-7, CHESM-20 and CHESM-32. Antioxidant attributes, including total phenols, flavonoids and total antioxidant activity, also showed higher mean values in CHESM-32, CHESM-20 and CHESM-7. Mineral composition varied significantly, in particular potassium, phosphorus and calcium content.

The heatmap showed strong positive associations among pod weight, pulp weight, aril dimensions and aril percentage. TSS, total sugars and ascorbic acid were positively correlated. Antioxidant traits were positively interrelated. Seed traits exhibited weaker or variable correlations with quality attributes. The characteristics of the promising Manila tamarind are described below:

CHESM-4: Pods are coiled, with peel colour turns from light green to deep pink at maturity with milky white aril. It has a pulp content of over 74% and fairly good shelf life. Fruits weigh more than 25 g, with TSS ranging from 22-26°B and acidity between 0.69-0.72%. It is a precocious and high-yielding genotype (about 46 kg/ tree) and is highly suitable for cultivation under rain-fed hot semi-arid conditions.



CHESM-4

CHESM-27: Trees are moderately vigorous with a semi-spreading growth habit. Pods are loosely twisted,

with peel colour turning from light green to deep maroon at maturity and a deep red aril. It has a pulp content exceeding 73% and is a high yielder (about 33 kg/ tree). Fruits weigh more than 22 g, with TSS around 24°B, acidity of 0.72% and ascorbic acid content of 120 mg/100 g.



CHESM-27

Characterization and evaluation of mahua germplasm

A total of 34 mahua genotypes were characterized and evaluated based on various traits. All traits exhibited wide variability among the genotypes. Leaf length ranged from 13.6 to 36.9 cm, while leaf width varied from 6.1 to 14.1 cm. Petiole length ranged from 1.8 to 9.6 cm and petiole thickness from 0.22 to 0.55 cm. Floral traits showed marked variation, with flower length ranging from 16.73 to 32.77 mm and flower width from 11.85 to 23.13 mm. Flower weight varied between 15.10 and 39.30 g. Seed traits also varied considerably, with seed length ranging from 2.65 to 4.40 cm and seed width from 1.03 to 2.86 cm. Seed weight ranged from 2.11 to 7.61 g, while seed kernel weight varied from 1.16 to 5.78 g. Among biochemical traits, oil content ranged from 38.38 to 58.83%. Acid value varied from 2.85 to 21.35 mg KOH g⁻¹ oil and free fatty acid content (as oleic acid) ranged from 1.10 to 11.69%. The highest variability was observed in free fatty acid (CV=49.42%) and acid value (CV=44.60%), while oil content showed comparatively lower variability (CV=9.99%). All traits differed significantly among genotypes ($P < 0.001$).

Reproductive and biochemical traits such as petiole length, flower weight, acid value and free fatty acids recorded high coefficients of variation. Strong positive associations were observed among flower-related traits (length, width and weight). Seed weight showed a strong positive correlation with seed kernel weight and both were positively associated with oil

content. Acid value and free fatty acids exhibited a very strong positive correlation. Leaf traits showed comparatively weaker associations with biochemical traits. The first three principal components together accounted for approximately 66.2% of the total variability among the Mahua genotypes. PC1 was associated with economic yield and oil productivity, with genotypes on the positive side exhibiting higher values for flower, seed and oil traits. PC2 was mainly influenced by leaf dimensions, while PC3 was dominated by acid value and free fatty acids.

Evaluation of custard apple germplasm

Seventy-four custard apple genotypes were evaluated using 18 quantitative traits to assess genetic diversity. K-means clustering grouped the genotypes into seven distinct clusters, indicating substantial variability in key traits such as fruit weight, pulp weight, pulp percentage, TSS and yield per plant. Cluster 6 exhibited superior performance for yield and edible pulp characteristics, along with relatively lower seed content. Clusters 2, 3 and 5 showed moderate yet stable performance, whereas Cluster 1 consisted of small-fruited genotypes with poor pulp recovery. Euclidean distance analysis (6.54-251.19) further confirmed a high level of genetic divergence among the genotypes. Notably, genotype CHESCA-13 was the most divergent, especially in comparison to CHESCA-6, CHESCA-41 and CHESCA-47, underscoring its potential as a valuable donor parent for hybridization programs aimed at developing low-seeded, high-quality cultivars.

Evaluation of custard apple hybrids

The evaluation of 12 custard apple hybrids showed wide variability. Fruit weight ranged from 162-710 g, with CAH-1 producing the largest fruits (11.98-13.82 cm length; 11.12-11.50 cm breadth) and CAH-5 the smallest; CAH-2 and CAH-4 were intermediate. Leaf size was highest in CAH-4 (length up to 12.52 cm) and CAH-1 and lowest in CAH-5. Fruit suture length, pedicel length and breadth were highest in CAH-1 and lowest in CAH-5. Seed number ranged from 15 (CAH-3) to 50 (CAH-1). Seed length was highest in CAH-3 and seed breadth in CAH-5. TSS ranged from 24.56-28.69°B (highest in CAH-5 and CAH-3; lowest in CAH-4). CAH-5 recorded the highest yield per plant (28.23-32.12 kg), followed by CAH-3 (24.23-27.12 kg) and CAH-2 (22.32-24.23

kg), while CAH-1 recorded 17.23-20.13 kg per plant.



CAH-1

CAH-2



CAH-3

CAH-4

Evaluation of Red Sitaphal (custard apple) germplasm

In Red Sitaphal, 32 genotypes are maintained and evaluated under field conditions. Fruit weight ranged from 149 to 258 g and TSS from 20 to 26°B. Genotypes CHESRCA-05, CHESRCA-12 and CHESRCA-16 were found promising, recording higher yield than others. Maximum pulp percentage was observed in CHESRCA-16 (66.26%) followed by CHESRCA-12 (64.42%).

Evaluation of Ramphal germplasm

Twenty-three Ramphal genotypes were evaluated under field conditions and multivariate analysis was performed to elucidate relationships among morphological, quality and yield traits. Strong positive correlations were observed among fruit weight, pulp weight and pulp percentage ($r = 0.72-0.95$), while pulp-to-shell ratio showed a negative association with shell weight ($r = -0.65$). Principal component analysis explained over 70% of the total variation, with the first two components mainly influenced by fruit morphological and biochemical traits. Canonical correlation analysis showed a strong association ($r = 0.982$, $p < 0.001$) between fruit

morphology and quality traits. Path analysis identified fruit weight, pulp weight, pulp percentage and tree height as major contributors to yield. Based on overall performance, CHESR-18, CHESR-14, CHESR-19 and CHESR-1 were identified as superior genotypes.



Variability in fruits in Ramphal

Evaluation of wood apple germplasm for biochemical traits

The biochemical evaluation of 62 wood apple genotypes revealed substantial variability in phenolic content, flavonoids, antioxidant activity and nutritional composition. Under different solvent systems (80% aqueous methanol, ethanol and acetone), total phenolic content was higher in aqueous ethanol and acetone extracts, with Selection-22, Selection-1 and Selection-9 recording the highest values. Total flavonoid content was also higher in ethanol extracts, particularly in Selection-15, Selection-27 and Selection-10. Antioxidant activity assessed through DPPH radical scavenging, FRAP, metal chelating activity and reducing power showed significant variation, with ethanol extracts generally recording higher values. Selection-10 and Selection-22 showed higher FRAP values and reducing power, while metal chelating activity was higher in Thar Gaurav and Selection-29. Nutritional traits varied across genotypes, with higher protein content observed in Selection-22, Selection-23 and Selection-29. Overall Selection-22, Selection-10 and Selection-15 were identified as promising genotypes for antioxidant-rich and nutraceutical quality improvement in wood apple.

Evaluation of karonda germplasm

The evaluation of 62 karonda genotypes revealed wide genetic variability in various traits. Leaf length ranged from 3.74-15.38 cm, leaf breadth from 2.13-12.48 cm and spine length from 1.9-7.36 cm. Fruit weight varied from 0.42-13.58 g, fruit length from 6.17-27.64 mm and fruit breadth from 6.13-25.56 mm. TSS ranged from 9.23-28.18°B, acidity from 0.10-2.65% and ascorbic acid from 95.53-742.36 mg/100 g pulp. Total sugars ranged from 6.17-28.10% and reducing sugars from 3.12-16.38%. Phenolic content ranged from 110-727 mg/100 g pulp and flavonoids from 75-321 mg/100 g pulp. Antioxidant activity varied widely, with FRAP values from 98-727 mg/100 g, DPPH activity from 6.8-51.2% inhibition and TEAC up to 51.24% inhibition. Nutritional traits also showed variation, with potassium (109-742 mg/100 g), vitamin A (75-325 µg/100 g) and anthocyanin (98-4,867 mg/100 g). Floral traits varied considerably, with flowers per inflorescence ranging from 6-10, petal length from 2.09-2.68 cm and petal width from 4.95-5.35 mm. Overall, CHESK-4, CHESK-20, CHESK-28 and CHESK-62 were identified as superior genotypes.



Variability in fruit and leaf traits in karonda

Evaluation of tamarind germplasm

Thirty-two tamarind genotypes were evaluated using DUS guidelines, of which CHEST-11 and CHEST-27 were identified as promising under semi-arid conditions of western India. CHEST-27 is a semi-tall genotype with a thick trunk and drooping branches. It records 14.8% acidity, 57% total sugars, 27% reducing sugars, 21 mg/100 g vitamin C and 3.32 mg/100 g protein. This genotype produces 60 kg fruit per plant, with 55% pulp content and TSS of 72°B. It shows peak ripening in the last week of March.



CHEST-27

Evaluation of chironji germplasm

Thirty chironji genotypes were evaluated for growth, flowering, fruiting and fruit quality traits. Among them, CHESC-2 emerged as a promising genotype with a semi-spreading growth habit, high fruit set and regular bearing. It recorded a fruit weight of 1.18 g, TSS of 23.22°B, total sugars of 12.22%, vitamin C content of 49.15 mg/100 g and kernel protein content of 32.42%.

2.3 Improvement in Vegetable Crops

At ICAR-CIAH, Bikaner

Monitoring, maintenance and seed enhancement

During 2025, regular monitoring of arid vegetable genetic resources (about 500 lines) stored in the gene-bank facilities which mainly comprised of melons (280), gourds (60), chillies (45), tomato (15), brinjal (30), cluster bean, cowpea and beans (35) was done for their safe conservation. In addition, perennial germplasm of khejri, sehjan, guarpatha, kundru, kakoda, phog, meetha-neem and many-more native crop-plants of vegetable significance were maintained in the field repository.

The three years multi-location data of cluster bean variety Thar Bhadavi under AICRP (VC) and KVK's trials were assessed for state variety proposal. The cowpea (AHCP-1-4-1 & AHCP-2-3), brinjal (Thar Rachit & CIAH-22), palak (Thar Hariparna), ivy gourd (Thar Sundari) and Nagauri paan-methi (AHLM-1) were further tested at KVK's for regional performance in Rajasthan. Basic seed enhancement of identified varieties of sponge gourd (Thar Tapish), mateera (Thar Manak & Thar Madhur), Indian bean (Thar Kartiki & Thar Maghi), cluster bean (Thar Bhadavi), palak (Thar Hariparna) and bottle gourd (Thar Samridhi) was done to fulfill national indents and multi-location trials. Likewise, cowpea (AHCP-3-3), ridge gourd (AHRG-15-4-1/a), velvet bean (AHVB-1), sehjan (CIAH-MO-1) and curry-leaf (AHMN-1) genotypes studied for over the years performance and characterized.



Tender pods of cowpea genotype AHCP-3-3

Seed regeneration and evaluation in muskmelon genotypes

Under germplasm maintenance, seed regeneration of muskmelon genotypes was undertaken during the spring–summer season of 2025 and evaluated for storage behaviour, seed longevity under different packaging conditions, germination after ageing, and crop vigour. A total of 81 muskmelon genotypes conserved in the CIAH gene bank (stored under refrigerator and deep-freezer at -20°C conditions) during 2002–2012 were studied, comprising basic germplasm, pre-breeding lines, advanced selections and varieties.

Detailed field evaluation was carried out for 55 genotypes. Based on standardized packaging methodology, muskmelon seeds can be safely stored for 10–15 years under refrigerated and deep-freeze (-20°C) conditions for breeding purposes. However, a regeneration cycle of 10 years is recommended to maintain good germination, plant vigour, fruit yield and seed quality. The germplasm was sown on 15 February 2025 using 12–22 year-old stored seeds and evaluated during the spring–summer season. Germination was observed within 5–14 days in 75 entries with good seedling vigour. Normal vine growth and fruiting were recorded in 55 genotypes. The crop was evaluated for 35 prioritized agro-morphological traits. Seeds were bulked and stored for further conservation.

Considerable variability was observed for key traits, including days to first male flower (33.67–46.33 DAS), node number to first male flower (2.11–6.85), days to first female flower (42.33–58.67 DAS), node number to first female flower (2.85–8.64), vine length

at 45 DAS (30.78–65.16 cm), fruit length (4.07–11.36 cm), fruit diameter (4.95–13.66 cm), fruit weight (0.105–1.215 kg) and flesh thickness (0.63–2.31 cm). Genotypes AHMM-17 (IC-321342), AHMM-20 (IC-321345) and AHMM-27 (IC-321352) were identified as promising for earliness and fruit traits. The stabilized genotype CIAH-MM-1 showed superiority for fruit quality, earliness, marketable yield and vine growth under heat-stressed arid conditions.



Fruit variability in muskmelon germplasm

Breeding for high temperature tolerant round melon

During 2025, breeding efforts for high temperature tolerance and fruit quality in round melon indicated that selections AHRM-1/2017/17-a (L-1 and L-2) performed poorly under spring–summer conditions in hot arid environments, whereas genotype CIAH-RM-1 showed superior performance during the rainy season. It exhibited early flowering (28–32 DAS), early harvest (41 DAS) and produced 4–6 pickings with a marketable yield of 1.28–1.65 kg per plant. The genotype showed uniform vine growth, desirable culinary quality (medium-sized, light green, soft fruits), prolific bearing of tender fruits (41–68 DAS) and mature fruits (70–85 DAS), making it suitable for *kharif* cultivation in arid regions. Characterization during 2024–2025 revealed early fruiting (41.67–45.33 DAS), moderate leaf size, high fruit number (14.82–22.65 fruits/plant), and desirable fruit traits (4.11–5.79 cm length, 5.41–7.28 cm diameter, 72.47–139.68 g weight), with a yield potential of 142.65–218.72 q/ha, confirming CIAH-RM-1 as a promising genotype for arid conditions.



Bearing behavior and tender
fruits of round melon (CIAH-RM-1)

Bottle gourd breeding for high temperature tolerance

During 2025, breeding efforts for high temperature tolerance and marketable yield in long-fruited bottle gourd revealed that selections AHLS/2017/01 (L-1) and AHLS/2017/02 (L-2) evaluated across spring–summer and rainy–winter seasons, with genotype CIAH-LS-1 showing consistent superiority under hot arid conditions. The genotype performed well across seasons and was comparable with the round-fruited variety Thar Samridhi for yield potential. It was also evaluated under AICRP-VC trials. CIAH-LS-1 exhibited uniform vine growth, early fruiting (~62 DAS) and multiple harvests (7–11 pickings), along with moderate flowering duration (male: 38.67–43.67 DAS; female: 47.33–52.67 DAS) and stable vegetative traits. The tender fruits at marketable stage were of A-grade quality, measuring 18.48–21.52 cm in length, 6.19–8.72 cm in diameter, and weighing 463.75–510.87 g, with an average yield of 4.26–5.63 kg per plant, indicating its suitability for cultivation under hot arid environments.



Marketable and mature fruit of
bottle gourd (CIAH-LS-1)

Improvement of drumstick

Systematic germplasm utilization and improvement in drumstick have been carried leading to the development and clonal maintenance of 17 distinct isolates. Among these, the elite genotype AHMO-1-4s was identified as highly promising for marketable pods and greens, and maintained clonally for seed production under isolation. During 2025, its seed-propagated progeny CIAH-MO-1 (eight-year-old plantation) was evaluated for growth regularity and biomass production under defined training, pruning, and management practices to mitigate low temperature and frost stress.

The progeny CIAH-MO-1 demonstrated superior performance under hot arid conditions, with uniform growth, early bearing (within two years) and regular high yield. It produces medium-sized, dark green pods (42–65 cm length, 44–78 g weight) with excellent quality, along with heavy pod setting during March–April and October–December. The genotype also showed high biomass potential, including tender pods, mature pods, and leaves (25–28% dry recovery), along with drought tolerance and good response to pruning, making it suitable for cultivation in arid regions.



Vegetative growth, flowering and pods of sehjan
(CIAH-MO-1)

Evaluation of khejri genotypes

Fourteen elite genotypes identified by CIAH from the year 2000 to 2005 and established clonally for *ex-situ* conservation in khejri (*Prosopis cineraria*) germplasm plot were maintained with good management practices and uniform plants were marked for DUS characterization. Khejri variety Thar Shobha and Thar Amruta plantations studied in context to standardize SOP's as annual practices of training-pruning/ lopping and inter-culture operations for managing gall infestation. Observations were recorded on growth, pod yield and bio-mass production over the years under rainfed conditions. In addition, Khejri Selection-3, 4, 5 & 6 studied for sangri harvest in response to pruning practices and *in-situ* bud-grafting performed for varietal evaluation. The recorded data over the years (2023 to 2025) of above selections compiled during 2025 for the characterization of genotypes.

Khejri Selection-3 (IC-657788): The plant of Khejri Selection-3 is moderate in growth and bearing longer pods of better quality. Tender pods at fresh marketable harvest stage are green in colour (143C), straight, roundish, 18.71–31.12 cm length and 1.17–2.46 g weight, and recorded 24.31% dehydration recovery (dried sangri).



Mature pods of Khejri Selection-3

Khejri Selection-4 (IC-657789): The plant of Khejri Selection-4 is moderate in growth and bearing medium sized pods of good culinary quality. Tender pods at

fresh marketable harvest stage are light green in colour, straight, flat shape, 16.22–21.14 cm length and 0.49–1.19 g weight and recorded 24.17% dehydration recovery (dried sangri). Tender pod maturity is one week later than variety Thar Shobha and thus recorded scope to extent period of sangri harvesting.



Marketable pods of Khejri Selection-4

Khejri Selection-5 (IC-657790): The plant of Khejri Selection-5 is moderate in growth and bearing medium sized pods, 8-12 pods/ cluster and good vegetable cooking quality. Tender pods at fresh marketable harvest stage are light green in colour (144A), straight, roundish, 14.64–21.13 cm length, 2.71-3.06 mm width and 0.69–1.36 g weight, and recorded 25.11% dehydration recovery (dried sangri). The maturity of tender pods is one week earlier than the variety Thar Shobha and thus depicting scope to extent the period of sangri harvesting.



Marketable stage pods of Khejri Selection-5

Khejri Selection-6 (IC-657791): The plant of Khejri Selection-6 is moderate in growth and bearing medium sizes pods (6-11 pods/cluster) of excellent culinary quality. Tender pods at fresh marketable harvest stages are deep green in colour, straight, roundish shape, 19.12–25.31 cm length, 2.96-3.54 mm width and 1.75–2.24 g weight, and recorded 25.22% dehydration recovery (dried sangri). The sensory evaluation of

vegetable is rated maximum among the genotypes tested.



Marketable pods of Khejri Selection-6

Generation advancement and selection in watermelon

During the summer season of 2025, the F_6 population (275 plants) derived from the cross AHW/BR-22 $\times$ YF 5-2-7 (non-lobed type) was raised. The population exhibited considerable variation in ovary length (1.1–1.5 cm), fruit weight (2.5–3.5 kg), fruit length (23.4–28.5 cm), fruit diameter (14.8–18.6 cm), rind thickness (1.3–1.7 cm), total soluble solids (11.8–15.9%) and leaf shape (non-lobed type). Trait-specific selection was carried out based on desirable attributes, including long fruit shape, dark green rind colour, yellow flesh colour, higher total soluble solids (TSS) and non-lobed leaf type.



F_6 population (AHW/YF Sel.-1)

Breeding of watermelon for resistance against bud necrosis virus

Five cross combinations were developed using BIL-53 as a donor parent for resistance against bud necrosis virus disease. These crosses were evaluated during the rainy season of 2025. The results revealed significant variation in disease incidence among the crosses. The cross BIL-53 $\times$ Arka Shyama F_1 (13.3%) recorded the lowest disease incidence, followed by

BIL-53 $\times$ AHW/YF-Sel.-1 F_1 (17.3%) and BIL-53 $\times$ AHW/YF-Sel.-2 F_1 (19.5%).

Evaluation of advanced lines of watermelon

Two advanced watermelon lines showed promising performance during the summer season of 2025. The line AHW/BR-22, belonging to the long-fruited 'ice box' segment, exhibited 50% female flowering at 40–44 DAS, with the first harvest at 70–74 DAS. It produced a hairy ovary measuring 1.2–1.9 cm in length and 0.3–0.5 cm in diameter. Fruits were 21.2–28.5 cm long and 14.2–16.9 cm in diameter, with an average weight of 1.5–2.5 kg. The flesh was dark red with total soluble solids (TSS) ranging from 13.9–15.2%. Each plant produced 3–4 marketable fruits with rind thickness of 1.2–1.5 cm and an attractive dark green rind colour.

The advanced line AHW/BR-43 PL5, also belonging to the long-fruited segment, consistently performed well, attaining 50% female flowering at 50–52 DAS and first harvest at 79–82 DAS. The fruits were light green in colour with red flesh. The ovary was long, measuring 1.9–2.5 cm in length and 0.4–0.7 cm in diameter. Fruits weighed 2.8–3.2 kg with TSS ranging from 12.2–14.3%. Each plant produced 3–4 marketable fruits.

AHMM/BR-52: A promising line of muskmelon

The advanced line AHMM/BR-52 was evaluated during the summer season of 2025 and found promising. It produced round fruits with a reddish-brown rind marked by 10 green sutures and greenish-white flesh. The flesh thickness ranged from 1.8–2.4 cm, with total soluble solids (TSS) of 7.8–10.5%. Fruit weight varied from 520–670 g. The fruits attained harvest maturity in 70–78 days after sowing.



AHMM/BR-52: promising line

Intensification of research on drumstick in arid region

With the objective to intensify the research on drumstick, a new germplasm block has been established. A total of 35 germplasm accessions were introduced from CHES, Vejalpur (Gujarat) during May 2025. Seeds were sown in nursery in polybags on 05 July 2025, and healthy seedlings were transplanted in the field on 31 July 2025. Observations on morphological traits were recorded at monthly intervals after transplanting, including basal stem diameter, number of primary, secondary and tertiary branches, height to first branch, plant height, leaf length and width, petiole length and diameter and leaflet dimensions. Leaf and flower samples were collected, dried and stored at ambient conditions for analysis of nutrients, vitamins, minerals, antioxidants and other quality parameters. The evaluation revealed wide variability in morphological traits.

Evaluation of Indian bean germplasm

During the rainy–winter season of 2025, nine F_1 hybrids were evaluated, and their F_2 generation was advanced for further evaluation and selection. In addition, eight entries under AICRP (VC) were evaluated in the Dolichos bean (pole type) AVT-I varietal trial, including Thar Maghi and Thar Kartiki, during the rainy season of 2025.

Evaluation and characterization of chilli germplasm

During 2025, 114 chilli (*Capsicum annum* L.) germplasm accessions, including 14 commercial check varieties, were characterized using 45 prioritized horticultural traits. These included growth, flowering, maturity and green fruit attributes, with 25 quantitative traits analyzed to assess genetic potential for future utilization. Selfing was performed to obtain advanced generation seeds of the selected lines for the targeted traits. Trait relationship reveals new information of some flowering traits which are having positive correlation with fruit yield. The genotypes are diverse enough to select the desirable traits and boost the combination breeding.



Morphological variation in fruit traits of chilli

Evaluation of fennel varieties under arid ecology

Twenty six fennel accessions collected from various sources were evaluated for yield and important agronomic traits, including plant height, number of umbels per plant, umbellets per umbel, seed weight and yield. The evaluation aimed to identify high-yielding, stable genotypes suited to arid environments, with the ability to tolerate fluctuations in high temperature. To enhance variability and broaden the scope for selection under arid conditions, mutagenic treatments were also applied to two promising genotypes, AF-1 and GF-11, using gamma (γ) radiation at different dose levels. The treated populations were raised and screened for morphological variations and improved yield attributes.



Field view of evaluation trial of fennel



Variations in M_2 populations of fennel

Evaluation of unique green-seeded fenugreek lines

A multi-location evaluation trial was conducted in collaboration with ICAR-NRCSS, Ajmer, to assess the performance of unique green-seeded fenugreek germplasm line across different environments. The trial comprised four green-seeded lines along with three yellow-seeded varieties as checks. Observations were recorded on growth, yield, and associated agronomic traits at all locations to evaluate adaptability, stability, and overall performance of the green-seeded lines in comparison to standard checks. The study will facilitate the identification of superior green-seeded fenugreek lines for use in breeding programs and potential commercial cultivation under diverse agro-climatic conditions.



Yellow seeded
fenugreek

Green seeded
fenugreek

At CHES, Vejalpur, Godhra

Germplasm evaluation and characterization of drumstick

Germplasm of drumstick was evaluated for important horticultural and qualitative traits (2016-2025). The germplasm exhibited wide variability for morphological and biochemical characters. Basal stem circumference ranged from 30.5–115.0 cm, while trunk circumference varied from 30–126 cm. Stem height ranged from 55–153 cm. The number of primary branches varied from 1–6 and secondary branches from 1–7. Tree height ranged from 3.75–8.70 m, while canopy spread varied from 2.6–8.4 m (E–W) and 3.3–8.7 m (N–S). Pod weight ranged from 40–280 g. Biochemical traits also showed considerable variation.

Total phenolic content ranged from 26.14–39.97 mg GAE/ 100 g, while vitamin C content varied from 192.53–267.12 mg/ 100 g. Antioxidant activity ranged from 4.64–21.71 $\mu\text{mol TE/ g}$ (DPPH) and 12.18–34.41 $\mu\text{mol TE/ g}$ (FRAP). Dry matter content varied from 10.39–20.25%, while moisture

content ranged from 79.75–89.61%. Mineral composition showed wide variation with potassium (612.15–964.27 mg/ 100 g), calcium (1354.24–1983.47 mg/ 100 g), magnesium (212.58–410.32 mg/ 100 g) and iron (25.73–35.68 mg/100 g). Based on overall performance, germplasm lines CHESD-34, CHESD-42, CHESD-45, CHESD-50 and CHESD-52 were identified as elite for important horticultural traits.

Evaluation and generation advancement in bottle gourd

Promising accessions of bottle gourd viz., LS-20-1 $\times$ LS-14-1, LS-28 $\times$ LS-20-2, LS-3 $\times$ LS-2, LS-42 $\times$ LS-32-2 and Baina, along with varieties (Thar Avani, Thar Samridhi, Pusa Sandesh and Arka Bahar), were evaluated for horticultural traits. The elite line LS-28 $\times$ LS-20-2 (long type), advanced to the F₂ generation, and recorded 18.2 fruits per plant with a yield of 15.3 kg per plant. The performance of the variety Thar Avani was also assessed for morphological and yield traits under rainfed semi-arid conditions.



Promising line of bottle gourd LS-28 $\times$ LS-20-2
(long type)

Evaluation and generation advancement in pumpkin

Two promising mini-box-type (local) pumpkin lines were purified and advanced to the sixth

generation. These were evaluated for morphological, yield, biochemical, antioxidant and nutritional traits.



Variation in pumpkin fruits

Generation advancement and evaluation of cucumber

The cucumber germplasm lines (CHES C-1 to CHES C-7) were evaluated for growth, yield and quality traits. Among these, the promising lines CHES C-1, CHES C-2, CHES C-3 and CHES C-4 were advanced to the sixth generation and analyzed for biochemical composition, antioxidant activity and nutritional attributes.

Characterization of ivy gourd accessions

A total of 28 gynoeceous accessions of ivy gourd, including varieties Thar Sadabahar and Thar Dipti, were evaluated for genetic diversity, morphological, yield and quality traits, along with antioxidant potential. The evaluation revealed wide variability in growth, yield and fruit traits, including fruit size, number of flowers and yield per plant. Significant variation was also observed in physiological and biochemical attributes, particularly antioxidant activities such as CUPRAC, DPPH and FRAP. The results indicated substantial genetic diversity among the accessions for morphological, yield and quality parameters.

2.4 Biotechnological and Biochemical Studies

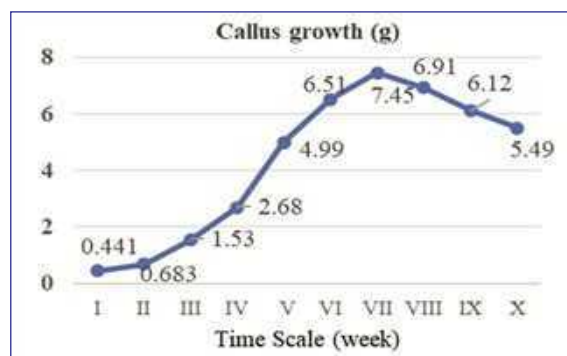
Effect of hormones on callus multiplication of date palm

Callus was obtained in limited quantity from shoot tip explants of the Barhee cultivar. This callus was subjected to multiplication and the development of a large quantity of embryogenic cultures through a cell suspension culture system. The cell suspension culture procedure was optimized on MS medium containing different concentrations of 2,4-D, NAA and BA,

maintained on a rotary shaker at 100 rpm under a 16/8 h (light/ dark) photoperiod with a light intensity of 1000 lux. The suspensions were observed for cell shape, size, cell cluster formation and embryo formation. The cultures were highly heterogeneous, containing embryos of different shapes, such as spherical, elongated and rooted forms, with sizes ranging from 1 mm to 10 mm. Under these conditions, a large number of heterogeneous cell suspensions, as well as immature and mature embryos, developed within 7–30 days of the culture period. Repeated suspension cultures followed by plating on solid MS medium resulted in the development of approximately 3000 cultures at different stages of somatic embryogenesis, including embryogenic callus, somatic embryos, germinated embryos and rooted plantlets, which were successfully established.

Optimization of embryogenic callus suspension culture in date palm

500 mg callus transferred to 50 ml of liquid MS medium supplemented with 300 mg of activated charcoal. The suspension culture was optimized using MS medium with varying concentrations of 2,4-D (0.1mg, 0.5mg and 1.0 mg) and WH. Cultures were maintained on a rotary shaker at 100 RPM under a 16/8-hour light/dark photoperiod at 1000 lux. The cultures were passed through a 500-micron mesh filter and observed for cell shape, size and cluster formation.



Callus growth curve in suspension culture of date palm



Callus growth after planting on solid media



Date palm plantlets of cv. Barhee with well-developed roots, ready for hardening

Identification and characterization of heat stress responsive genes in chilli

To know the complexity and structural divergence in heat stress responsive genes of chilli, a total of 199 genes encoding heat shock protein (*CaHSP*) were identified through a genome-wide survey of the *Capsicum annuum* genome. Identified gene were characterized with all sort of bioinformatic analysis. The molecular weight of *CaHSP* proteins ranged from 6.12 kDa to 157.85 kDa. The gene structural analysis revealed that 164 genes having complex exon-intron arrangements and 35 possessing single exon configurations.

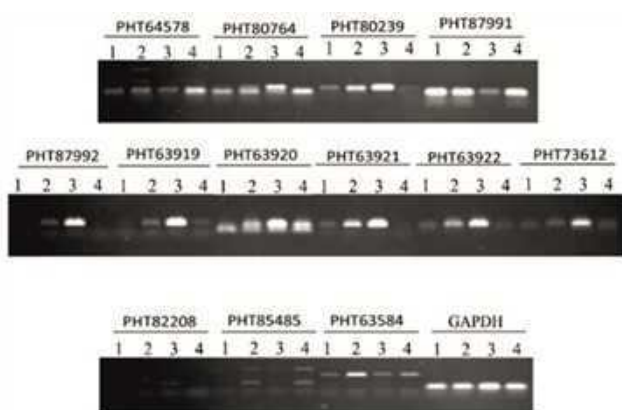
Chromosomal mapping revealed chromosome 1 containing the highest number of *CaHSP* genes. Motif analysis indicating both conserved and lineage-specific functions. Phylogenetic analysis classified the genes into seven major groups, reflecting functional

divergence. Promoter analysis identified 135 *cis*-regulatory elements, grouped into 07 functional categories, many associated with heat stress response. Gene network analysis revealed strong interaction networks among *CaHSP* proteins. Gene Ontology annotation indicated involvement of *CaHSP* genes in critical biological processes, including response to heat stress. *In silico* expression profiling demonstrated dynamic transcriptional regulation of the *CaHSP* genes in heat stress conditions. The expression of selected *CaHSP* genes across tissues indicated varied organ-specific functional roles under natural and stress conditions. Expression analysis revealed seven genes like PHT80239, PHT87991, PHT87992, PHT63920, PHT63921, PHT63922 and PHT85485 significantly upregulated in the tolerant genotype as compared to control.

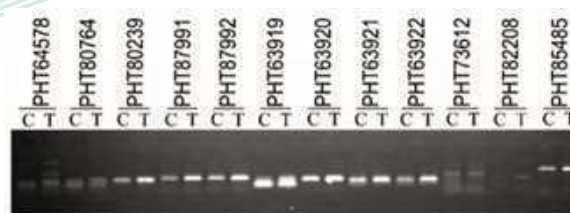




In silico gene expression analysis of *CaHSP* genes during time course interval of heat stress treatment in chilli



Tissue-specific expression analysis of *CaHSP* genes on cDNA template synthesized from RNA preparation of different tissues of chilli. The numerical 1, 2, 3 and 4 indicate the different tissues viz. un-opened flower bud, opened flower, leaf and fruit, respectively



Expression analysis of *CaHSP* genes during heat stress treatment between heat tolerant (DLS-161-1) and heat susceptible (Pusa Sadabahar) genotypes. The alphabets C and T indicate the heat tolerant (DLS-161-1) and susceptible (Pusa Sadabahar) genotypes, respectively

Bioprospecting potential of jamun germplasm

Fruits and seeds of twelve jamun germplasm collected from CHES, Vejalpur were evaluated for their bioprospecting potential. The samples were analysed for total phenolic content (TPC), total flavonoid content (TFC) and total antioxidant activity (TAA). Phytochemical profiling of fruit pulp revealed significant variability among germplasm. TPC ranged from 1.660 to 9.573 mg GAE g⁻¹, with Konkani Bahadoli, CHES-J-72 and CHES-J-17 recording the highest values, while CHES-J-119 showed the lowest. TFC varied between 0.100 and 0.283 mg catE g⁻¹, with CHES-J-72, CHES-J-17 and Konkani Bahadoli exhibiting superior flavonoid content. TAA ranged from 3.597 to 16.230 mg AAE g⁻¹, with CHES-J-72 showing maximum antioxidant activity, followed by CHES-J-17 and Konkani Bahadoli. Overall, CHES-J-72, CHES-J-17 and Konkani Bahadoli demonstrated superior phytochemical profiles in fruit pulp.

Similarly, jamun seeds exhibited marked biochemical diversity. Seed TPC ranged from 99.01 to 239.74 mg GAE g⁻¹, with CHES-J-72, Katha and CHES-J-21 recording the highest values, while Konkani Bahadoli showed the lowest. TFC varied from 2.64 to 5.09 mg catE g⁻¹, with CHES-J-117 and Katha. TAA ranged between 227.53 and 408.70 mg AAE g⁻¹, with Katha, CHES-J-21 and CHES-J-23 showing maximum antioxidant activity. Overall, Katha, CHES-J-72, CHES-J-21 and CHES-J-117 emerged as promising germplasm for functional food and nutraceutical applications.

Fatty acid profiling of oil extracted from seeds of mahua germplasm

A total of 34 mahua germplasm were evaluated for fatty acid profile of their seed oil. The fatty acid

composition of mahua seed oil across the evaluated samples revealed marked variation in both saturated and unsaturated fatty acids. Overall, the oil profile was dominated by C18 fatty acids, particularly oleic (C18:1n9c) 35.78%, linoleic (C18:2n6c) 15.14%, palmitic (C16:0) 21.92% and stearic acids (C18:0) 25.04%, which collectively constituted the major proportion of total fatty acids. Across the oil extracted from seeds of germplasm, total saturated fatty acids (SFA)-predominantly palmitic (C16:0) and stearic (C18:0), with minor contributions from arachidic (C20:0), lauric (C12:0), myristic (C14:0), caprylic (C8:0) and capric (C10:0) acids, constituted a substantial yet comparatively lower proportion of total fatty acids (ranging from 40 to 55%). Palmitic and stearic acids were the dominant saturated fatty acid components and accessions with relatively higher stearic acid content are likely to exhibit enhanced oxidative stability without significant compromise in nutritional quality.

In contrast, total unsaturated fatty acids (UFA), comprising both monounsaturated (MUFA) and polyunsaturated fatty acids (PUFA), represented the major fraction of the oil, accounting for approximately 45–60% of total fatty acids. Oleic acid (C18:1n9c) was the principal MUFA and contributed markedly to total UFA, reflecting a favourable balance between oxidative stability and health-promoting properties. Total PUFA, mainly represented by linoleic acid (C18:2n6c) and α -linolenic acid (C18:3n3), varied from 8 to 19% among the samples, with linoleic acid as the predominant PUFA and α -linolenic acid present in smaller but nutritionally important amounts. The mahua seed oil samples exhibited a high UFA/ SFA ratio with a balanced PUFA fraction dominated by linoleic acid, highlighting the nutritional quality of the oil and potential of selected accessions for developing varieties with improved health attributes and storage stability.

2.5 Crop Production

At ICAR-CIAH, Bikaner

Effect of pollen sources on fruit set and fruit parameters of date palm

A study was conducted to evaluate the response of date palm cultivars (Barhee, Halawy,

Khalas and Medjool) to different pollen sources (CIAH/DP/M-1, CIAH/DP/M-2, CIAH/DP/M-3 and Ghanami), under hot arid conditions. Among the different pollen sources, CIAH/DP/M-1 recorded the highest fruit set (15.40%) followed by Ghanami (14.90%), whereas CIAH/DP/M-3 showed the lowest (11.05%). Among the female cultivars, Barhee exhibited the maximum fruit set (15.85%) followed by Halawy (15.35%), while Medjool recorded the minimum (9.40%). Pollination of Medjool with CIAH/DP/M-1 resulted in the highest number of fruits per strand (32) and produced the largest fruits with maximum length (36.58 mm) and width (23.31 mm), along with highest TSS (51.64°B). Whereas, Khalas pollinated with CIAH/DP/M-1 recorded the maximum fruit bunch weight (8.73 kg) and yield/ plant (78.04 kg).

Effect of different pollination methods on fruit set and fruit quality of date palm

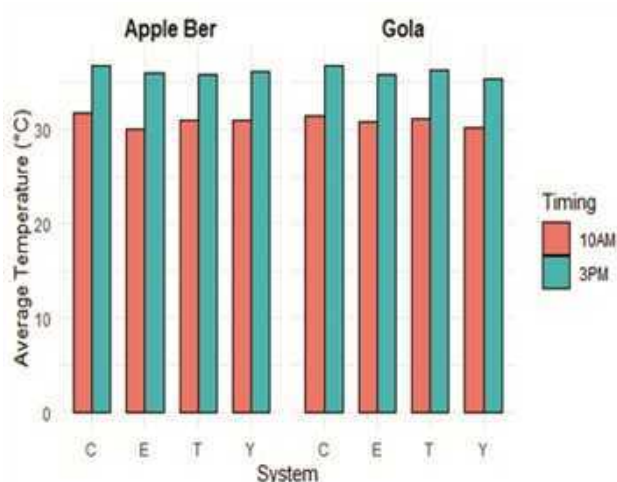
The study was conducted to find out, effect of different pollination methods on fruit set, yield and quality parameters of date palm under arid conditions. Four varieties (Halawy, Barhee, Khalas and Khuneizi) were subjected to four pollination methods, namely strand, cotton bud, dusting and pollen suspension. The maximum number of fruits per strand (16.91) was recorded in Barhee with strand pollination, which was considerably higher than the minimum value (6.71) observed in Khalas with spray pollination. The highest bunch weight (7.89 kg) and yield per plant (62.88 kg) were also recorded in Barhee under spray pollination. The highest total soluble solids content (47.31°B) was observed in Khunezi with spray pollination, whereas the lowest value (33.96°B) was recorded in Khalas under dusting pollination.

Optimizing ber production system in hot arid ecosystem

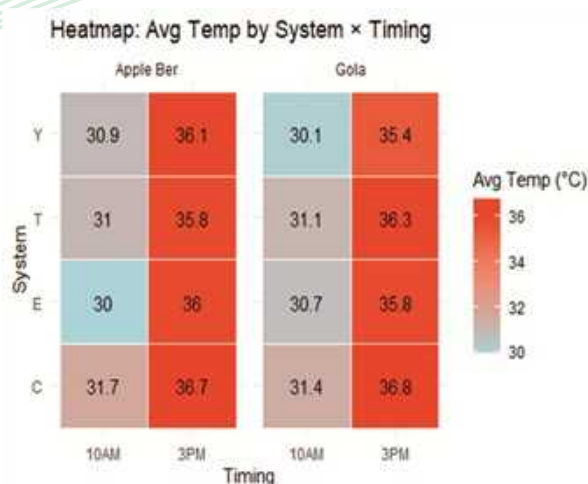
Conducted a study on standardization of plant architecture in ber using four training systems, namely Y-shape, espalier, telephone, along with the conventional system as control, on four varieties, namely Gola, Apple Ber, Goma Kirti and Thar Sevika. The Y-shape system recorded a significantly higher yield per plant, whereas no significant differences were observed among the telephone, espalier and control

treatments. Additionally, the Y-shape and telephone systems produced a higher proportion of superior-grade fruits. The espalier system, however, improved operational efficiency by enabling easier harvesting and better fruit accessibility. From an economic standpoint, the Y-shape system yielded the highest net returns and benefit-cost ratio, making it the most suitable option for profitable ber cultivation under arid conditions.

In addition to the plant architecture standardization study, supplementary investigations are currently being conducted to improve the ber production system with respect to rootstock compatibility and branch strength for supporting different training systems. Canopy temperature difference (CTD) was also evaluated to assess plant stress and genotype $\times$ environment interactions. Canopy temperature increased from 10 AM to 3 PM across all training systems in both Apple Ber and Gola. Morning temperatures ranged from 30.0 to 31.7°C, while afternoon temperatures increased to 35.4–36.8°C. The control (C) recorded the highest canopy temperature at 3 PM (36.7°C in Apple Ber and 36.8°C in Gola), whereas Y-shape and espalier systems maintained relatively lower values. The canopy temperature difference (CTD) ranged from 4.5 to 5.8°C across treatments. Among the varieties, Gola under Y-shape exhibited comparatively lower afternoon temperature (35.4°C).



Average canopy temperature (°C) at 10 AM and 3 PM in Apple Ber and Gola under different training systems (C: Control, E: Espalier, T: Telephone, Y: Y-shape)



Heatmap of canopy temperature (°C) showing CTD variation across training systems in Apple Ber and Gola

Natural farming of aonla under arid region

The study was conducted to evaluate the effect of different natural farming treatments on fruit quality and yield of aonla under arid conditions. Various natural inputs, including Panchgavya, Jiwamrita, Ghan Jiwamrita, Agniastara and Tumbastra, were applied individually and in combination to assess their influence on key physico-chemical traits and productivity. Natural farming treatments showed a significant effect on fruit quality of aonla. The highest pulp fresh weight (30.56 g) was recorded under Panchgavya + Jiwamrita treatment. Maximum TSS (12.47%) was observed with Ghan Jiwamrita + Agniastara + Tumbastra. Vitamin C content was highest (309 mg/100 g pulp) under Ghan Jiwamrita + Tumbastra, which also recorded the lowest acidity (1.57%). Fruit yield was not significantly influenced by the treatments; however, the highest yield (68.09 kg/ plant) was obtained with Panchgavya 3% spray followed by Panchgavya + Jiwamrita (67.88 kg/ plant).

Natural farming of ber under arid region

Natural farming treatments significantly influenced fruit physical, biochemical traits, and yield. The maximum fruit diameter (3.24 cm), volume (19.29 ml) and pulp weight (20.27 g) were recorded under Panchgavya 3% spray. TSS was highest (18.35%) with Jiwamrita (10% spray) followed by Ghan Jiwamrita + Agniastara + Tumbastra (17.77%). Vitamin C content was highest (93.42 mg/100 g) under Ghan Jiwamrita + Agniastara + Tumbastra, which was at par with all

treatments except Jiwamrita. Acidity ranged from 0.20 to 0.29% with the lowest in control. The highest yield (56.95 kg/ plant) was obtained under Ghan Jiwamrita + Agniastra + Tumbastra, which was at par with all treatments except control.

Effect of organic manures on soil properties in ber orchard

The study evaluated the effect of various organic nutrient sources, including control (no amendment), FYM, vermicompost, FYM + biofertilizers, vermicompost + biofertilizers and crop residue + decomposer, on soil properties and ber productivity under arid conditions. The results showed that organic manures significantly affected ber yield as well as soil physical, chemical and biological properties. Highest fruit yield was recorded under vermicompost (41.8 kg/ tree) followed by FYM + vermicompost (37.1 kg/ tree), while the control showed the lowest yield (29.3 kg/ tree).

Soil physical properties markedly improved under organic treatments. Bulk density ranged from 1.26 to 1.62 Mg m⁻³ with higher values under FYM + biofertilizers, while total porosity reached a maximum under vermicompost (46.08%). Water holding capacity and hydraulic conductivity showed the highest values under vermicompost (12.84% and 15.89 cm/ hr, respectively) followed closely by vermicompost + biofertilizers. Chemical properties of soil were also significantly influenced by the application of organic inputs. Soil pH and electrical conductivity (EC) decreased under organic treatments with vermicompost showing the lowest values (pH 7.78 and EC 0.671 dS m⁻¹) compared to the control (pH 8.45 and EC 0.856 dS m⁻¹). Organic carbon content increased markedly with the highest value recorded under FYM + biofertilizers (0.51%) followed by vermicompost + biofertilizers (0.49%), as compared to 0.24% in the control. CEC and exchangeable bases improved under organic nutrient management. The highest CEC (10.66 cmol (p⁺)/ kg) was observed with vermicompost + biofertilizers, compared to 7.83 cmol (p⁺)/ kg in the control. Exchangeable Ca, Mg and K increased, while exchangeable Na decreased compared to the control.

Available nutrient content increased under organic treatments. Vermicompost + biofertilizers recorded the highest nitrogen (125.47 kg/ ha), while FYM + biofertilizers showed maximum phosphorus

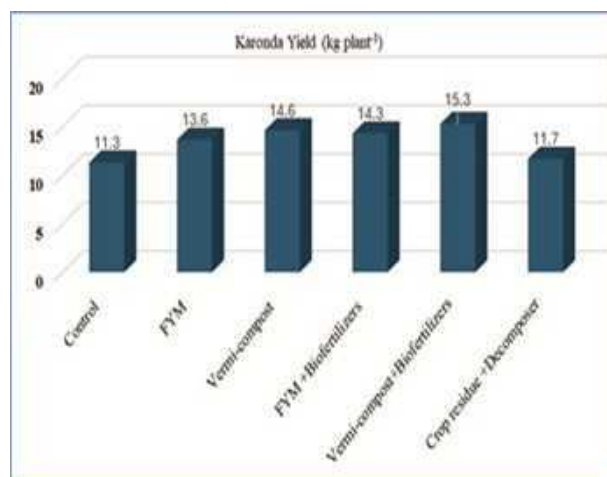
(24.31 kg/ ha) and potassium (268.01 kg/ ha), compared to 92.01 kg/ ha N, 17.63 kg/ ha P and 211.5 kg/ ha K in the control.

Soil carbon fractions were significantly influenced by organic amendments. Total carbon was highest under FYM + biofertilizers (0.868 g/ kg). Labile and non-labile carbon fractions also increased under integrated treatments. Nitrogen fractions showed a similar trend with FYM + biofertilizers recording the highest ammoniacal nitrogen (18.51 g/ kg), nitrate nitrogen (8.61 g/ kg), mineralizable nitrogen (25.11 g/ kg) and total nitrogen (0.088 g/ kg).

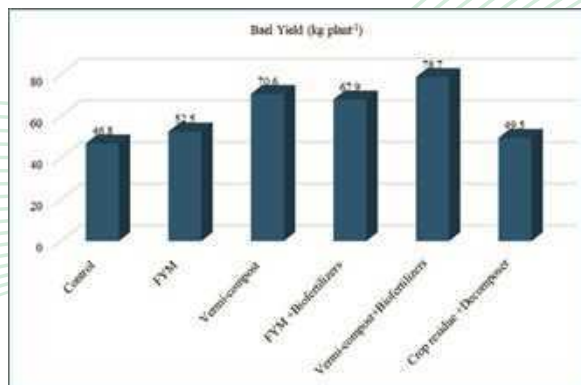
Soil biological properties were significantly improved with organic inputs. Enzymatic activities, including fluorescein diacetate (2.01 µg g⁻¹ soil 12 h⁻¹), dehydrogenase (1.09 µg TPF g⁻¹ soil 12 h⁻¹) and urease (9.07 µg NH₄⁺-N g⁻¹ h⁻¹) were highest under FYM + biofertilizers. Similarly, microbial biomass carbon (92.52 mg C/ kg), nitrogen (4.91 mg N/ kg) and phosphorus (2.31 mg P/ kg) were maximum under FYM + biofertilizers.

Effect of organic manures on karonda and bael

Karonda yield was significantly influenced by different organic nutrient sources. The highest yield (15.3 kg/ plant) was recorded with vermicompost + biofertilizers followed by vermicompost (14.6 kg/ plant) and FYM + biofertilizers (14.3 kg/ plant), while the lowest was observed in control (11.3 kg/ plant). Similarly, bael yield was significantly influenced by different nutrient treatments. The control recorded the lowest yield (46.8 kg/ plant), whereas vermicompost-based treatments significantly increased yield with the highest (78.7 kg/ plant) under vermicompost.



Effect of organic treatments on karonda yield



Effect of organic treatments on bael yield

Studies on soil and water conservation practices in ber

Productivity of ber in hot arid regions is constrained by poor soil health and moisture stress. Integrated nutrient management involving RDF, FYM, mulching and foliar sprays can improve soil properties, water use efficiency and yield. Therefore, the present study was conducted to evaluate their effects on soil health, water conservation and productivity of ber. The experiment included eleven treatments comprising NPK (100% RDF) alone and in combination with FYM (30 and 60 kg/ tree), mulching (black polythene and crop residues) and foliar sprays of kaolin (3, 6 and 9%), K₂SO₄ (100 and 200 ppm) and salicylic acid (200 ppm). The results revealed that different nutrient management and mulching treatments significantly influenced yield, quality and soil properties of ber under hot arid conditions.

Among the treatments, NPK 100% RDF + 60 kg FYM + crop residue mulching recorded the highest values for fruit length (3.90 cm), fruit diameter (3.52 cm), fruit weight (24 g), pulp weight (21.69 g) and yield (53.39 kg/ tree); soil properties including particle density (2.67 Mg m⁻³), water holding capacity (13.78%) and hydraulic conductivity (16.32 cm/ hr); chemical properties such as organic carbon (0.49%), CEC (10.76 cmol (p⁺)/ kg), exchangeable Ca (4.49 meq 100/ g), K (0.99 meq 100/ g), available N (142.37 kg/ ha), P (28.88 kg/ ha) and K (248.57 kg/ ha); carbon fractions including inorganic carbon (0.298), total organic carbon (0.594), total carbon (0.892), very labile (0.088), labile (0.161), less labile (0.158) and non-labile (0.279); nitrogen fractions including ammoniacal N (18.48), nitrate N (8.88), mineralizable N (26.38) and total N (0.086); enzymatic activities

such as fluorescein diacetate (2.49), dehydrogenase (1.35) and alkaline phosphatase (137); and microbial properties including microbial biomass carbon (96.31 mg C/ kg), nitrogen (4.97 mg N/ kg), phosphorus (2.47 mg P/ kg) and microbial populations of bacteria (3.61×10^5 per g), fungi (0.77×10^5 per g) and actinomycetes (1.85×10^5 per g). The treatment also recorded the lowest pH (7.69) and EC (0.411 dS m⁻¹). In most parameters, NPK 100% RDF + 60 kg FYM + black polythene mulching closely followed that of NPK 100% RDF + 60 kg FYM + crop residue mulching

However, certain parameters such as TSS (20.24%) and total sugar (9.09%) were highest under NPK 100% RDF + 30 kg FYM + K₂SO₄ spray, while ascorbic acid (107.45 mg 100 g⁻¹), urease activity (9.37) and exchangeable Mg (2.66 meq 100 g⁻¹) were the highest under NPK 100% RDF + 60 kg FYM + black polythene mulching. In contrast, NPK 100% RDF alone recorded the lowest values for most parameters, along with the highest pH (8.46) and EC (0.756 dS m⁻¹).

Fruit drop management and optimization of yield in ber

An experiment was conducted to evaluate the effect of organic manure, inorganic fertilizers and agrochemicals on growth, yield, fruit set and fruit drop in ber cv. Gola. The experiment was laid out in a randomized block design with nine treatments in an already established ber orchard. The treatments included T₁: Absolute control, T₂: RDF (500:250:250 g NPK per plant), T₃: FYM sole, T₄: FYM (50%) + RDF (50%), T₅: T₄ + Fluopyrum, T₆: T₄ + micronutrients, T₇: T₄ + *Trichoderma*, T₈: T₄ + neem cake and T₉: T₄ + GA₃ (50 ppm) + NAA (30 ppm).

The results revealed that T₉ {FYM (50%) + RDF (50%) + GA₃ (50 ppm) + NAA (30 ppm; PGR applied at flowering and fruit set stage)} recorded higher fruit set (16.75), number of fruits (13.44), fruit weight (98.5 g), fruit length (33.83 mm), fruit width (32.33 mm), TSS (18.4°B) and recorded 12% higher yield over control (16 kg/ tree).

Effect of waste wool on ashwagandha production

The study was undertaken to explore sustainable strategies for enhancing ashwagandha production in arid regions through the integration of waste wool with organic and inorganic fertilizers under a drip irrigation

system. The study consisted of nine treatment combinations, including waste wool, FYM, biochar, a control (T_1), and integrated nutrient treatments (T_2 – T_9). Baseline soil analysis conducted prior to the experiment indicated a pH range of 7.92–8.57, electrical conductivity of 0.131–0.189 dS m^{-1} and low organic carbon content (0.15–0.18%).

A marked variation in soil moisture dynamics was observed over a 10-day period. The control (T_1) showed rapid moisture depletion, declining from 7.68% to 1.07%, whereas treatments incorporating waste wool (T_2 , T_3 , T_6 and T_7) maintained relatively higher moisture levels (>2.7%) at the end of the observation period.

Among all treatments, T_6 (wool waste @ 7.5 t/ha + FYM @ 15 t/ha) significantly enhanced growth, yield and quality of ashwagandha, recording the tallest plants (51.63 cm), most branches per plant (6.23), highest number of berries per plant (92.73), superior fresh (10.58 g) and dry berry weight (2.09 g), maximum fresh (5.23 g) and dry root weight (2.35 g), highest root diameter (10.17 mm), root length (17.09 cm), shoot diameter (7.42 mm), shoot height (34.06 cm), shoot biomass (30.33 g per plant), fresh root yield (1998 kg/ha), dry root yield (651.17 kg/ha), flavonoid content (50.56 mg CE g^{-1} d.w.b.) and phenolic content (55.4 mg GAE g^{-1} d.w.b.).



Ashwagandha roots

At CHES, Vejalpur, Godhra

Integrated nutrient management (INM) in bael

In bael cv. Goma Yashi, INM significantly influenced plant growth, yield and fruit quality at CHES, Vejalpur. The highest plant height (5.85 m) was recorded with the standard recommended dose of NPK followed by grass mulch + FYM + neem cake + 50 % RD of NPK + *Azotobacter* + VAM culture (5.35 m). Similarly, maximum plant spread (5.75 m), stem girth (35.35 cm) and fruit retention (42.12 fruits/plant)

were achieved with grass mulch + FYM + neem cake + 50% RD of NPK + *Azotobacter* + VAM culture. Results of study revealed non-significant differences for fruit weight and size among the various treatment combinations, but exhibited significant variation in quality attributes in terms of TSS in pulp and mucilage and vitamin C.

Performance of bael under high density planting

The performance of bael cv. Goma Yashi under high-density planting was evaluated at CHES, Vejalpur. The experimental block was established during 2020-21 in a uniform plot size of 24 m $\times$ 24 m with five spacing treatments: 6 m $\times$ 6 m, 6 m $\times$ 4 m, 8 m $\times$ 6 m, 8 m $\times$ 4 m and 4 m $\times$ 4 m. The highest yield per plant (17 kg) was recorded at the widest spacing of 8 m $\times$ 6 m, whereas the lowest yield per plant (8.32 kg) was observed at the closest spacing of 4 m $\times$ 4 m. However, when yield was expressed on a per hectare basis, the trend was reversed. The maximum yield (52 q/ha) was obtained at the closest spacing of 4 m $\times$ 4 m followed by 6 m $\times$ 4 m (51.75 q/ha), 6 m $\times$ 6 m (40.08 q/ha), 8 m $\times$ 6 m (35.42 q/ha) and 8 m $\times$ 4 m (31.25 q/ha). These results indicate that under rainfed semi-arid conditions, higher planting density is more advantageous for maximizing total yield, whereas moderate spacing such as 6 m $\times$ 4 m offers a balanced approach by maintaining relatively high yield per hectare along with better individual plant performance

Studies on soil chemical properties

Soil samples from experimental block I were collected and analyzed on a plot-wise basis to assess the fertility status of the experimental field. The parameters analyzed included electrical conductivity (EC, dS m^{-1}) and pH (1:2.5 soil-water ratio), available nitrogen (kg/ha), available phosphorus (ppm) extracted using Olsen's reagent, exchangeable potassium, calcium, and magnesium (ppm) extracted with neutral normal ammonium acetate, sulphur (ppm) extracted using calcium chloride, and micronutrients such as iron (Fe), manganese (Mn), zinc (Zn), and copper (Cu) (ppm) extracted using DTPA.

The electrical conductivity (EC) of the soils ranged from 0.48 to 2.93 dS m^{-1} , while soil pH varied from 7.8 to 9.1. The available nitrogen content ranged from 50 to 84 kg/ha. Available phosphorus ranged from 5.6 to 15.4 ppm, whereas exchangeable potassium varied from 87.5 to 137.5 ppm.

Exchangeable calcium and magnesium ranged from 4344 to 5891 ppm and 547 to 844 ppm, respectively. Calcium chloride extractable sulphur content varied from 19.5 to 52.5 ppm. Among micronutrients, DTPA-extractable iron ranged from 44 to 99 ppm, manganese from 12 to 26 ppm, zinc from 0.4 to 1.1 ppm and copper from 2 to 5 ppm.

Soil EC, pH and primary nutrient status of experimental block - I

Plot No.	EC (dSm ⁻¹)	pH	N (ppm)	P (ppm)	K (ppm)
1.	0.48	7.8	82	7.2	114.5
2.	2.39	8.6	78	8.1	117
3.	2.93	8.0	75	6.8	112.5
4.	1.80	8.0	71	9.0	125
5.	0.72	8.0	50	9.4	100
6.	0.60	8.2	50	7.3	112.5
7.	0.78	8.3	79	8.5	110
8.	0.58	8.7	84	8.0	125
9.	0.54	9.0	58	13.3	102
10.	2.78	9.1	84	15.4	137.5
11.	0.52	8.6	76	9.0	125
12.	0.80	8.0	84	7.3	87.5
13.	0.75	8.1	68	5.6	95

Secondary and micronutrient status (ppm) of soil in experimental block I

Plot No.	Ca	Mg	S	Fe	Mn	Zn	Cu
1.	4825	794	25.6	75	13	0.7	3
2.	4685	752	30.1	82	19	0.6	4
3.	4516	813	35.2	91	26	0.5	4
4.	5031	563	19.5	68	18	0.4	3
5.	4672	672	34.5	66	14	0.6	2
6.	5609	828	22.4	73	14	0.4	2
7.	5364	758	25.2	70	16	0.6	3
8.	5297	703	52.5	74	18	0.8	2
9.	4859	641	33	44	12	0.5	3
10.	4531	547	22.5	79	14	1.1	3
11.	5891	844	40.5	50	13	1.0	3
12.	4344	750	25.6	99	17	0.6	4
13.	5248	812	31.5	85	14	0.9	5

2.6 Crop Protection

Control measures of Alternaria leaf spot in date palm

Date palm is affected by Alternaria leaf spot

disease caused by *Alternaria alternata* (Fr.) Keissler. A field trial was conducted in 2025 at the date palm block of the institute on the variety Halawy to evaluate the efficacy of selected botanicals and fungicides for the management of Alternaria leaf spot. Seven treatments were tested under field conditions: Azoxystrobin + Difenconazole @ 0.1%, Difenconazole @ 0.1%, neem leaf extract @ 5%, tumba fruit extract @ 5%, Agneyastra formulation @ 5%, aak leaf extract @ 5% and a control (water spray).

The percent disease index (PDI) ranged from 14.29% to 28.43% across all treatments. Among the seven treatments, Azoxystrobin + Difenconazole (0.1%) was found to be the most effective, recording the lowest PDI of 14.29% and achieving 49.74% disease control. This was followed by Difenconazole (0.1%), which recorded a PDI of 17.36% and provided 38.94% disease control.

Management of bacterial blight of pomegranate

Among biotic stresses, bacterial blight caused by *Xanthomonas campestris* pv. *punicae* is one of the major threats to pomegranate cultivation in India. A field trial was conducted during the rainy season of 2025 at the Pomegranate Block of the institute on the variety Bhagwa to evaluate the efficacy of botanicals, essential oils, bactericides and fungicides for the management of bacterial blight. The experiment was laid out in a randomized block design (RBD) with three replications under field conditions. The treatments included: clove oil (0.2%) + 2-bromo-2-nitro-1,3-propanediol (Bronopol) @ 0.05%, clove oil (0.2%) + copper oxychloride (0.25%), thyme oil (0.2%) + Bronopol (0.05%), thyme oil (0.2%) + copper oxychloride (0.25%), clove oil (0.2%) + Bronopol (0.05%) + copper oxychloride (0.25%), thyme oil (0.2%) + Bronopol (0.05%) + copper oxychloride (0.25%), Bronopol (0.05%) + copper oxychloride (0.25%), Bronopol (0.05%) + captan (0.2%), aak leaf extract @ 5%, neem leaf extract @ 5% and an untreated control.

Among the treatments, clove oil (0.2%) + 2-bromo-2-nitro 1,3-propanediol (Bronopol) @ 0.05% + copper oxychloride (0.25%) was found the most effective treatment against bacterial blight with minimum disease index (PDI) of 13.91% and highest disease control of 52.15%, followed by thyme oil (0.2%) + Bronopol (0.05%) + copper oxychloride

(0.25%) with disease index of 16.72% and 42.48% disease control.

Identification of Orthotospoviruses using newly devised degenerate primers

Bud necrosis disease is most common and devastating disease of watermelon. The disease incidence ranged from 25 to 70% and causes significant yield losses. To identify the associated type species of virus two sets of degenerate primers were devised by aligning the sequences of all the genera of orthotospoviruses from NCBI GenBank to amplify the partial RdRp and coat protein genes. Two set of novel degenerate primers were devised by aligning sequencing of orthotospoviruses (WBNV & GBNV). The devised primer pair synthesized common for both WBNV and GBNV using the RdRp region sequences amplify ~592 bp region WGB-Rp- F1: AGAGCAATCGTGCAACAATA, WGB-Rp-R1: CCAATCRTATATCATCAARCAT) and other sets from the coat protein region WGB-CP-F1: ACCATGTCTAMCGTYAAGCARCT & WGB-CP-R1: GARGCAGAAAGWACTTTTRGCTAC to amplify nearly 638 bp region and with the same forward primer the reverses primer amplify nearly 860bp region or full CP, WGB-CP-R2: TTACAMTTCCAGMGAAGKRCYAG for detection and diagnosis of virus associated with the watermelon bud necrosis disease. Further the amplicons were sequenced and confirm the specificity.

Characterization of *Lasiodiplodia theobromae* in lasoda

Lasiodiplodia theobromae is a phytopathogenic fungus causing dieback with a very wide host range found to be infecting the lasoda plants. The isolated fungus, initially produced distinct fluffy white colonies on potato dextrose agar (PDA) and rapidly turn dark grey to black within 2–3 days due to abundant aerial mycelium. It produced globose one septate, unicellular, later becoming dark brown, thick-walled conidia. The pathogen was further characterized using the multi locus sequencing with ITS, TEF1 α and RPB2 primers. Sequence results showed 98% similarity with the reference sequence of *Lasiodiplodia theobromae* confirm the pathogen. Under *in-vitro* conditions, the pathogen culture was evaluated for 9 commercial fungicides and found sensitive to the Bavistin, Tebuconazole + Trifloxystrobin and Bavistin +

Mancozeb fungicides.



Lasiodiplodia theobromae mycelium growth on PDA

Prevalence of insect pests and natural enemies at CHES, Vejalpur

The experimental field for each crop was divided into uniform sampling units (plants/ plots) and plants were randomly selected during each observation to ensure unbiased representation. Random sampling of insect pests and their natural enemies was conducted in bael, chironji and vegetable crops including dolichos bean, yardlong bean and vegetable cowpea.

Sampling was carried out at regular intervals throughout the cropping period, preferably during peak insect activity in the early morning and late afternoon. Large-sized insect pests were monitored through visual inspection of trunks, branches, leaves, flowers and fruits. Mobile insects were manually collected and sweep netting was performed in a zig-zag pattern across the field.

Small-sized pests and natural enemies were assessed by examining leaves, shoots and fruits using a hand lens. Specimens were collected using aspirators, beat sheet methods and, when necessary, leaf-washing techniques to recover minute insects. All specimens were properly labelled with crop, date and location details. Sedentary pests and immature stages were recorded through direct observation.

In bael (cv. Goma Yashi), the major insect pests recorded included lemon butterfly (*Papilio*

demoleus), leaf roller (*Psorosticha zizyphi*) and scale insects. The insects like Asian weaver ant (*Oecophylla smaragdina*), black thrips (*Thrips* sp.), psyllids (*Trioza* sp.) and lac insect (*Kerria lacca*) were observed in chironji (cv. Goma Priya).

In vegetable cowpea (cv. Thar Jyothi), several insect pests were recorded, including the white leaf hopper (*Cofana* sp.), brown mirid bug (*Hyalopeplus* sp.), bean aphid (*Aphis craccivora*), green leaf hopper (*Empoasca* sp.), leaf webber (*Omiodes* sp.), Bihar hairy caterpillar (*Spilosoma* sp.), pumpkin beetle (*Aulacophora* sp.) and oriental chinch bug (*Cletus* sp.). In dolichos bean and yardlong bean, the major insect pests observed were Bihar hairy caterpillar (*Spilosoma obliqua*), cabbage looper (*Trichoplusia ni*), tussock moth caterpillar (*Olene mendosa*) and common trig cricket (*Trigonidium* sp.). Additionally, sap-feeding and bug pests such as bean aphid (*Aphis craccivora*), bean bug (*Riptortus* sp.), bordered plant bug (*Physopelta* sp.), brown marmorated stink bug (*Halyomorpha* sp.) and bean whitefly (*Bemisia tabaci*) were also recorded.

Several natural enemies of insect pests were recorded across the crops. The ladybird beetle (*Coccinella transversalis*) was observed feeding primarily on aphids, while the wave striped ladybird beetle (*Cheilomenes sexmaculata*) targeted both aphids and mealybugs. Hoverfly maggots were also found preying on aphids and green lacewings (*Nothancyla* sp.) contributed to aphid suppression. Additionally, rove beetles and brown spiders were recorded as generalist predators, feeding on a variety of insect pests of semi-arid fruit and vegetable crops.



Natural enemies recorded in bael and vegetable cowpea

2.7 Post-Harvest Management and Value Addition Standardization of harvesting stages

The optimal harvesting stages have been standardized for traditional fruits and vegetables to

enhance the efficiency and quality of on-farm drying methods. For drying purposes, fruits and pods of ker, kheemp, khejri and guarphali should be harvested at the tender green stages and approximately 12-15, 8-12, 10-18 and 12-20 days after fruit or pod set, respectively. Harvesting of ker fruits beyond 15 days resulted into seed hardening and increased acidity, and rendering them unsuitable for pickling or drying.

Similarly, khejri pods (*sangri*) harvested after 18 days from setting or pod development hardened the seed and lignified pod walls which deteriorate textural quality and drying suitability. Lasoda fruits were best harvested at the fully developed mature green stage when the latex around the stone becomes diluted and begins to exude naturally from the stalk end upon removal of the basal cap. Ripen lasoda fruits with increased sugar content and loss of firmness is not suitable for culinary or pickling applications.

Standardization of blanching duration

Blanching is recommended for tender pods of sangri, guarphali and kheemp and lasoda fruits prior to drying. The blanching duration using boiling water is standardized and it is 5 minutes for sangri and guarphali, 7 minutes for kheemp and 25-28 minutes for lasoda. The duration of process is influenced by tissue hardness of produce, fruit or pod thickness and the chosen blanching method. Lasoda fruits requires the longest blanching time due to its firm texture and thicker pericarp while kheemp took slightly longer blanching than sangri and guarphali due to its denser tissue structure.

Sun drying and dried product yield

Notable variation in drying time among the different crop-commodity was recorded and it is approximately 36-48 hours for sangri, 48 hours for ker fruits, 24-28 hours for kumat seeds and 48 hours for kheemp pods. A wide-range of variations has been recorded in the drying yield of edible parts of arid horticultural crop-plants produces. The highest dried product recovery was recorded in bordi fruits ($49.51 \pm 1.98\%$) followed by jharber fruits ($45.58 \pm 1.86\%$) and kumat seeds ($43.87 \pm 1.16\%$). Relatively high drying yields were also measured in phog flower buds ($30.84 \pm 0.73\%$) followed by khejri pods, ($25.70 \pm 1.34\%$), guarphali ($21.14 \pm 0.93\%$), ker fruits ($18.04 \pm 1.34\%$), lasoda fruits ($16.24 \pm 0.49\%$), kheemp pods ($16.12 \pm 0.77\%$) and

kachri fruits ($13.91 \pm 0.63\%$).

The dry product yield of paan-methi leaf-lets and tinda fruits were comparatively low $6.14 \pm 0.23\%$ and $9.86 \pm 1.03\%$, respectively. The lowest dry product recovery was recorded in kakdia fruit slices ($5.73 \pm 0.32\%$).

Standardization of harvesting stage in ker

In ker, fruiting typically occurs in clusters and each cluster often contains fruits of different stages of maturity, and some of them are suitable for processing quality harvest while others are either very immature or over-mature. At horticultural maturity, the fruits morphological attributes are green skin and pulp colour, small, soft inseparable seeds, and fruit dimensions are ranges 0.43-0.56 g weight, 6.95-8.48 mm length, 6.10-7.32 mm diameter. Once the seeds begin to harden, the immature fruits start accumulation of bitter compounds and rendering them unsuitable for pickling or uses as vegetable culinary. Therefore, to ensure optimal quality for processing purposes, fruits should be harvested 2-4 times between 8-12 days from setting at an interval of 3-4 days to collect the maximum number of marketable quality fruits ideal for value-addition.



Green ker fruits suitable for processing

Protocol to reduce acidity in ker fruits

An innovative and expedited method for the acidity removal has been standardized and complete protocol developed. This novel technique utilizes a lactic acid-based fermentation process that

significantly reduces the time required for bitterness removal along with preserving the desirable colour and quality of the fruits. As compared to conventional practices, the lactic acid fermentation method offers faster (3 days) and cost-efficient alternative for bitterness removal with the added benefit of maintaining superior fruit quality colour and appearance.

Innovative method to preserve ker fruits

Traditionally, the fresh ker fruits are preserved through sun-drying for off-season consumption and marketing. The sun-drying practices resulted into a considerable loss in medicinal and nutritional properties and also drastically affect texture, colour, cooking quality and overall sensory attributes. To address the problem, new methods standardized and developed innovative preservation techniques to enhance shelf-life in addition retaining the fruit's desirable qualities and bioactive compounds.

Brining technique: Following the de-bittering (acidity removal) stage, the ker fruits were preserved by immersion in a 5% salt (NaCl) solution along with addition of 120 ppm potassium metabisulphite to inhibits the microbial growth during storage. The prepared fruits were then sealed in glass or food-grade plastic containers. This method effectively preserves the fruits for 8-10 months.

Freezing technique: The de-bittered ker fruits were blanched in hot water for two minutes, air-dried, and then packed in food-grade polyethylene bags. The fruits were stored at -5°C in deep-freezers. This technique extends the storage life to 18-20 months and wider scope for fruits availability. This preservation method ensuring minimal degradation to green colour, bioactive and medicinal compounds. Before uses, the frozen fruits should be soaked in tap water for about one hour to prevent condensation (sweating) and raise the temperature to ambient conditions.

Market-oriented packaging of ker

Consumer friendly-packaging technology has been standardized for popularizing the ker fruits in modern markets. Processed fruits were packed in consumer-oriented small packaging to facilitate easy transportation and making year-round availability for market-chain such as shopping malls and app-based online door to door delivery system. Fruits were

packed in 200–300-gram glass or food grade plastic bottles with 5% brine solution to cater the need of nuclear families. Similarly, frozen green ker fruits were also packed into 200-gram food-grade poly-bags for added convenience and to enhance accessibility for urban consumers by maintaining freshness and quality of the fruits.



Consumer-oriented packaging of processed and preserved ker fruits

2.8 Agricultural Extension

Impact assessment of adoption of date palm in hot arid region of Rajasthan

During 2025, data on adoption, area and production under improved varieties of date palm were collected and documented through online and offline methods in six districts of the hot arid region of Rajasthan, namely Bikaner, Sri Ganganagar, Hanumangarh, Jodhpur, Pali and Nagaur. The findings revealed that the maximum area under date palm was in Bikaner (298.6 ha), followed by Sri Ganganagar (158.4 ha), Hanumangarh (122.3 ha), Jodhpur (65.6

ha), Nagaur (62.5 ha) and Pali (38.6 ha). The corresponding production was 2836.7 MT, 1504.8 MT, 1161.8 MT, 623.2 MT, 593.7 MT and 366.7 MT, respectively. The cost of establishment of a date palm orchard ranged from ₹ 3.2-4.6 lakh per ha, while in succeeding years the cost of field operations and management ranged from ₹ 1.2-1.5 lakh per ha per year. The selling price of quality fresh date fruits fluctuated between ₹ 4000-6000 per quintal, and the B:C ratio ranged between 2.8 and 5.7 in 4-10 year old orchards.

Significant social changes were also observed, including an increase of 34-42 per cent of farmers moving from laggardism to innovatism, closer interaction among farmers for exchange of knowledge and inputs, a 12-15 per cent increase in commodity interest groups, greater cosmopolitanism and scientific orientation (34-38%), and more than 20 per cent increase in windfall profits among first adopters. More than 40 per cent of farmers reported increased knowledge, awareness and interest regarding date palm cultivation and its commercial potential.

Impact assessment of adoption of pomegranate in hot arid region of Rajasthan

The area under improved pomegranate varieties was highest in Jodhpur (403.2 ha), followed by Bikaner (366.5 ha), Pali (212.6 ha), Nagaur (161.5 ha), Sri Ganganagar (62.5 ha) and Hanumangarh (10.0 ha) during 2025. The corresponding production was 1403.1 MT, 2418.9 MT, 2661.1 MT, 1065.9 MT, 412.5 MT and 66.0 MT, respectively. The cost of establishment of a pomegranate orchard ranged from ₹ 1.20-1.42 lakh per ha, while the annual cost of field operations and maintenance in succeeding years ranged from ₹ 0.90-1.22 lakh per ha. The selling price of quality fresh fruits fluctuated between ₹ 4500-7000 per quintal, and the B:C ratio ranged from 2.6 to 4.3 in 3-13 year old orchards.

Consumer preferences and determinants of fruit consumption in hot arid regions of Rajasthan

The study revealed that among arid fruits, pomegranate and citrus remained the most preferred choices, reflecting their affordability and perceived health benefits, while preferences for underutilized fruits such as bael varied across regions. The findings further indicated that banana and mango were the most preferred tropical fruits, largely owing to their

widespread availability and cultural significance. Among temperate fruits, apple emerged as the most favoured fruit due to its perceived health benefits, whereas less common fruits such as apricot received relatively lower preference ratings. Fruit consumption frequency was positively associated with age, urban residence, and favourable taste and texture attributes, while it was negatively influenced by affordability concerns, preference for tropical fruits, and residence

in Rajasthan compared with other states. Preference for arid fruits was positively affected by education level, perceived health benefits, taste and texture, cultural influences, availability, and preference for tropical fruits, but showed a negative association with preference for temperate fruits. Overall, the findings underscore the importance of socio-economic and product-specific factors in shaping fruit consumption and preference patterns in hot arid regions.

3. Externally Funded Projects

At ICAR-CIAH, Bikaner

Project: Development of infrastructure facility for PEQ and hardening of date palm tissue culture plants & mass multiplication of other important arid fruit crops

Funding agency: MIDH, New Delhi

Achievements: Samples (50 no.) of date palm were collected from Jodhpur, Jaisalmer and Bikaner for assessing the incidence and distribution of diverse phytopathogens. In most of the samples *Alternaria* leaf spot like symptoms were observed. However, few samples showed somewhat different types of symptoms. The associated fungal pathogens were isolated and purified on PDA. Three species of *Alternaria* and one new species *Neodeightonia phoenicum* have been identified from the samples. Based on the distinguish colony morphology, 16 morphotypes of *Alternaria* spp. were preliminary identified from the 40 samples collected from Bikaner, Jodhpur and Jaisalmer.



Symptomatic variability of leaf spot and blight disease on date palm



Morphological diversity in the isolated fungi from date palm samples

Project: Clean Plant Program (Citrus)

Funding agency: NHB & ADB

Achievements: A total of 108 samples of *Citrus* spp. including Kinnow, Malta, lemon, acid lime, grape fruit, rough lemon, Chakotra, grape fruit, Nagpur Orange and Sweet Orange were collected from farmer's orchards, ICAR centers, SAUs and CAU of Agra and Jhansi districts (Uttar Pradesh), Aboha (Punjab), Sriganganagar, Hanumangarh, Kota, Bharatpur and Jhalawar districts (Rajasthan), Hisar, Fatehabad, Sirsa districts (Haryana), Jammu, Samba and Udhampur (J&K) and their adjoining areas during October - December 2025. All samples were submitted to Referral Laboratory, IARI, New Delhi for virus risk analysis.

Project: DUS Centre for Ber

Funding agency: PPV&FRA, New Delhi

Achievements: Onsite data collection of nine ber varieties of farmers were assigned in Jharkhand and Bihar state from PPV&FRA. Among them three exhibit distinctive traits i.e. Ber Sangbari (Acknowledgement No. REG/2015/937), Ber Geruwa (Acknowledgement No. REG/2015/938), and Sugri (Acknowledgement No. REG/2016/1797). Their validation report submitted to authority for consideration.



Ber Sangbari



Ber Geruwa



Sugri

Project: Production of quality planting material of Khejri

Funding agency: NABARD Regional Centre, Jaipur

Achievements: Entrepreneurial Development Training Programmes were conducted for skill upgradation in Khejri bud grafting, benefiting more than 60 participants, and over 5,000 quality planting materials of Khejri cv. Thar Shobha were distributed.

Project: DUS Centre (Watermelon and Muskmelon)-Nodal Centre

Funding agency: PPV&FRA, New Delhi

Achievements: During summer season of 2025, conducted the DUS testing of 03 entries of watermelon (NBH-3124, NBH-3086 and Arka Shyama) and 06 entries of muskmelon (Dharwad Delux, Kartik, 20CICC0023, 20CICC0018, 20CICC0022 and 20CICC0017). Characterized and multiplied the seed of a farmer variety of muskmelon for DUS testing. Additionally, maintained the seed of all reference varieties of watermelon and muskmelon for further use in DUS testing.

Project: DUS Centre for Date palm

Funding agency: PPV&FRA, New Delhi

Achievements: Maintained 42 reference varieties of date palm in field repository for DUS testing of candidate varieties. The observation were recorded on morphological, fruiting, quality and yield attributing parameters as per DUS descriptors. On-site DUS testing of four candidate varieties was carried out in Rajasthan and Gujarat. ST-1/REG/2021/0170, ST-2/REG/2021/0171 and ST-3/REG/2021/0172 varieties were evaluated at Saheb ki Dhani, Village and Post Anwa, Tehsil Dooni, District Tonk, Rajasthan. SONA-100, another candidate variety was tested at Village Zarapara, Taluk Mundra, District Kachchh, Gujarat.



On-site DUS testing of date palm

Project: Development of DUS testing guidelines of Khejri

Funding agency: PPV&FRA, New Delhi

Achievements: Based on primary documentation and preliminary field evaluation, a total of 29 khejri genotypes were identified and marked for detailed morphological characterization. A comprehensive set of distinct, uniform, and stable (DUS) descriptors

covering leaf, inflorescence, flower, pod, seed traits, and plant growth habit was identified to facilitate the development of DUS testing guidelines for the crop. Considerable phenotypic variability was observed among the selected genotypes for most of the recorded traits, indicating good potential for establishing reliable DUS descriptors. In addition, a herbarium for each genotype was prepared, comprising representative leaf, flower, pod, and seed specimens, to support accurate documentation and future reference.

Project: Enhancing food and water security in arid region through improved understanding of quantity, quality and management of blue, green and grey water

Funding agency: DST, New Delhi

Activity: Conjunctive use of surface and ground water resources in arid horticultural crops

Achievements: The field experiment on 'Conjunctive use of surface (canal) and ground water (tube well) in pomegranate crop in sandy soils of western Rajasthan' was executed. Among all the treatments, maximum number of fruits/ plant (75.75) and fruit weight (229.15 g) was observed in T_1 treatment (100% canal water) which was statistically at par with T_2 (75 % canal water + 25% tube well water) treatment (73.59 and 225.14 g) as compared to minimum recorded in T_6 (100% tube well water EC-6.00 dSm⁻¹) treatment (65.92 and 215.79 g), respectively. The maximum fruit yield/ plant (17.14 kg) was observed in T_1 treatment (100% canal water) which was at statistically par with T_2 (75 % canal water + 25% tube well water) treatment (16.68 kg) and T_3 (50 % canal water + 50% tube well water) treatment (16.03 kg) while minimum fruit yield/ plant recorded in T_6 (100% tube well water EC with 6.00 dSm⁻¹) treatment (14.04 kg/ plant), respectively. Therefore, it can be concluded that in hot arid climate of western Rajasthan, pomegranate can be successfully grown in sandy soil with conjunctive use of canal and saline ground water (50% canal water + 50% tube well water with EC of 2.25 dSm⁻¹) without compromising fruit yield and quality as compared to canal irrigation water alone. However, pomegranate can tolerate saline irrigation water up to EC 4 to 6 dSm⁻¹ with slight reduction in yield.

Project: Training/ skill development about arid horticulture for livelihood creation

Funding agency: Ayana Renewable Power Pvt. Ltd., Bengaluru

Achievements: The capacity building programs, including six on-site awareness camps and six on-campus sessions, were successfully organized, with around 300 farmers participating. Technologies developed by the institute were disseminated through the distribution of planting material during awareness camps, along with demonstrations of improved technologies and varieties. Additionally, knowledge on arid horticulture was shared by facilitating farmers' visits to the institute.

Project: Effect of Solutek melons solution on agronomic performance of muskmelon

Funding agency: Mahadhan AgriTech Ltd., Pune

Achievements: The experiment was conducted using the variety Thar Mahima with seven treatment combinations in a randomized block design with three replications. The study aims to generate scientific evidence on the potential of Solutek melons solution for improving productivity and fruit quality of muskmelon in arid region. The crop was sown during the first week of September following recommended agronomic practices. Observations were recorded on growth parameters (vine length, number of branches and internodal distance), yield attributes (fruit weight, fruit size, number of fruits per plant, yield per plant and plot) and quality parameters (TSS, sugars, keeping quality and fruit cracking).

Project: Optimization of natural waste wool technology for horticultural crops to facilitate climate resilient farming system in the arid region

Funding agency: CRG under NMNF

Achievements: Experiment was conducted on optimization of natural waste wool technology for lettuce (*Lactuca sativa L.*) cultivation in arid regions which represents an innovative and sustainable approach to improve crop productivity under moisture-limited conditions. The observations of growth and yield attributes parameters were recorded as per treatments.

At CHES, Vejalpur, Godhra

Project: DUS Nodal Centre for Bael

Funding agency: PPV&FRA, New Delhi

Achievements: Maintained a total of nineteen reference varieties of bael (Goma Yashi, Thar Shivangi, Thar Gauri, Thar Bhavya, Thar Neelkanth, Thar Srishti, Thar Prakriti, Thar Divya, NB-7, NB-9, NB-5, NB-16, NB-17, Pant Sujata, Pant Aparna, Pant Shivani, Pant Urvashi, CISHB-1 and CISHB-2). Facilitated the registration of one farmer's variety of bael in PPV&FRA, New Delhi.

Project: DUS Nodal Centre for Chironji and Tamarind

Funding agency: PPV&FRA, New Delhi

Achievements: Eleven reference varieties of tamarind namely Pratishthan, PKM-1, T-263, Ajanta, Urigam, Goma Prateek, Sweet Type, CHEST-10, Thar Rashmi, Red Type and Bantoor were maintained for DUS testing of candidate variety. Twenty reference varieties/ genotypes of chironji (Thar Priya, CHESC-2, CHESC-23, CHESC-20, CHESC-11, CHESC-4, CHESC-3, CHESC-10, CHESC-8, CHESC-26, CHESC-6, CHESC-18, CHESC-25, CHESC-5, CHESC-1, CHESC-9, CHESC-27, CHESC-17, CHESC-24 and CHESC-29) were maintained in the field repository. Facilitated to register two farmer's varieties of tamarind with PPV&FRA, New Delhi.

Project: DUS Co-nodal Centre for Aonla

Funding agency: PPV&FRA, New Delhi

Achievements: During the year maintained reference varieties viz., Chakaiya, Banarsi, Francis, Krishna, Kanchan, NA-10, Anand-1, Anand-2, NA-7, NA-6, Goma Aishwarya, BSR-1, Laxmi-52 and BSR-2 for DUS testing of candidate varieties.

Project: Development of DUS testing guidelines for Mahua (Nodal Centre)

Funding agency: PPV&FRA, New Delhi

Achievements: Standardized descriptors covering key morphological traits of tree, leaf, flower, and fruit were identified and validated through field evaluation of diverse 34 accessions including varieties. Appropriate states of expression and methods of assessment were defined to ensure uniformity and repeatability. The guidelines provide a scientific framework for reliable varietal identification, protection of plant breeders' rights, and promotion of Mahua as an important indigenous tree species.

Project: DUS Co-nodal Centre for Jamun

Funding agency: PPV&FRA, New Delhi

Achievements: Maintained eight candidate/ reference varieties viz., Goma Priyanka, Konkan Bahadoli, CISHJ-42, Thar Kranti, Jamwant, Gokak-1, Round the Year Jamun and Gokak-2 at field repository of CHES, Godhra. In addition, detailed observations have been recorded on 15 accessions to define descriptor states and support guidelines.

Project: Development of DUS test guidelines for Khirni

Funding agency: PPV&FRA, New Delhi

Achievements: The development of DUS test guidelines for Khirni was initiated during the current year to support varietal characterization and protection under PPV&FRA. The study is in progress on 15 accessions, including the variety *Thar Rituraj*. Preliminary work involves identification of key morphological descriptors and standardization of observation protocols.

4 (a). Transfer of Technology

Training programs organized

Dated	Title of the training	Place	Participants		
			Male	Female	Total
18.02.2025 to 17.05.2025	Plant tissue culture	ICAR-CIAH, Bikaner	-	1	1
20.02.2025	Improved production technologies of summer vegetables	Tejarasar, Bikaner	16	04	20
21.02.2025	Improved production technologies of summer vegetables	Gigasar, Bikaner	24	07	31
08.03.2025	Training for women on International Women Day	ICAR-CIAH, Bikaner	-	28	28
27.05.2025	Improved production technologies of <i>kharif</i> vegetables	ICAR-CIAH, Bikaner	50	04	54
19.06.2025	Improved production technologies of <i>kharif</i> vegetables	ICAR-CIAH, Bikaner	42	03	45
20.06.2025	Improved production technologies of <i>kharif</i> vegetables	ICAR-CIAH, Bikaner	07	-	07
04.07.2025	Use and importance of Agri - Drone in agriculture	Lunkarnsar, Bikaner	12	03	15
11.07.2025	Improved production technologies of <i>Kkharif</i> vegetables	Khinchiya (4 KHM), Bikaner	15	04	19
13.07.2025	Modern technologies of ridge gourd production	Husangsar, Bikaner	18	06	24
22.08.2025 to 24.11.2025	Plant tissue culture	ICAR-CIAH, Bikaner	-	1	1
11.10.2025	Improved production technologies of <i>rabi</i> vegetables	ICAR-CIAH, Bikaner	57	01	58
19.11.2025	Improved production technologies of arid horticulture and post-harvest management	ICAR-CIAH, Bikaner	38	03	41

Field day/ days/ weeks/ fortnights/ campaigns, etc.

- Organized one day on campus National Tribal Horticulture Fair at CHES, Vejalpur on 27.03.2025.
- Conducted *Poshan Pakhwara* from 08.04.2025 to 22.04.2025 at ICAR-CIAH, Bikaner
- Conducted one day on campus National Bael Day at CHES, Vejalpur on 28.04.2025.
- Organized the *Vikshit Krishi Sankalp Abhiyan* (VKSA) from 29th May 2025 to 12th June 2025 in collaboration with KVKs and line departments of the Government of Rajasthan, covering 48,000 farmers across 92 villages.
- Organized International Yoga Day-2025 on 21.06.2025.
- Organized *Swachchhata Hi Sewa* Program

(17.09.2025 to 02.10.2025) at ICAR-CIAH, Bikaner.

- Conducted an awareness and cleanliness drive in the adopted village under the *Mera Gaon Mera Gorav* program in Bikaner on 20.09.2025 and 30.09.2025.
- Organized one day on campus awareness program on *Pradhan Mantri Dhan Dhaanya Krishi Yojana* at ICAR-CIAH, Bikaner and CHES, Vejalpur on 11.10.2025.
- Celebrated World Soil Health Day-2025 in collaboration with KNGNGO, Diyatra on 05.12.2025.
- Conducted an outreach program in the tribal villages of Panchmahal under the *Janjatiya Gaurav Varsh Pakhwada 2025*, organized by CHES, Vejalpur on 15.11.2025.
- Organized *Swachhta Pakhwada 2025* at ICAR-CIAH, Bikaner during 16.12.2025 to 31.12.2025.
- Celebrated *Kisan Diwas* at Diyatra village of Bikaner district of Rajasthan on 23.12.2025.
- Celebrated *Kisan Samman Diwas* at CHES, Vejalpur on 23.12.2025.



Demonstrations conducted

- 10 FLDs on improved production technologies of arid vegetables, including kachri (AHK-119), snapmelon (AHS-82), ridge gourd (Thar Karni), and longmelon (Thar Sheetal), were conducted at Tejarasar, Gigasar, Husangsar, and Khinchiya villages in Bikaner district, Rajasthan.
- A field demonstration on the technology 'Surface Covering Protective Vegetable Nursery Scheme for Hot Arid Climate' was conducted at KVK Fatehpur and KVK Chomu during September 2025.



Technological exhibitions

- The Institute showcased its technological exhibition at ICAR-NRC on Camel on 11.01.2025 during the International Camel Festival in Bikaner and awarded second best exhibition award.
- Displayed the technological exhibition at NRCSS, Ajmer on 19.01.2025 during the Silver Jubilee Kisan Mela 2025 and received the best exhibition award.
- Displayed the Institute's technological exhibition at 14 BD, Khajuwala, Bikaner on 28.01.2025 during the *Kisan Mela* and Exhibition during 28.01.2025 to 29.01.2025, and received the best exhibition award.
- Displayed the technological exhibition during the *Kisan Mela/ Krishi Mahotsav* organized by ATMA and SKD University, Hanumangarh during 08.03.2025 to 10.03.2025.
- Exhibited the Institute's technologies during the three-day *Kisan Mela/ Krishi Mahotsav* organized by SKRAU and ATMA at SKRAU, Bikaner during 25.03.2025 to 27.03.2025.
- Displayed the Institute's technological exhibition

during *Hariyali Teej* under the State-Level Forest Mahotsav on 27.07.2025 at the RAC Campus, Bikaner.

- Exhibited the technologies during the pearl millet technology demonstration and farmers' meet at ICAR- IIMR RRS on Pearl Millet at Gudamalani, Barmer on 21.09.2025.
- Displayed the Institute's technological exhibition during the Foundation Day of ICAR-CIAH on 01.10.2025.
- Exhibited the technologies at the Institute during the program of PMDDKY, Pulse, and other schemes launched by the Hon'ble Prime Minister on 11.10.2025.



Dated	Title of the training	Place	Participants		
			Male	Female	Total
13.05.2025 to 15.05.2025	Hands on training, pruning, plant propagation of arid horticultural crops	ICAR-CIAH, Bikaner	72	03	75
23.05.2025	Enhanced nutrition and livelihood opportunities through arid horticulture interventions with agriculture	Kanasar Chota, Bikaner	30	-	30
22.08.2025	Enhanced nutrition and livelihood opportunities through arid horticulture interventions with agriculture	Sarah Kunjia, Bikaner	27	02	29
26.09.2025	Income generation through integrated arid horticulture and agriculture practices	Kanasar, Bikaner	30	04	34
08.10.2025	Importance of fruit crops for health, economy, job opportunities and ecological restoration	21 JMD village, Bikaner	31	04	35
14.10.2025 to 16.10.2025	Skill development and entrepreneurship opportunities through budding technology in khejri	ICAR-CIAH, Bikaner	08	03	11
07.11.2025	Importance of fruit crops for health, economy, job opportunities and ecological restoration	16 JMD, Bikaner	18	03	21
20.11.2025	Improved production technologies of citrus crops under hot arid regions.	ICAR-CIAH, Bikaner	25	-	25

Visits of farmers/ students/ stakeholders

- More than 2,400 farmers, students and stakeholders visited the Institute, where they experienced its developed technologies first-hand. The problem-solving interactive discussions were held during these visits. Additionally, around 3,000 technical folders were distributed among farmers and other stakeholders.
- Provided over 100 technological advisories (both online and offline) and conducted around 50 diagnostic and advisory field visits in farmers' fields and adopted villages to offer technical guidance.
- Institute technologies were disseminated to farmers and other stakeholders through various meetings, programs and advisory sessions conducted in collaboration with State line departments and KVKs.



MoUs signed

- Signed a MoU with Mahadhan AgriTech Limited for undertaking the sponsored project 'Effect of Solute Melons Solution on the Agronomic Performance of Muskmelon' for the period of 2025–2027.

HRD activities

- Conducted a three-month internship/ training program on 'Micro-Propagation of Horticultural Crops' for undergraduate students from HNB Garhwal University during 19.02.2025 to 18.05.2025.
- Organized a three-month offline internship training on 'Plant Tissue Culture' for Ms. Anjali Saraswat, a student of B.Sc. Biotechnology,

JECRC University during 18.02.2025 to 17.05.2025.

- Provided a three-month offline internship training on 'Plant Tissue Culture' for Ms. Tripti Agarwal, a student of B.Sc. Biotechnology, JECRC University during 25.08.2025 to 24.11.2025.
- Organized an International Conference on Technology Innovations & Sustainable Development of Date Palm-2025 (ICDP-2025) on 29-30th June, 2025 at Bhuj, Gujarat. About 135 participants attended the event in person, including scientists, students, extension workers,



private partners and progressive farmers. The event was further enriched by the presence of delegates from Morocco, Finland and the UAE.

Other outreach activities

Five client-oriented programs were organized for technology commercialization, involving 21 participants. The programs includes as

- Ber cultivation, greenhouse farming, vegetable production, cactus pear technology and orchard establishment.
- *In-situ* budding techniques in ber and khejri with NGO, Bhuj, Gujarat.
- Planning for technology transfer through CSR funding in vegetable farming.
- Detailed discussions on cactus pear production and nursery technologies.
- Interaction with a local entrepreneur from Bikaner to strengthen prospects for technology adoption and commercialization.

4 (b). ICAR-KVK, Panchmahal

OFT on assessment of little leaf disease management in brinjal crop

On Farm Trial (OFT) was conducted during *kharif* season 2025 for management of little leaf disease of brinjal involving 12 trials. The efficacy of three treatments were assessed viz., T₁ - Farmer's practices (no use of chemicals to manage little leaf disease), T₂ - Seedling treatment for 20-30 minutes with (Streptomycin sulphate + Tetracyclin hydrochloride @ 150 ppm) + destruction of the infected plants + need based foliar application of Streptomycin sulphate + Tetracyclin hydrochloride @ 150 ppm and Imidacloprid @ 0.3 ml/ litre and T₃ - T₂ + installation of yellow sticky traps @ 15 per ha after 20 days of transplanting for the management of vector (trap was replaced at monthly interval).

Among the treatments, T₃ demonstrated the most significant impact, resulting in the lowest disease infestation rate at 15% and the highest yield (281.50 q/ ha). T₃ gave gross return of ₹ 168,900/- ha, and B:C ratio of 3.66, indicating superior economic and production benefits over other treatments.

OFT on management of thrips, *Thrips parvispinus* (Karny) infesting chilli

OFT on 'Management of Thrips, *Thrips parvispinus* (Karny) infesting Chilli,' focused on pest management strategies. Three technological options have been evaluated: T₁ - involving farmer's traditional practices (irrational insecticide use); T₂ - application of azadirachtin 10000 ppm at 0.003% (30 ml per 10 litre of water); and T₃ - spray of *Pseudomonas fluorescens* 1% WP (40 g per 10 litre of water) at the time of flowering. The study included 12 farmers, with experiments conducted on their respective fields.

Treatment T₁ recorded 12.98% plant infestation with a yield of 91.23 q/ ha, gross return of ₹ 109,476/- ha and B:C ratio of 2.58. T₂ showed the best performance with lowest infestation (6.68%),

highest yield (131.65 q/ ha), maximum gross return of ₹ 157,980/- ha and B:C ratio of 3.44. Treatment T₃ recorded 8.70% infestation, yield of 112.40 q/ha, gross return of ₹ 134,880/- ha and B:C ratio of 2.99, indicating moderate performance.

OFT on assessment of preparation methods of green chilli sauces for more shelf life

OFT on 'Assessment of Preparation Methods of Green Chilli Sauces for More Shelf Life' falls under the thematic area of food preservation. Three technologies were evaluated viz., T₁ represented the farmer's practice, preparing green chilli chutney using green chilli, salt, and garlic, T₂ included green chilli (1 kg), water (250 ml), salt (30 g), potassium metabisulphite (1 g/ kg) and oil (3 tsp) and T₃ consisted of green chilli (1 kg), water (250 ml), salt (30 g), asafoetida (1 g/ kg) and glacial acetic acid (30 ml). The study involved 12 farmers and farm women.

Shelf life evaluation of green chilli sauce compared farmer's practice (T₁) with assessed practices (T₂ and T₃) under room and refrigerator temperatures along with sensory quality. T₁ showed a short shelf life of 2-3 days at room temperature and 6 days under refrigeration, though sensory evaluation remained acceptable (WMS > 4.00). In T₂, shelf life increased significantly to 20 days at room temperature and 140 days in the refrigerator with WMS > 4.00. T₃ recorded 15 days at room temperature and 110 days in refrigeration, also maintaining sensory acceptability (WMS > 4.00), indicating improved preservation with added preservatives.

OFT on assessment of effect of mulch material on vegetable production at rural kitchen gardens

OFT on 'Assessment of Effect of Mulch Material on Vegetable Production at Rural Kitchen Gardens,' focuses on the use of agro textiles. The problem identified was the lack of knowledge about different mulching materials and their benefits for crop

production. Three technologies were assessed in 12 trials. T_1 represented the farmer's practice with no mulch application, T_2 involved the use of organic mulch using paddy straw applied in a 7–15 cm thick layer and T_3 consisted of black plastic mulch (25 micron). The study involved 12 farmers and farm women.

Under the farmer's practice (T_1) without mulch, the yield was 40 kg/ unit with a gross return of ₹ 2400 and a B:C ratio of 2.40. The assessed practice T_2 using organic mulch (paddy straw) produced 48 kg/ unit yield, gross return of ₹ 2880, and B:C ratio of 2.88. The assessed practice T_3 using black plastic mulch recorded the highest yield of 50 kg/ unit with gross return of ₹ 3000 and B:C ratio of 2.72, showing improved productivity and profitability.

Frontline Demonstrations (FLDs)

During the year 2025, conducted a total of 10 FLDs at various farmer's fields. The total area covered under FLDs was 88.5 ha, involving 177 farmers.

Entrepreneurial program for women empowerment organized

KVK undertook impactful initiatives to empower rural women through sustainable dairy farming. A series of training programs and input support measures were implemented to enhance their knowledge and boost income from dairy-based livelihoods.

- **Trainings:** 12 sessions on clean milk production, fodder cultivation, and Azolla farming.
- **Input support:** Provided mineral mixture, feed, fodder seeds, Azolla culture, and clean milk kits.
- **Technology promotion:** Introduced AI with sex-sorted semen for obtaining female calf.
- **Income boost:** Daily income per milch animal rise from ₹ 200-250 to ₹ 280-350.
- **Sustainability:** Promoted animal based farming practices for long-term impact.

Replacing paddy with soybean for sustainable farming

To reduce irrigation needs and improve farmer's income, KVK promoted soybean (var. NRC-37) as alternative to paddy during *Kharif*. Through mass demonstrations, farmers achieved better returns and ecological benefits.

- **Adoption:** 300 farmers across 150 ha in 6 villages adopted soybean, replacing 50% paddy area.
- **Income enhance:** Income increased from ₹ 32,000/ ha (paddy) to ₹ 47,000/ ha (soybean).
- **Soil improvement:** Soybean improved soil fertility through natural nitrogen fixation (24-35 kg N/ ha).
- **Natural resource management:** Reduced ground water use.
- **Nutritional security:** Soybean is reliable source to solve protein deficiency. Its consumption improved family health.

Training programs organized

During 2025, organized 94 training programs (On/ Off campus) on agriculture and allied sectors, engaging 2832 participants including 1803 male and 1029 female.

Internship course

A total of 9 students completed internship training during 2025. The internships were undertaken by students pursuing B.Sc. (Agriculture) and B.Sc. (Agricultural Engineering) at Parul University, Vadodara, and Ganpat University, Mehsana, as part of their academic training.

Viksit Krishi Sankalp Abhiyan

Under the Viksit Krishi Sankalp Abhiyan (VKSA) organized from 29th May to 12th June, 2025, in 13 talukas across Panchmahal and Mahisagar districts of Gujarat, covering 103 villages. The campaign reached a total of 21,278 participants, including farmers and other stakeholders in the agriculture sector.

National Mission on Edible Oil-Oil Seeds Project (NMEO)

Conducted 79 training program in collaboration with District Agriculture Department as a Technical Support Agency on National Mission on Edible Oil-Oil Seeds Project (NMEO) of various cluster of Panchmahal and Mahisagar district involving 3160 participants.

Activities under Agriculture Drone Project

A total of 12 activities were conducted,

benefiting 350 participants under Agriculture Drone Project. These activities included lectures on *Prakrutik Kheti* and demonstrations on the spraying of Nano Urea through drones.

Support to Farmer Producer Organizations (FPOs)

Various activities, including advisory services, group meetings, and lectures, were conducted in Farmer Producer Organizations (FPOs) across the Panchmahal and Mahisagar districts of Gujarat. A total of 846 participants were engaged through these programs. The activities were carried out at Khet Utpadak Sahakari Mandali Ltd. (Lunawada) with 125 participants, Godhmba Farmer Produce Company (Ghoghamba) with 180 participants, Santrampur Farmer Produce Organisation (Santrampur) with 123 participants, Shahera FPO (Shahera) with 150 participants, Kadana FPO (Kadana) with 128 participants, and Halol FPO (Halol) with 140 participants.

Interactive learning at KVK under 'Bagless Days' Program

Under the National Education Policy's 'Bagless Days' Program, interactive learning activities were organized at the KVK involving students from 12 schools, with a total participation of 780 students. The program included demonstrations of various KVK units, interactive sessions with students, quiz competitions, and demonstrations on the use of drones in agriculture, providing practical exposure and enhancing students' interest in agricultural sciences.

Live telecast of Pradhan Mantri Kisan Samman Nidhi

A live telecast of the Pradhan Mantri Kisan Samman Nidhi (PM-Kisan) program was organized covering the disbursement of the 19th, 20th, and 21st instalments. On 24 February 2025, the 19th instalment reached 1,000 farmers, followed by the 20th instalment on 2 August 2025 for 250 farmers, and the 21st instalment on 19th November 2025 for 100 farmers. A total of 1,350 farmers participated in the program.

Live telecast of the launch of the Prime Minister Dhan-Dhaanya Krishi Yojna

On 11th December 2025, a live telecast of the launch of the Prime Minister Dhan-Dhaanya Krishi Yojna (PMDDKY) was organized. The program

aimed to create awareness among farmers about the scheme and its benefits for enhancing agricultural productivity and income. A total of 210 participants, including farmers and farm women, attended the event.

Collaborative activities conducted

Provided the technical support on agriculture and allied subject to the farmers attended different training programs organized in collaboration to various agencies. A total of 2155 farmers were benefitted.

Achievements of projects

- i. **NICRA Project:** Introduction of soybean to replace paddy area (70 acre), demonstration of fodder crop (Sorghum Cofs -31), chaff cutter, azolla, mineral mixture and concentrate feed for dairy animals to enhance milk production (40-45%).
- ii. **District Agro-Meteorology Unit (DAMU) Project:** 5000 farmers are connected to DAMU and benefitted with regular agro advisories.
- iii. **Seed Hub Project:** Produced 5 q seed of green gram variety GAM 5 and 7 q seed of GJG 5 variety of chickpea.
- iv. **FOM Project:** Conducted training programs, awareness programs, soil testing, etc.
- v. **National Mission on Natural Farming:** Training was provided to 3,017 farmers in Panchmahal and 2,811 farmers in Mahisagar, along with field visits, awareness camps, and input distribution to promote natural farming adoption.

TV Programs on DD Kisan

- Dr. Kanak Lata delivered a talk on 'Use of Solar Energy in Agriculture' on 24.09.2025.

Radio talks delivered (All India Radio, Godhra)

- Dr. Kanak Lata delivered a talk on 'Microgreens' on 20.06.2025
- Dr. J.K. Jadav delivered a talk on 'Public Private Partnership in *Prakrutik Kheti*' on 20.06.2025.
- Dr. Shakti Khajuria delivered a talk on 'Pest and diseases management in natural farming' on 09.08.2025.

- Ms. Renu delivered a talk on '*Mahila swasthyama shree anna nu poshan mahatva*' on 16.08.2025.

Folders published

- Shishuo na aarogya maate khajur – ek paushtik ane vishvasniya vikalp* (in Gujarati language).
- Prakrutik Kheti ma Jivamrut no Upyog vikalp* (in Gujarati language).
- Prakrutik Kheti ma Ghan Jivamrut Banavvani Paddhati* (in Gujarati language).
- Prakrutik Kheti ma Aachchhadan (Mulching) nu Mahatva* (in Gujarati language).
- एनीमिया :आयरन की कमी की रोकथाम में आयरन युक्त खाद्य पदार्थों की भूमिका (in Hindi language).
- कृषि में महिलाओं के लिए सुरक्षात्मक वस्त्रों की भूमिका (in Hindi language).



Extension activities organized

Name of activity	Number	No. of participants
Field Day	4	89
Day celebration	7	236
Kisan Goshti	5	152
Campaign	2	62
Farmer scientist interaction	5	165
Workshop	2	52
Farmers meeting	7	187
Kisan Mela	2	355
Exhibition	6	852
Awareness camp	4	355
Advisory services	225	350
Telephone helpline	825	825
Diagnostic visit	28	105
Method demonstration	66	186
Farm visit of visitors	7	168
Total	1195	4139



4 (c). SCSP and TSP Activities

During 2025, the institute effectively implemented training programs under the SCSP and TSP Schemes, reaching a total of 3,957 SC and ST farmers. The capacity-building initiatives focused on key agricultural practices, including advanced plant propagation techniques, integrated nutrient management, crop diversification, and the establishment of nutri-gardens for household nutritional security. In addition to knowledge dissemination, the institute ensured timely distribution of critical agricultural and livelihood inputs such as fertilizers (including MOP), micronutrients, groundnut seeds, improved vegetable seed kits for *rabi* season, cluster bean seed packets, snap melon seeds, fruit planting materials, plastic crates, sprayers, ridge guards, and seed grain bins.

To support allied and livelihood activities, beneficiaries were also provided with milk collection cans (steel), sewing machines, torches, and water dispenser bottles. These training programs served as an effective platform for farmer-scientist interaction, enabling participants to gain hands-on experience, adopt improved technologies, and enhance farm productivity. Furthermore, the celebration of International Women's Day emphasized the empowerment of SC women farmers through skill-oriented training and awareness activities. These initiatives significantly contributed to promoting sustainable agriculture, improving livelihoods, and strengthening the resilience of the local farming system in arid regions.

Training programs and input distribution under SCSP Scheme at Bikaner

S.No.	Title of training	Date	Place	Beneficiaries (Nos.)
1.	International Women Day: from soil to success, empowering women with plant propagation in arid areas	08.03.2025	Pemasar Village, Bikaner	28
2.	Improved technology of <i>kharif</i> vegetables	27.05.2025	5 GM, 7 GM Chhatargarh Block, Bikaner	50
3.	Improved technology of <i>kharif</i> vegetables	19.06.2025	Kharbara, Chhatargarh Block, Bikaner	43
4.	Improved technology of <i>kharif</i> vegetables	20.06.2025	Khara Village, Bikaner	07
5.	Improved technology of <i>kharif</i> vegetables	11.10.2025	Dhirdeshar Chotiyan Village, Shri Dungargarh	58
6.	Improved production technology of arid horticulture and post - harvest management	19.11.2025	17 KYD , Khajuwala, Village, Bikaner	41
7.	Improved production technology of arid fruits and vegetables	22.12.2025	Ambasar Village Bikaner	40



Training programs and input distribution under TSP Scheme

At ICAR-CIAH, Bikaner

S.No.	Title of training	Date	Place	Beneficiaries (Nos.)
1.	<i>Poshan vatika</i> and input distribution	30.07.2025	Borikua, Gujiya, Garada, Mahudiya and Amarapura Village, Udaipur	311
2.	Nutrient and water management in nursery establishment for getting higher income and input distribution	31.07.2025	Khandi Obari, Kherwara, Panchayat, Udaipur	110
3.	Advanced propagation techniques for higher productivity and income in fruit crops and input distribution	01.08.2025	KVK, Dungarpur	111
4.	Capacity building program on distribution of quality planting material for fruit orchards and input distribution	02.08.2025	Rawa Village, Udaipur	128
5.	Training on nutrient, irrigation, and pest management in fruit crops and input distribution	03.08.2025	Nala, Chanawda, Girwa Tehsil, Udaipur	66
6.	Entrepreneurship and orchard management techniques for getting higher income and input distribution	04.08.2025	Kaduamri, Banswara,	164
7.	Sustainable nutrition and income with orchard development and input distribution	04.08.2025	Nayakheda, Udaipur	95
8.	Nutrient and water management in orchard establishment for getting higher income and input distribution	05.08.2025	Kanpur, Udaipur	70
9.	Advances in horticulture: The role of improved varieties in fruit crop sustainability and growth and input distribution	05.08.2025	Jawar, Udaipur	95



At CHES, Vejalpur, Godhra

S.No.	Event	Date	Place	Beneficiaries (Nos.)
1.	National tribal horticulture fair	27.03.2025	CHES, Vejalpur	550
2.	National bael day	28.04.2025	CHES, Vejalpur	570
3.	Prime Minister Dhan Dhaanya Krishi Yojana (PMDDKY)	11.10.2025	CHES, Vejalpur	570
4.	<i>Janjatiya Gaurav Varsh Pakhwada</i> - 2025	13.11.2025 15.11.2025	Navanagar Zinjari	450
5.	<i>Kisan Samman Diwas</i>	23.12.2025	CHES, Vejalpur	200
6.	Agri-inputs distribution to the farmers	23.12.2025	CHES, Vejalpur	200



5. Training and Capacity Building

Training and capacity building of ICAR-CIAH employees

All scientists of the institute attended an IPR awareness workshop on 10th February 2025 and a workshop on protection of plant varieties held on 27th

March, 2025 organized by ICAR-CIAH.

The following personnel of the institute underwent in different training programs:

S.No.	Name	Topic	Organization	Duration
1.	Dr. D.S. Mishra Principal Scientist	Training of Master Trainers on Vigilance Perspectives	ICAR-NAARM, Hyderabad	17-19 th Nov., 2025
2.	Dr. D.K. Sarolia Principal Scientist	Artificial intelligence on MOOC training program (Online)	ICAR-NAARM, Hyderabad	13 th Feb. to 05 th March, 2025
3.	Dr. B.R. Choudhary Principal Scientist	Training program for the development of Master Trainers under the <i>Rashtriya Karmayogi Jan Seva Program – Phase II (Zone II)</i>	ICAR-CAZRI, Jodhpur	06-08 th Oct., 2025
4.	Sh. R.C. Balai Scientist	Online Orientation Workshop on “Mission Karmayogi”	ICAR, New Delhi	27 th Feb., 2025
5.	Dr. Manpreet Kaur Scientist	Training / workshop on Social resilience for sustainable societies	Asian Productivity Organization	31 st March to 02 nd April, 2025
		Online training course on “Agri - Export and import management” (Online)	NIAM, Jaipur	01 st Sept. to 30 th Nov., 2025
6.	Dr. Sagar N. Scientist	Orientation Training Program of ARS Probationer (One Month)	ICAR-CIAH, Bikaner and CHES, Vejalpur	27 th Oct. to 26 th Nov., 2025
		Professional Attachment Training for ARS Probationer Scientist	ICRISAT, Hyderabad	01 st Dec., 2025 to 27 th Feb., 2026
7.	Ms. Renu ACTO	Microgreens Mastery: Techniques and tips for efficient production (Online)	ICAR-IIHR, Bengaluru	23 rd May, 2025
8.	Sh. Rampal Verma Sr. A.O.	Training program for the development of Master Trainers under the <i>Rashtriya Karmayogi Jan Seva Program – Phase II (Zone II)</i>	ICAR-CAZRI, Jodhpur	06-08 th Oct., 2025

Seminar/ symposium/ workshop attended

Dr. Jagadish Rane

- Attended Brainstorming Meet on Desert Meteorology Program and Presented Arid Horticulture perspectives held at Jaipur on 16th April, 2025.
- Participated in 03 days Annual Zonal Workshop of KVKs held at Bhuj on 20th July, 2025.
- Participated in 29th Annual Group Meeting of AICRP on AZF at MPKV, Rahuri from 22-24th August, 2025.
- Attended Brainstorming Committee Meet on Desert Meteorology and Climate Research on 29th September, 25 at SKRAU, Bikaner.
- Participated in the Krishi Gyandhara 2.0 release program organized by the Hon'ble Agriculture Minister at Durgapura from 16-17th October, 2025.
- Participated in 1st National Seminar on “Innovation and Sustainability in Agriculture for Achieving Sustainable Development Goals (SDGs)” from 30-31st October, 2025 at College of Agriculture, Bawal, Haryana.
- Participated in AICRP on IFS during 28-30th November, 2025 at RARI, Durgapura, Jaipur and Co-chaired session on IFS modules at different centres.
- Attended National Citrus Symposium-2025 held at Jalgaon during 21-23rd December, 2025.

Dr. A.K. Singh

- Participated in International Conference on Technology innovation and Sustainable Development in Date Palm, 29-30th June, 2025 at Bhuj, Gujarat.
- Participated in 11th Indian Horticulture Congress and International Meet, 2025 held at UAS, Bengaluru during 06-09th November, 2025.

Dr. S.K. Maheshwari

- Attended 4th International Conference on "Global Perspectives on Smart Agriculture: From Precision Farming to Community Empowerment" held at RNB Global University, Bikaner during 27-28th February, 2025.

- Attended International Conference on “Technological Innovations and Sustainable Development of Date Palm 2025” held at Bhuj during 29-30th June, 2025.
- Attended National Citrus Symposium -2025 held at Jalgaon during 21-23th December, 2025.

Dr. S.R. Meena

- Participated in STAR National Conference organized on "Current trend in agriculture research and extension services: shaping the future of sustainable agriculture and food security" at RARI, Jaipur from 23-25th February, 2025.

Dr. D.S. Mishra

- Attended National Virtual Conference on “Agriculture & Nutritional Security for Sustainable Growth” organized by Samagra Vikas Welfare Society (SVWS), Uttar Pradesh on 11th January, 2025.

Dr. D.K. Sarolia

- Attended 4th International Conference on “Global perspectives on smart agriculture from precision farming to community empowerment” (on line) organized by RNB Global University, Bikaner on 27th February, 2025.
- Attended International Conference on “Technology Innovation & Sustainable Development of Date Palm” organized at Bhuj on 29-30th June, 2025.

Dr. B.R. Choudhary

- Attended (Online) 4th International Conference on "Global Perspectives on Smart Agriculture: From Precision Farming to Community Empowerment" organized by RNB Global University RNB Global City, Bikaner during 27-28th February 2025.
- Participated in International Conference on “Technology Innovations & Sustainable Development of Date Palm” organized at Bhuj during 29-30th June, 2025.

Dr. Ramkesh Meena

- Attended the International Conference on “Date Palm titled “Technological Interventions and Sustainable Development of Date Palm” organized at Bhuj on 29-30th June, 2025.
- Participated in the 4th International Conference on

“Global Perspectives on Smart Agriculture: From Precision Farming to Community Empowerment” organized by RNB Global University, Bikaner during 27–28th February, 2025.

Dr. M.K. Berwal

- Attended National Conference on “Emerging Innovations in Biochemistry and Biotechnology for Holistic Development” held at SKUAST-JAMMU (J&K) during 6–7th March, 2025.

Dr. Ramesh Kumar

- Participated in International Conference on “Global Research initiatives for Agriculture, Science and Technology (GRIAST-2025)” organized by IGKV, Raipur during 20 - 22nd January, 2025.

Dr. R.P. Meena

- Participated in the 8 days online training program on “Decoding non-coding Genome: Insights into Gene Expression and Regulatory Interplay” at New Delhi during February 25 – March 04, 2025.
- Attended online workshop on “Virome Profiling in Plants: Advanced Methods for Discovery and Analysis” during 10–11th March, 2025.
- Attended International conference on “Technology Innovations & Sustainable Development of Date Palm” held at Bhuj during 29–30th June, 2025.

Dr. L.P. Yadav

- Attended International Agriculture Conference on “Navigating Unique Trends in Agricultural Research, Innovation Engineering, Nutrition, and Technology (NUTRIENT-2025)” virtually during 20–21st February, 2025.
- Attended National Conference on “Digital Technologies for Transforming the Horticulture Sector,” held at IARI, New Delhi during 28–30th January, 2025.

Sh. R.C. Balai

- Participated in STAR National Conference on “Current Trends in Agriculture Research and Extension Services: Shaping the future of sustainable agriculture and food security” held at RARI Durgapura during 23–25th February, 2025.
- Attended International Conference on “Emerging

challenges in sustainable development and environmental conservation (ICECSDEC-2025)” held during 26–28th May, 2025 at MGSU, Bikaner

Dr. Chet Ram

- Attended “International Conference on Technology innovations and sustainable development of date palm” organized at Bhuj during 29–30th June, 2025.
- Attended 2nd International Workshop-cum-Webinar on “Advances in CRISPR-Cas genome editing in plants” organized by Glostem Private Limited, Chandigarh through online mode during 10–12th December, 2025.

Dr. Anita Meena

- Attended National Conference on “Current Trends in Agricultural Research and Extension Services: Shaping the future of sustainable agriculture and food security” held at RARI, Durgapura during 23–25th February, 2025.
- Attended International Conference on “Global Perspectives on Smart Agriculture: From Precision Farming to Community Empowerment” held at RNB Global University, Bikaner during 27–28th February, 2025.
- Attended International Conference on “Technology Innovations & Sustainable Development of Date Palm”, Bhuj during 29–30th June, 2025.
- Attended Xth International Conference on “GRISAAS-2025” held at MPUAT, Udaipur during 05–07th October, 2025.

Dr. P.S. Gurjar

- Attended one day “NABARD Credit Seminar” held on 12th February, 2025 at Marriot Hotel, Durgapura.
- Attended 1st International Conference on “Farming System Research” held during 07–09th March, 2025 at ICAR-IIFSR, Meerut.
- Attended International Conference on “Technology Innovations and Sustainable Development of Date Palm” held during 29–30th June, 2025 at Bhuj.
- Attended 11th Indian Horticulture Congress–2025 and International Meet held during 06–09th

November, 2025 at UAS, Bengaluru.

Dr. Hanuman Ram

- Attended National Conference on “Digital Technologies for Transforming the Horticulture” during 28-30th January, 2025 at ICAR-IARI, New Delhi.

Dr. Pawan Kumar

- Attended National Conference on “Digital Technologies for Transforming the Horticulture” organised by ICAR-IARI, New Delhi during January 28-30, 2025.
- Attended workshop on new education policy at RNB Global University, Bikaner.

Dr. Manpreet Kaur

- Participated in International Conference on “Technology Innovations & Sustainable Development of Date Palm” at Bhuj during 29-30th June, 2025.

Dr. Anil

- Attended International Conference on “Technology Innovation and Sustainable Development of Date Palm” at Bhuj during 29-30th June, 2025.
- Attended 11th Indian Horticulture Congress-2025 and International Meet held at UAS, Bengaluru during 06-09th November, 2025.

Meetings attended

Dr. Jagadish Rane

- Attend Rajasthan Kisan Aayog state level meeting on 03rd April, 2025 at Jaipur.
- Attended Prof. M.S. Swaminathan Foundation Day Function at New Delhi on 05th June, 2025.
- Participated in Viksit Krishi Sankalp Abhiyan meeting at Paniyara, Bhanpura (Jambughoda Taluka) villages of Panchmahal District, Gujarat on 08th June, 2025.
- Attended a meeting at Pant Krishi Bhawan, Jaipur on 13th June, 2025.
- Attend World Camel Day- 2025 at ICAR-NRCC, Bikaner on 22nd June, 2025.
- Attended DBT-BIRAC Review Committee Meeting at New Delhi on 16th July, 2025.

- Attended ICAR Foundation Day Program at ICAR, New Delhi on 16th July, 2025.
- Attended a meeting regarding Detailed Project Report (DPR) and other CPP/ CPCs related issues on 17th July, 2025 at New Delhi.
- Attended Hon'ble 'PM-Kisan' program on 02nd August, 2025.
- Attended Rajasthan Kisan Aayog Meeting at RAJUWAS, Bikaner on 05th August, 2025.
- Attended SAC meeting at KVK, Sardarshar, Churu on 26th September, 2025.
- Attended SAC meeting of KVK, Panchmahal on 11th December, 2025.

Dr. A.K. Singh

- Participated in 29th Annual Group Meeting of AICRP on AZF at MPKV, Rahuri during 22-24th August, 2025.

Dr. S.K. Maheshwari

- Attended a CPC review online meeting under Chairmanship of DDG under CPP on 13th June, 2025.
- Attended a meeting related to Clean Plant Program (CPP) held at New Delhi on 17th July, 2025.
- Attended a meeting with team of NHB for site/field selection of Clean Plant Centre (CPC-Citrus) under Clean Plant Program (CPP) on 19th September, 2025.
- Attended a meeting and site visit for Clean Plant Centre (CPC) with Shri Pushpanathan (Environment Specialist, ADB) on 09th December, 2025.

Dr. S.R. Meena

- Participated in Research Interface meeting held at CAZRI, RSS, Bikaner on January 31, 2025.
- Attended VKSA-2025 during May 29 to June 12, 2025.
- Attended live streaming of PM-KISAN Program – *Dhandhanya Yojna* on 02nd August, 2025.
- Attended a Zoom meeting on National Space Day on 23rd August, 2025.
- Attended a consultant meeting with stake holders under Clean Plant Program sponsored by MIDH,

GOI, New Delhi and NHB New Delhi on 02nd September, 2025.

- Attended online telecast on Prime Minister Dhan Dhanya Krishi Yojna (PMDDKY), Pulse Mission along with the some other schemes launched by PM on 11th October, 2025.

Dr. D.S. Mishra

- Attended the DUS review meeting during 24- 25th March, 2025 at New Delhi.
- Attended the AICRP on AZF Research Workers Meet during 22-24th August, 2025 at MPKV, Rahuri.
- Attended 21st Foundation Day of PPV&FRA & Award Function on 12th November, 2025 at New Delhi.
- Attended the SAC meeting of KVK, Panchmahal on 11th December, 2025.

Dr. D.K. Sarolia

- Attended Half Yearly review meeting of NABARD-Khejri project held at Jaipur on 02nd January, 2025.
- Attended IMC meeting of ICAR-CIAH, Bikaner held on 12th March, 2025.
- Attended Annual review meeting of DUS activities held at New Delhi on 24-25th March, 2025.

Dr. B.R. Choudhary

- Attended Annual review meeting of DUS activities held at New Delhi on 24-25th March, 2025.

Dr. Ramesh Kumar

- Attended and organized AICRP on AZF meeting for preparation of annual report on 19th May, 2025.
- Attended and organized AICRP on AZF meeting on “AGM Report and compiled Data Book” on 02nd June, 2025.
- Attended and organized meeting “Preparation of AGM report and Databook” of AICRP on AZF from 02-03rd June, 2025.
- Attended and organized “AICRP on AZF Progress of Annual Group Meeting Report” on 18th June, 2025.
- Attended and organized “AICRP on AZF meeting for EFC- Budget, Achievement and Targets” on

12th August, 2025.

- Attended and organized “Annual Group Meeting” of AICRP on AZF held at MPKV, Rahuri from 22-24th August, 2025.
- Attended and organized AICRP on AZF meetings for finalization of new trials on 8-9th, 17th and 25th September, 2025.

Dr. R.P. Meena

- Attended interaction meeting with CPP officials held at ICAR-CIAH, Bikaner on 19th September, 2025.

Dr. L.P. Yadav

- Attended Agriculture Minister interactive meeting for VKSA achievements held virtually on 24th June, 2025.
- Virtually attended a meeting Chaired by DDG, Hort. Sci. to prepare vision document for Vikshit Bharat-2047 held on 04th August, 2025.
- Attended the closing ceremony of Viksit Krishi Sankalp Abhiyan (VKSA) at KVK, Lunkaransar.

Sh. R.C. Balai

- Attended a farmers training meeting at KVK, Lunkaransar on 12th May, 2025.
- Participated in VKSA-2025 during May 29 - June 12, 2025.
- Attended a meeting on District Oilseed Mission on 14th June, 2025.
- Attended live streaming of PM-KISAN Program – *Dhandhanya Yojna* on 02nd August, 2025.
- Attended a Zoom meeting on National Space Day on 23rd August, 2025.
- Attended a meeting of Zonal Research and Extension Advisory Council at SKRAU, Bikaner.
- Participated a consultant meeting with stake holders under Clean Plant Program on 02nd September, 2025

Dr. Chet Ram

- Attended “*Guvatta Yatra*-Awareness Program on NABL Accreditation” at ICAR-CSWRI-Avikanagar on 17th December, 2025.

Dr. Anita Meena

- Attended institute Foundation Day and Institute

Technology Day during 28 - 30th September, 2025.

Dr. Pawan Kumar

- Attended review meeting on the progress of project “FSPF-Production of quality planting material of Khejri” on 16th July, 2025.
- Attended Vikshit Krishi Sanklap Abhiyan (VKSA) program on 06th June, 2025.
- Attended as expert for monitoring of DUS trials of watermelon and muskmelon at ICAR-CIAH, Bikaner on 25th April, 2025

Dr. Manpreet Kaur

- Attended World Intellectual Property Right (IPR) on 02nd May, 2025.
- Attended a meeting of VKSA on 26th May, 2025.

Dr. Anil

- Attended RAC meeting held on 13- 14th November, 2025 held at CHES, Vejalpur.
- Attended meeting of State Level project screening committee under RKVY at Krushibhawan, Gandhinagar, Gujarat on 14th November, 2025.

Dr. Sagar N.

- Attended the *Ekta Diwas* Pledge at ICAR-CIAH, Bikaner on 31st October, 2025.
- Attended a program as part of *Janjatiya Gaurav Varsh Pakhwada* 2025 on 15th November, 2025.
- Attended the Oath Taking Program for Constitution Day on 26th November, 2025.

6 (a). Women Empowerment

Training Programs for Women Empowerment

Training programs for women empowerment play a crucial role in enhancing the socio-economic status of women, particularly in rural and arid regions. These programs are designed to strengthen technical knowledge, practical skills, and entrepreneurial capabilities among women farmers and self-help groups. Through need-based and hands-on training, participants are equipped with improved agricultural practices, nursery management, value addition, and sustainable resource management techniques. Special emphasis is placed on leadership development, financial literacy, and decision-making skills to promote self-reliance and confidence. As a result, these initiatives contributed to increased income generation, improved household nutrition, and active participation of women in farm and allied activities. A total of approximately 1,653 women were empowered through various training programs.

The specific training modules organized during the year 2025 for women are as follows:

- Training on modern propagation methods for quality nursery production in fruit crops in arid and semi-arid region.
- Capacity building on sustainable and water-efficient crop production in arid and semi-arid regions.
- Training program on establishment and management of nutri-gardens for household nutrition.
- Awareness and training on economic and nutritional benefits of nutri-gardens for food and nutritional security.

- Training on organic and natural farming in arid and semi-arid region.
- Hands-on training on plant propagation, nursery establishment, management, and maintenance for fruit crops.
- Awareness program on farmers' rights, Govt. schemes, and development opportunities.
- Entrepreneurship development program for SHGs on value addition and income generation.
- Training on resource management in underutilized fruit and vegetable crops.
- Field day and farmer-scientist interaction program for technology dissemination and knowledge exchange.
- Training on fruit-based cropping systems for enhanced farm productivity and sustainability.
- Field day and farmer-scientist interaction meet for knowledge exchange.



Skill oriented training programs



Training program organized for women

6 (b). Person with Disabilities (*Divyangjan*)

Accessibility for Persons with Disabilities (*Divyangjan*)

The Institute has installed ramps and accessible washrooms in all office buildings and guest houses to (*Divyangjan*). Additionally, scientists have interacted

with them and organized visits to the museum, experimental fields, and other areas of interest.

7. Awards and Recognitions

Dr. A.K. Singh

- Acted as Convener in International Conference on Technology innovation and Sustainable Development in Date Palm held at Bhuj, Gujarat during 29–30th June, 2025.
- Acted as Convener for the session on action taken on recommendations of the 29th research workers group meeting and the plenary session of AICRP on AZF held at MPKV, Rahuri during 22–24th August, 2025.
- Acted as Convener in the plant genetic resource management session of the 29th research workers group meeting of AICRP on AZF held at MPKV, Rahuri during 22–24th August, 2025.

Dr. S.K. Maheshwari

- Acted as Rapporteur in poster presentation of International Conference on Technological Innovations and Sustainable Development of Date Palm held at Bhuj, Gujarat during 29–30th June, 2025
- Acted as the ICAR-nominated team member during a field visit conducted on 8th October 2025 in Balotra district, Rajasthan, to assess the incidence and management practices of pomegranate diseases.
- Nominated as mentor for ICAR orientation training programme of ARS probationer Dr. Sagar N. (Scientist) during 27th October –26th November, 2025 at ICAR-CIAH, Bikaner.

Dr. S.R. Meena

- Received STAR Excellence Award–2025 in STAR National Conference organised by Science and Technology Application Society at Jaipur during 23–25th February, 2025.
- Received conference gold medal award for oral presentation in STAR National Conference organised by Science and Technology Application

Society at Jaipur during 23–25th February, 2025.

- Nominated as National Convener of STAR National Conference organised by Science and Technology Application Society at Jaipur during 23–25th February, 2025.
- Acted as Co-Chairman of the oral presentation session, chairman of the poster presentation session and Co-Chairman of the poster presentation session in STAR National Conference organised by Science and Technology Application Society at Jaipur during 23–25th February, 2025.
- Acted as special guests during the farmers fair and exhibition programmes organized by office–gram panchayat, 14 BD, Panchayat Samiti, Khajuwala, Bikaner, on 28th January, 2025.
- Honoured as guest of honour during the Kisan Mela/ Krishi Mohatshva organized by ATMA and SKD University held at Hanumangarh during 08–11th March, 2025.

Dr. D.S. Mishra

- Received the eminent scientist award conferred by SVWS, U.P. during the year 2025.
- Acted as Editor for Progressive Horticulture, ISAH Indian Journal of Arid Horticulture and Greenhouse Plant Production Journal, Arak University, Iran.
- Acted as member of the SAC meeting of KVK, Panchmahal and Dahod.
- Acted as Convener in IIIrd & IVth session of planting density, orchard management & crop regulation & water and nutrient management in the 29th research workers group meeting and the plenary session of AICRP on AZF held at MPKV, Rahuri during 22–24th August, 2025.
- Evaluated progress report of R&D project on development of nutraceutical rich value-added

products and shelf-life extension in Jamun on 21st November 2025 funded by Council of Science & Technology, Lucknow.

Dr. D.K. Sarolia

- Acted as Convener for the session on action taken on recommendations of the 29th research workers group meeting and the plenary session of AICRP on AZF held at MPKV, Rahuri during 22–24th August, 2025.
- Acted as Rapporteur in the plant genetic resource management session of the 29th research workers group meeting of AICRP on AZF held at MPKV, Rahuri during 22–24th August, 2025.
- Acted as Convener at the International Conference on Technology Innovation & Sustainable Development of Date Palm held at Bhuj, Gujarat during 29–30th June, 2025.
- Nominated as a Training Programme Assessor and evaluated trainees on 20th March 2025.
- Acted as course instructor (UG) at Institute of Agribusiness Management (IABM-SKRAU) for the course on Fruit Production & Post-Harvest Management (ABM-5309) during 2024–25.

Dr. B.R. Choudhary

- Acted as a Co-organizing secretary of International Conference on Technology Innovation & Sustainable Development of Date Palm held during 29–30th June, 2025 at Bhuj, Gujarat
- Acted as Editor-in Chief of ISAH Indian Journal of Arid Horticulture.

Dr. Ramkesh Meena

- Acted as Rapporteur for the crop improvement theme at the International Conference on Technology Innovation & Sustainable Development of Date Palm held at Bhuj, Gujarat during 29–30th June, 2025.
- Acted as date palm crop curator for the selection of the site for the annual training centre at the mechanized date palm farm, Bikaner, by the department of horticulture, Bikaner on 15th January, 2025.
- Acted as a date palm crop curator at the

Government Mechanized Khajoor Farm Bikaner to select a site for Administrative Bhawan on 15th January, 2025.

Dr. M.K. Berwal

- Received First Prize in Hindi Kavya Path during Hindi Pakhwara celebrated during September 2025 at ICAR–CIAH, Bikaner.

Dr. Ramesh Kumar

- Acted as Rapporteur for the session on action taken on recommendations of the 29th research workers group meeting and the plenary session of AICRP on AZF held at MPKV, Rahuri during 22–24th August, 2025.
- Acted as Rapporteur in the plant genetic resource management session of the 29th research workers group meeting of AICRP on AZF, held at MPKV, Rahuri during 22–24th August, 2025.
- Acted as Associate Editor of ISAH Indian Journal of Arid Horticulture.
- Acted as Editor of Journal of Agriculture and Ecology.
- Acted as Nodal Officer EFC of AICRP on AZF for preparation of EFC document (2026–2031) and achievements (2021–2026).

Dr. L.P. Yadav

- Received design registration certificate from office of the comptroller general of patents, designs and trade marks (India) dated 5th February 2025 on Horticulture Pollinating Smart Machine (Design No. 446936–001) registered under the Designs Act, 2000 and the Designs Rules, 2001.
- Received an appreciation certificate for outstanding contribution in Horticulture (Vegetable Science) on the occasion of Republic Day 2025, conferred by the Deputy Speaker, Gujarat Legislative Assembly, Gujarat.
- Acted as Associate Editor of Current Horticulture journal.
- Acted as Editorial board Member of International Journal of Environment, Agriculture and Biotechnology.
- Received IInd prize in Hindi Essay competition

during Hindi Pakhwara celebrated at ICAR-CIAH, Bikaner.

Dr. Chet Ram

- Received best oral presentation award in International Conference on Technology Innovations & Sustainable Development of Date Palm held during 29–30th June, 2025 at Bhuj, Gujarat.
- Acted as Guide to supervise a M.Sc. Plant Biotechnology student, Department of Biotechnology, CoA, SKRAU, Bikaner during 2025.

Dr. Anita Meena

- Awarded the best poster presentation in the International Conference on Technology Innovations & Sustainable Development of Date Palm held at Bhuj, Gujarat during 29–30th June, 2025.
- Awarded best oral presentation in Xth International Conference in hybrid mode on global research initiatives for sustainable agriculture & allied sciences (GRISAAS–2025) held at MPUAT, Udaipur during 05–07th October, 2025.

Dr. P.S. Gurjar

- Received the best oral presentation award in International Conference on Technology Innovations & Sustainable Development of Date Palm held during 29–30th June, 2025 at Bhuj, Gujarat.
- Received the best oral presentation award in the 11th Indian Horticulture Congress–2025 and International Meet organized during 06–09th November, 2025 at UAS, Bengaluru.
- Received copy write for "Khejri-Thar Shobha Ki Vyavsayik Kheti".

Dr. K.L. Kumawat

- Received best oral presentation award in Xth

International Conference in hybrid mode on global research initiatives for sustainable agriculture & allied sciences (GRISAAS–2025) held during 05–07th October, 2025 at MPUAT, Udaipur.

- Acted as Rapporteur in varietal improvement session of the 29th research workers group meeting of AICRP on AZF held at MPKV, Rahuri during 22–24th August, 2025.

Dr. Hanuman Ram

- Received best oral presentation award in National Conference on digital technologies for transforming the horticulture sector held during 28–30th January, 2025 at ICAR-IARI, New Delhi.

Dr. Pawan Kumar

- Acted as Editor of Crop Improvement section of ISAH Indian Journal of Arid Horticulture.

Dr. Anil

- Received best poster presentation award in 11th Indian Horticulture Congress–2025 and International Meet organized during 06–09th November, 2025 at UAS, Bengaluru.

Dr. Manpreet Kaur

- Received certificate of Appreciation in recognition of contribution as member of organizing team for International Conference on Technological Innovations and Sustainable Development of Date Palm held at Bhuj, Gujarat during 29–30th June, 2025.
- Received certificate of Appreciation for acting as Rapporteur at the International Conference on Technological Innovations and Sustainable Development of Date Palm held at Bhuj, Gujarat during 29–30th June, 2025.
- Served as Member of Conference Secretariat for the International Conference on Technological Innovations and Sustainable Development of Date Palm held at Bhuj, Gujarat during 29–30th June, 2025.

8. Publications

Research paper (70)

- Basavaraj, P.S., Rane, J., Ishwaryalaxmi, V.G., Anil Kumar, C., Kumar, M., Babar, R., Gangurde, A., Shinde, S., Shreekanth, D., Boraiah, K.M., Harisha, C.B., Halli, H., Reddy, S. and Prabhakar, M. 2025. Unravelling chickpea (*Cicer arietinum* L.) genotype stability through univariate and multivariate approaches under varying soil types and water regimes. *Indian Journal of Genetics and Plant Breeding*, 85(4): 578-592.
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- Choudhary, B.R., Ram, H., Rane, J. and Pandey, S. 2025. Inheritance pattern of leaf and fruit traits in watermelon [*Citrullus lanatus* (Thunb) Mansf.]. *Journal of Horticultural Sciences*, 20(1).
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- Gantayat, A., Choudhary, B.R., Yadav, P.K., Kumar, P., Gupta, D. and Chaubey, T. 2025. Mean performance, correlation and path coefficient analysis in sponge gourd under arid environment of western Rajasthan. *Vegetable Science*, 52(1): 128-135.
- Gantayat, A., Choudhary, B.R., Yadav, P.K., Ram, C., Sharma, Y., Kumar, N., Chaubey, T. and Singh, D.K. 2025. Genetic variability analysis for yield traits in sponge gourd (*Luffa cylindrica*) in arid environment. *Current Horticulture*, 13(3): 26-29.
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9. Research Projects

On-going Research Projects		Name of PI & Co-PI
CIAH:1	Introduction, collection, characterization, conservation and evaluation of germplasm of arid and semi-arid fruit and vegetable crops	
(a)	Aonla (<i>Emblica officinalis</i> Gaertn)	Dr. A.K. Singh Dr. D.S. Mishra
(b)	Bael (<i>Aegle marmelos</i> Correa.)	Dr. A.K. Singh Dr. Ramkesh Meena Dr. Vikas Yadav Dr. Lal Chand Dr. Chet Ram*
(c)	Wood apple (<i>Feronia limonia</i>) and custard apple (<i>Annona squamosa</i>), tamarind, chironji, karonda, palmyra palm and tendu	Dr. Vikas Yadav Dr. A.K. Singh
(d)	Jamun, mahua, rayan, phalsa, manila tamarind and Indian dates	Dr. D.S. Mishra Dr. V.V. Appa Rao Dr. M.K. Berwal*
(e)	Guava and acid lime	Dr. D. S. Mishra Dr. V.V. Appa Rao Dr. Vikas Yadav
(f)	Maintenance and use of arid vegetable genetic resources for crop improvement	Dr. D.K. Samadia Dr. A.K. Verma Dr. Hanuman Ram
(g)	Collection, conservation and utilization of un-tapped minor fruits of hot arid region	Dr. K.L. Kumawat Dr. P.S. Gurjar Dr. D.K. Samadia
CIAH:2	Improvement of arid and semi-arid fruit and vegetable crops including biotechnological interventions	
(a)	Enhancement of genetic potency of tomato and chilli under heat stressed arid environment	Dr. Hanuman Ram Dr. A.K. Verma Dr. D.K. Samadia
(b)	Genetic improvement of arid vegetable legumes for quality yield under heat stressed environment	Dr. A.K. Verma Dr. Hanuman Ram
(c)	Genetic improvement in pomegranate under hot arid environment of Rajasthan	Dr. Ramesh Kumar Dr. M.K. Berwal Dr. Chet Ram Dr. Lal Chand

(d)	Breeding behaviour and population studies in diverse horticultural species under hyper arid conditions	Dr. Pawan Kumar Dr. B.R. Choudhary Dr. K.L. Kumawat
(e)	Optimization of cell suspension technology for micro propagation of popular varieties of date palm	Dr. Dhurendra Singh Dr. Pawan Kumar Dr. R.P. Meena Dr. Chet Ram* Dr. Ramkesh Meena Dr. Jagdish Rane
(f)	Isolation and validation of genes responsible for heat stress tolerance in chilli and tomato under hot arid region	Dr. Chet Ram Dr. Hanuman Ram
(g)	Breeding of cucurbitaceous crops (Watermelon and Muskmelon) for marketable yield, quality traits and climate resilience in arid ecology	Dr. B.R. Choudhary Dr. Pawan Kumar Dr. L. P. Yadav Dr. R. P. Meena
(h)	Genetic improvement of date palm for quality and climate resilience in hot arid conditions	Dr. Ramkesh Meena Dr. Dhurendra Singh Dr. Chet Ram Dr. R.P. Meena*
(i)	Improvement and utilization of drumstick (<i>Moringa oleifera</i>) germplasm under arid conditions	Dr. L.P. Yadav Dr. B.R. Choudhary
CIAH:3	Standardization of arid and semi-arid fruits and vegetables production technology	
(a)	Standardization of production technology of bael under rainfed semi-arid conditions of western India	Dr. A.K. Singh Dr. V.V. Appa Rao
(b)	Performance evaluation of citrus germplasm and rootstocks study under hot arid environment of Rajasthan	Dr. Lal Chand Dr. Ramesh Kumar Dr. Pawan Kumar Dr. M.K. Berwal*
(c)	Optimization of waste wool integration technology with organic and inorganic fertilizers for medicinal crop Ashwagandha (<i>Withania somnifera</i>) to facilitate climate resilient in the arid region	Dr. Anita Meena Dr. M.K. Jatav Dr. Manpreet Kaur
(d)	Soil health and water conservation in fruits of hot arid region	Dr. M.K. Jatav Dr. R.P. Meena Dr. Anita Meena Sh. R.C. Balai*
(e)	Development of protocols for organic and natural farming in fruit crops to enhance the sustainability in arid region	Dr. M.K. Jatav Dr. Anita Meena Sh. R.C. Balai Dr. M.K. Berwal
(f)	Effect of organics and agro-chemicals on fruit set and quality of ber (<i>Ziziphus mauritiana</i>) under hot arid conditions	Sh. R.C. Balai Dr. M.K. Jatav Dr. D.K. Sarolia Dr. Manpreet Kaur Dr. R.P. Meena*

CIAH:4	Plant health management studies in arid and semi-arid fruit and vegetable crops	
(a)	Major diseases and their control measures in important arid fruit crops (pomegranate and date palm)	Dr. S.K. Maheshwari Dr. Ramkesh Meena* Dr. Ramesh Kumar
(b)	Detection and diagnosis of virus and virus like pathogens associated with horticulture crops grown in hot arid ecosystem	Dr. R.P. Meena Dr. Chet Ram
(c)	Biodiversity, bioecology and management of insect pests associated with underutilized fruits and vegetable crops under semi-arid regions of Gujarat	Dr. Anil Dr. A.K. Singh Dr. R.P. Meena*
CIAH:5	Post-harvest management studies	
(a)	Standardization of techniques for pre- and post-harvest management, value addition and commercialization of desert horticultural crop-plants	Dr. P.S. Gurjar Dr. S.R. Meena Dr. M.K. Berwal Dr. K.L. Kumawat
(b)	Bio-prospecting of arid horticultural flora's adapted to environmental extremes of western India	Dr. M.K. Berwal Dr. P.S. Gurjar Dr. Ramesh Kumar Dr. D.S. Mishra
CIAH:6	Agriculture extension studies	
(a)	Impact assessment of adoption of pomegranate and date palm in hot arid and semi-arid regions of Rajasthan	Dr. S.R. Meena Sh. R.C. Balai Dr. Ramkesh Meena Dr. Manpreet Kaur Dr. Ramesh Kumar*
(b)	Market dynamics and growth analysis of major fruits and vegetables in the hot arid regions of Rajasthan	Dr. Manpreet Kaur Dr. S.R. Meena Sh. R.C. Balai

The bold letter indicating the name of PI whereas asterisk (*) indicating the "Associated" scientist for some specific activities.

Externally funded projects/ Collaborative projects

S.No.	Project Name	Name of PI & Co-PI
1.	DUS centre for watermelon and muskmelon	Dr. B.R. Choudhary Dr. Hanuman Ram
2.	DUS centre for ber	Dr. D.K. Sarolia
3.	DUS centre for date palm	Dr. Ramkesh Meena
4.	Development of DUS testing guidelines for khejri (<i>Prosopis cineraria</i>)	Dr. P.S. Gurjar Dr. A.K. Verma Dr. Hanuman Ram
5.	Development of DUS test guidelines for kalingda	Dr. B.R. Choudhary Dr. Pawan Kumar
6.	DUS nodal centre for bael	Dr. A.K. Singh

7.	DUS co-nodal centre for aonla	Dr. A.K. Singh
8.	DUS co-nodal centre for jamun	Dr. D.S. Mishra
9.	DUS nodal centre for chironji and tamarind	Dr. A.K. Singh
10.	Development of DUS testing guidelines for mahua	Dr. D.S. Mishra Dr. A.K. Singh
11.	Development of DUS test guidelines for khirni	Dr. D.S. Mishra Dr. A.K. Singh
12.	Enhancing food and water security in arid region through improved understanding of quantity, quality and management of blue, green and grey water	Dr. Ramesh Kumar
13.	Development of Hi-tech horticultural nursery with water harvesting structure (RKVY)	Dr. A.K. Singh Dr. L.P. Yadav Dr. V.V. Appa Rao
14.	Production of quality planting material of khejri (FSPF- NABARD)	Dr. D.K. Sarolia Dr. R.K. Meena Dr. K.L. Kumawat Dr. P.S. Gurjar
15.	Development of infrastructure facility for PEQ and hardening of date palm tissue culture plants & mass multiplication of other important arid fruit crops	Dr. Dhurendra Singh Dr. D.K. Sarolia Dr. R.K. Meena Dr. R.P. Meena Dr. Chet Ram
16.	Training and skill development on arid horticulture for livelihood creation	Dr. Jagadish Rane Dr. Lal Chand Sh. R.C. Balai Dr. Dhurendra Singh
17.	Effect of Solutek melons solution on agronomic performance of muskmelon	Dr. L.P. Yadav Dr. B.R. Choudhary
18.	Clean Plant Program (Citrus)	Dr. S.K. Maheshwari Dr. J.S. Gora Dr. Lal Chand Dr. R.P. Meena
19.	Biodiversity conservation of vegetable beans for sustainable production and nutritional security under rainfed hot semi-arid conditions	Dr. A.K. Singh Dr. Anil
20.	Optimisation of natural waste wool technology for horticultural crops to facilitate climate resilient farming system in the arid region	Dr. Anita Meena Dr. M.K. Jatav
21.	Development of high-tech nursery with water harvesting structure	Dr. A.K. Singh Dr. Anil

The bold letter indicating the name of PI

10. IMC, RAC and IRC

Institute Management Committee (IMC)

Chairman

Director, ICAR-CIAH, Bikaner

Members

Dr. V.B. Patel
ADG-I (Fruits and Plantation Crops)
Horticultural Science Division, ICAR, New Delhi

Director Horticulture
Govt. of Rajasthan, Pant Krishi Bhawan, Jaipur

Director Horticulture
Govt. of Gujarat, Krishi Bhawan,
Sector No.10-A, Gandhinagar

Vice Chancellor
Swami Keshwanand Rajasthan Agricultural
University, Bikaner

Sh. Shran Pal Singh
2/7 RHB old, ward No.25,
Suratgarh (Rajasthan)

Dr. Chetan Prakash Rajpurohit
In front of Govt. Press, Majisa Ki Badi, Bikaner

Sh. Sunil K. Agarwal
F&AO, ICAR-NRC on Seed Spices, Ajmer

Dr. A.K. Singh
I/c ICAR-CIAH, CHES, Vejalpur, Godhra

Dr. D.K. Sarolia
I/c PME, ICAR-CIAH, Bikaner

Dr. Ram Asrey
Principal Scientist
Post-Harvest Technology, ICAR-IARI, New Delhi

Member Secretary

Administrative Officer, ICAR-CIAH, Bikaner

39th IMC was held at ICAR-CIAH, Bikaner on 11 March, 2025

Institute Research Committee (IRC)

Chairman

Dr. Jagadish Rane
Director, ICAR-CIAH, Bikaner

Members

All scientist of ICAR-CIAH and CHES, Vejalpur,
Godhra Member Secretary

Member Secretary
Dr. R.P. Meena
Sr. Scientist, ICAR-CIAH, Bikaner

IRC-I meeting was held on 23-24 July 2025 and IRC-II on 06 August 2025 at ICAR-CIAH, Bikaner

Research Advisory Committee (RAC)

Chairman

Dr. T.A. More
Former Vice Chancellor, Mahatma Phule Krishi
Vidyapeeth, Rahuri, Maharashtra

Members

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Horticultural Science Division, ICAR, New Delhi

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Dr. Jai Singh Parihar
ISRO, Ahmedabad

Dr. Jyotsana Sharma
Former Acting Director
ICAR-NRC on Pomegranate, Solapur

Dr. K.N. Nagaich
RSKV, Gwalior

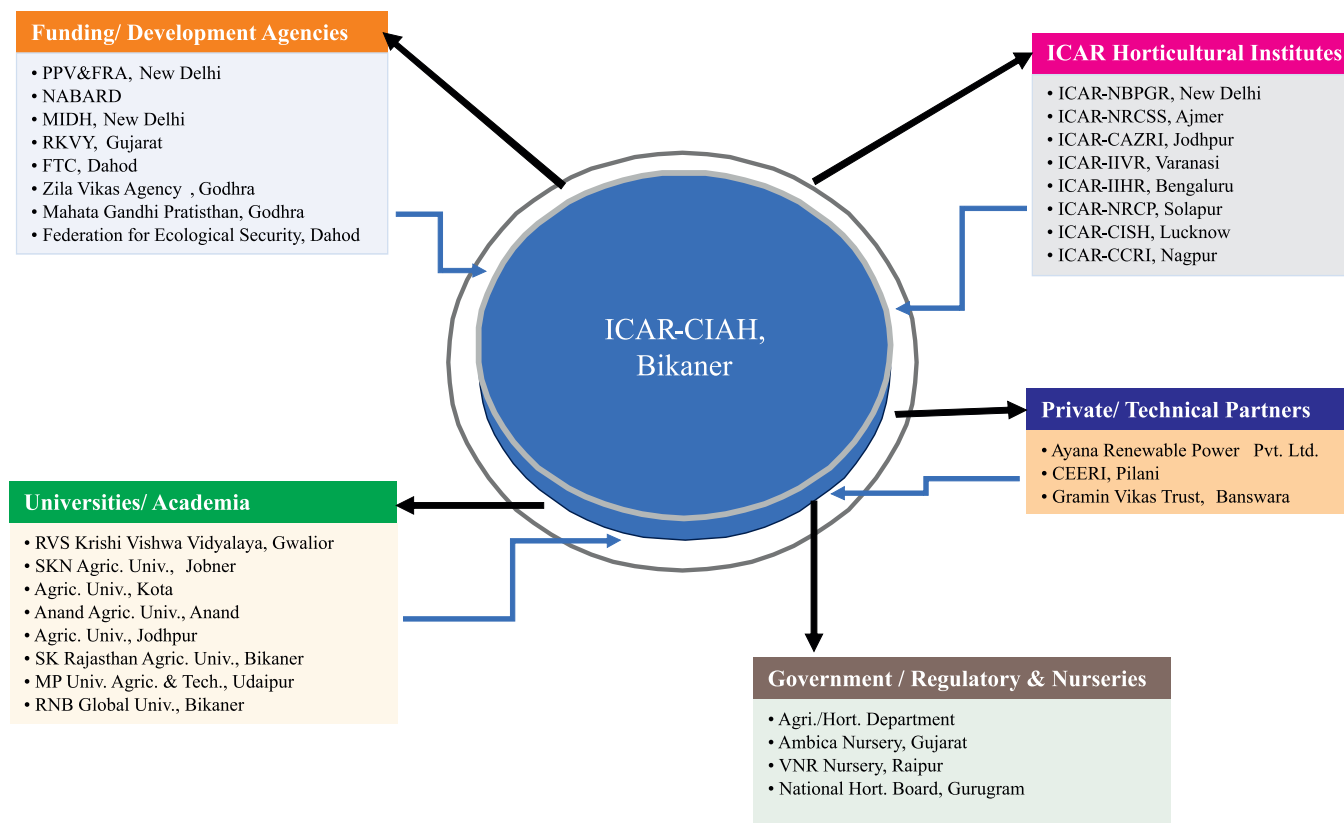
Dr. Jagadish Rane
Director, ICAR-CIAH, Bikaner

Member Secretary

Dr. D.K. Sarolia
I/c PME, ICAR-CIAH, Bikaner

RAC meeting was held at ICAR-CIAH, Bikaner during 13-14 November, 2025

11. Linkages and Collaborations



12. राजभाषा (Rajbhasha)

हिन्दी कार्यशाला का आयोजन

कलैण्डर वर्ष 2025 के दौरान संस्थान में कार्यरत अधिकारियों कर्मचारियों को हिन्दी में कार्य करने की प्रेरणा के लिए राजभाषा विभाग के निर्देशानुसार चार त्रैमासिक कार्यशालाओं का आयोजन किया गया। वर्ष 2025 की पहली कार्यशाला का आयोजन 18 मार्च को "गजल एवं गजल का फन" विषय पर किया गया था जिसमें श्री रवि शुक्ला, कार्यालय अधीक्षक, वाणिज्य शाखा, मण्डल रेल प्रबंधक कार्यालय, बीकानेर ने उपरोक्त विषय पर व्याख्यान दिया। वर्ष 2025 की दूसरी कार्यशाला का आयोजन दिनांक 30 जून को किया गया जिसमें डॉ. के.डी. आमेटा, प्राध्यापक एवं विभागाध्यक्ष (बागवानी), एमपीयूएटी, उदयपुर ने "सब्जियों की जैविक कृषि एवं मानव स्वास्थ्य" विषय पर व्याख्यान दिया। वर्ष 2025 की तीसरी कार्यशाला का आयोजन दिनांक 26 सितंबर को किया गया जिसमें श्री मोहर सिंह, पूर्व प्रधानाचार्य, राजकीय चोपड़ा स्कूल, बीकानेर ने "स्वच्छता" विषय पर व्याख्यान दिया। वर्ष 2025 की चौथी एवं अंतिम कार्यशाला का आयोजन दिनांक 24 दिसंबर को किया गया जिसमें डॉ. जी.डी. शर्मा, सहायक प्राध्यापक (मृदा विज्ञान), जनेकृषिवि, जबलपुर ने "अपशिष्ट प्रबंधन" विषय पर व्याख्यान दिया।

हिन्दी पखवाड़ा का आयोजन

संस्थान में दिनांक 12 से 26 सितम्बर 2025 तक हिन्दी पखवाड़ा आयोजित किया गया। इस दौरान 26 सितम्बर 2025 को हिन्दी कार्यशाला एवं हिन्दी पखवाड़ा समापन समारोह का आयोजन किया गया। इस कार्यक्रम के मुख्य अतिथि श्री मोहर सिंह जी, पूर्व प्रधानाचार्य, राजकीय चोपड़ा स्कूल, बीकानेर रहे एवं अध्यक्षता संस्थान के निदेशक, डॉ. जगदीश राणे ने की। समापन कार्यक्रम के मुख्य अतिथि श्री मोहर सिंह जी ने कहा कि हिन्दी न केवल भारत की राजभाषा है बल्कि यह जन-जन की भाषा है। उन्होंने कहा कि संवाद करने और अपनी बात समझाने के लिए हिन्दी भाषा एक सशक्त माध्यम है। विद्यालय में शिक्षण के दौरान भाषा से जुड़े अपने अनुभवों को भी उन्होंने साझा किया। साथ ही स्वच्छता से जुड़े होने के नाते स्वच्छता विषय पर भी प्रकाश डाला। इस अवसर पर अध्यक्षता करते हुए संस्थान के निदेशक डॉ. जगदीश राणे ने कहा कि भारत सरकार की योजना के अंतर्गत संस्थान में राजभाषा क्रियान्वयन संबंधित कार्य किया जाता रहा है एवं प्रतिवर्ष की भांति इस वर्ष भी हिन्दी दिवस के अवसर पर हिन्दी पखवाड़ा कार्यक्रम का

आयोजन किया जा रहा है। उन्होंने कहा कि इस अवसर पर हमें यह संकल्प लेना चाहिए कि अधिक से अधिक कार्य हिन्दी भाषा में करें और हिन्दी भाषा के प्रयोग को निरंतर बढ़ावा देने पर जोर दें। साथ ही संस्थान द्वारा विकसित तकनीकियों को किसानों तक पहुंचाने हेतु हिन्दी भाषा में प्रकाशन हेतु आव्हान किया। पखवाड़े के इस आयोजन में विभिन्न प्रतियोगिताएं यथा प्रश्न मंच, हिन्दी सामान्य ज्ञान, हिन्दी काव्य पाठ एवं हिन्दी निबंध लेखन रखी गयी थी जिनमें संस्थान के सभी कर्मिकों ने भाग लिया।

समापन समारोह के दौरान विभिन्न प्रतियोगिताओं में विजेताओं की घोषणा की गई जो निम्नानुसार रहे।

प्रश्न मंच प्रतियोगिता के विजेता

पुरस्कार	विजेताओं के नाम
प्रथम	टीम जी (श्री मिलन शर्मा, श्री मनोज व्यास, डॉ. एल.पी. यादव)
द्वितीय (संयुक्त रूप से)	टीम बी (डॉ. रमेश कुमार, डॉ. हनुमान राम, श्री महेश कुमार मीणा) टीम डी (श्री जितेंद्र गुर्जर, श्री राधाकिशन चौधरी, श्री नरेश कुमार) टीम ई (श्री बजरंग, श्री सूरज, सुश्री लक्की)
तृतीय (संयुक्त रूप से)	टीम ए (श्री आशुतोष, श्रीमती शिल्पा) टीम सी (श्री स्वरूप सिंह राठौड़, श्री रावत सिंह, श्री पी.आर. सिंह) टीम एफ (श्री अक्षय, श्री राजकुमार, श्री मुरली)

हिन्दी काव्य पाठ प्रतियोगिता के विजेता

वर्ग	पुरस्कार	विजेताओं के नाम
एम टी एस वर्ग	प्रथम	श्री मनोज व्यास
प्रशासनिक वर्ग	प्रथम	श्रीमती पूजा जोशी
	द्वितीय	श्री रावत सिंह
तकनीकी वर्ग	प्रथम	श्री मिलन शर्मा
	द्वितीय	श्री शिवलाल
	तृतीय	श्री महेश कुमार मीणा

वैज्ञानिक वर्ग	प्रथम	डॉ. एम.के. बेरवाल
	द्वितीय	डॉ. के.एल. कुमावत
एस आर एफ एवं वाई पी वर्ग	प्रथम (संयुक्त रूप)	श्रीमती शिल्पा श्री राधाकिशन चौधरी
	द्वितीय (संयुक्त रूप से)	श्री सूरजभान श्री लोकेश सुश्री लक्की राठौड़
	तृतीय (संयुक्त रूप से)	श्री मुरली श्री आशुतोष श्री बजरंग

हिन्दी कार्य प्रोत्साहन पुरस्कार के विजेता

श्री रावत सिंह
श्री पी.वी. नायक
श्रीमती पूजा जोशी
श्री पी.आर. सिंह
श्री स्वरूप चंद राठौड़

हिन्दी निबंध के विजेता

वर्ग	विजेता	विजेताओं के नाम
एम टी एस वर्ग	प्रथम	श्री मनोज व्यास
प्रशासनिक वर्ग	प्रथम	श्रीमती पूजा जोशी
	द्वितीय	श्री रावत सिंह
तकनीकी वर्ग	प्रथम	श्री मिलन शर्मा
	द्वितीय	श्री महेश कुमार मीणा
वैज्ञानिक वर्ग	प्रथम	डॉ. डी.के. सरोलिया
	द्वितीय	श्री आर.सी. बलाई
	तृतीय	डॉ. के.एल. कुमावत
एस आर एफ एवं वाई पी वर्ग	प्रथम	श्री लोकेश कुमार
	द्वितीय	श्री राधाकिशन चौधरी
	तृतीय	श्री नरेश कुमार

13. Distinguished Visitors

At ICAR-CIAH, Bikaner

S.No.	Date	VIP Visited
1.	24.02.2025	Dr. Mangala Rai, Former Secretary, DARE & DG, ICAR, New Delhi
2.	17.02.2025	Dr. K.S. Khokhar, Former Vice Chancellor, CCS, HAU, Hisar
3.	18.03.2025	Sh. Ravi Shukla, Divisional Railway Office Manager, Bikaner
4.	26.03.2025	Sh. Rajan Vishal, Secretary, Agriculture & Horticulture, Government of Rajasthan, Jaipur
5.	27.03.2025	Dr. A.K. Sharma, Former Professor & Head, SKRAU, Bikaner
6.	07.04.2025	Sh. Deepak Saharan, Sect. Olive Growers, Jaipur
7.	22.04.2025	Dr. D.P.S. Badwal, CEO, Agriculture & Horticulture, Jaipur
8.	19.06.2025	Dr. J.S. Sandhu, Former Vice Chancellor, SKN Agriculture University, Jobner
9.	05.07.2025	Sh. Nikhil Pareek, Director, Shrem Investment Manager Private Ltd., Mumbai
10.	08.07.2025	Sh. Subhash Bishnoi, AD, Govt. of Rajasthan
11.	08.07.2025	Sh. T.K. Joshi, Deputy Director, Hydrology Department, Bikaner
12.	30.07.2025	Dr. Sita Ram Yadav, ROCL, Lunkaransar
13.	11.09.2025	Dr. Harendra Raj Gautam, Former Head & Professor, YSP UHF, Solan
14.	11.09.2025	Dr. Pradeep Kumar Jatav, Deputy Director, NHB, Jaipur
15.	26.09.2025	Sh. Manohar Singh, Former Principal, Govt. Chopda School, Bikaner
16.	29.09.2025	Dr. O.P. Yadav, Former Director, ICAR-CAZRI, Jodhpur
17.	29.09.2025	Dr. D. Sivananda Pai, ADGM, Agronet, Advisory Services Division, New Delhi
18.	01.10.2025	Dr. A.K. Puniya, Director, NRC on Camel, Bikaner
19.	10.10.2025	Dr. M.S. Ladaniya, Former Director, ICAR-CCRI, Nagpur
20.	10.10.2025	Dr. D.G. Patil, Jain Irrigation Pvt. Ltd., Jalgaon
21.	11.10.2025	Sh. Jethanand Vyas, MLA, Bikaner West, Bikaner
22.	13-14.11.2025	Dr. Jyotsana Sharma, Former Acting Director, ICAR-NRC on Pomegranate, Solapur
23.	13-14.11.2025	Dr. Jai Singh Parihar, ISRO, Ahmedabad
24.	19.11.2025	Dr. Vishwanath Meghwal, MLA, Khajuwala, Bikaner
25.	03.12.2025	Smt. Seema Vijay, Programme Head, Doordarshan, Jaipur

At CHES, Vejalpur, Godhra

S.No.	Date	VIP Visited
1.	27.03.2025	Dr. Manish Das, Director, ICAR-DMAPR, Anand, Gujarat
2.		Dr. J.K. Patel, Directorate of Extension, AAU, Anand, Gujarat
3.		Dr. M.J. Kaledhonkar, Head, ICAR-IISWC, RS, Vasad, Gujarat
4.	28.04.2025	Dr. A.R. Kurubar, Director of Extension, UAS, Raichur, Karnataka
5.		Sh. Kalpesh Patel, Director Horticulture, Godhra, Gujarat
6.		Mr. Devesh Shukla, Founder Business Head and National Head, VNR, Nursery, Raipur, Chhattisgarh
7.	11.10.2025	Sh. Sanjaysinh Rathore, Member, Farmers' Association, Gujarat
8.		Sh. Mahideepsinh Gohil, Vice President – BJP, Kalol Taluka, Gujarat
9.		Smt. Savitaben Rathva, President, Kalol Taluka Panchayat, Gujarat



14. Personnel

Staff Position (including CHES, Vejalpur)

As on 31.12.2025

S. No.	Category	Sanctioned	In-position	Vacant
1.	RMP	01	01	Nil
2.	Scientific	44	29	15
3.	Technical	37	20	17
4.	Administration	26	17	10
5.	MTS	19	05	14
		14*	14*	00
Total	141	86	56	

*Provided by ICAR for regularization of CL (TS) and will be abolished as and when vacated.

At ICAR-CIAH, Bikaner

Dr. Jagadish Rane
Director

Scientific staff

1.	Dr. D.K. Samadia, Principal Scientist
2.	Dr. Dharendra Singh, Principal Scientist
3.	Dr. S.K. Maheshwari, Principal Scientist
4.	Dr. S.R. Meena, Principal Scientist
5.	Dr. M.K. Jatav, Principal Scientist
6.	Dr. D.K. Sarolia, Principal Scientist
7.	Dr. B.R. Choudhary, Principal Scientist
8.	Dr. Ramkesh Meena, Senior Scientist
9.	Dr. M.K. Berwal, Senior Scientist
10.	Dr. Ramesh Kumar, Senior Scientist
11.	Dr. R.P. Meena, Senior Scientist
12.	Dr. L.P. Yadav, Senior Scientist
13.	Dr. Vikas Yadav, Senior Scientist
14.	Dr. P.S. Gurjar, Senior Scientist
15.	Dr. K.L. Kumawat, Senior Scientist
16.	Sh. R.C. Balai, Scientist

17.	Dr. Chet Ram, Senior Scientist
18.	Dr. Anita Meena, Senior Scientist
19.	Dr. Lal Chand, Scientist
20.	Dr. A.K. Verma, Scientist
21.	Dr. Hanuman Ram, Scientist
22.	Dr. Pawan Kumar, Scientist
23.	Sh. M.K. Choudhary, Scientist (Study leave)
24.	Dr. Manpreet Kaur, Scientist

Administrative staff

1.	Sh. Ram Pal Verma, SAO
2.	Sh. Bharat Kumar Acharya, F&AO
3.	Sh. Kuldeep Pandey, AAO
4.	Sh. Rakesh Kumar Swami, Assistant
5.	Sh. Rajesh Daiya, Assistant
6.	Sh. P.V. Naik, Assistant
7.	Smt. Pooja Joshi, Personal Assistant
8.	Sh. Rawat Singh, UDC
9.	Sh. Gulla Ram, UDC
10.	Sh. S.C. Rathore, LDC

Technical staff

1.	Sh. Sanjay Patil, ACTO
2.	Sh. Bhoj Raj Khatri, STO
3.	Sh. Prithvi Raj Singh, TO
4.	Sh. Ashok Kumar Mali, TO
5.	Sh. B.C. Meena, TO
6.	Sh. S.L. Choudhary, STA
7.	Sh. Milan Sharma, Technician
8.	Sh. Shiv Lal, Technician
9.	Sh. Mahesh Kumar Meena, Technician

Multi Task Staff (MTS)

1.	Sh. Ghanshyam Khatri
2.	Sh. Mohan Lal
3.	Sh. Manoj Vyas

At CHES, Vejalpur, Godhra

Scientific staff

1.	Dr. A.K. Singh, Principal Scientist & I/c CHES
2.	Dr. V.V. Appa Rao, Principal Scientist
3.	Dr. D.S. Mishra, Principal Scientist
4.	Dr. Anil, Scientist
5.	Sh. Sagar N., Scientist

At ICAR-KVK, Panchmahal

	Sanctioned strength	In position	Vacant
Sr. Sci. & Head	01	01	Nil
SMS	06	03	03
T-4	03	03	Nil
T-1	02	Nil	02
Assistant	01	01	Nil
Steno-III	01	Nil	01
MTS	02	00	02
Total	16	08	08

1.	Dr. (Smt.) Kanak Lata, Sr. Scientist & Head
2.	Sh. J.K. Jadav, ACTO (Extension Education)
3.	Dr. Shakti Khajuria, ACTO (Plant Protection)
4.	Ms. Renu, ACTO (Home Science)
5.	Sh. Rakesh Meel, STO
6.	Sh. Kamlesh M. Parmar, STA (Computer Programmer)
7.	Sh. Pruthvisinh S. Gohil, STA (Lab Technician)
8.	Sh. Vishu Kamboj, Assistant

Administrative staff

1.	Sh. S.N. Patel, AAO
2.	Sh. H.S. Patel, Assistant
3.	Sh. V.R. Patani, Personal Assistant
4.	Smt. D.B. Patel, UDC
5.	Sh. D.U. Chauhan, UDC
6.	Smt. N.G. Solanki, LDC
7.	Sh. B.K. Panchal, LDC

Technical staff

1.	Sh. G.U. Trivedi, ACTO
2.	Sh. G.R. Baria, STO
3.	Sh. R.B. Baria, STO
4.	Sh. K.V. Parmar, TO
5.	Sh. B.F. Patelia, TO
6.	Sh. B.V. Rathva, TO
7.	Sh. R.V. Rathva, TO
8.	Sh. I.P. Thakor, TO
9.	Sh. S.J. Baria, TO
10.	Sh. A.S. Bilvar, Sr. Technician
11.	Sh. Chandubhai D. Rathva, Sr. Technician

New entrants

1. Sh. Ram Pal Verma joined as SAO on 01.04.2025.
2. Dr. L.P. Yadav joined as Senior Scientist (Veg. Sci.) on 29.04.2025.
3. Dr. Vikas Yadav joined as Senior Scientist (Fruit Sci.) on 14.05.2025.
4. Dr. Sagar N. joined as Scientist (Plant Pathology) on 27.10.2025 and transferred to CHES.

Promotion**Scientific staff**

S. No.	Previous position	Present position	No. of Staff
1.	Senior Scientist (RGP Rs. 9000)	Principal Scientist	01
2.	Senior Scientist (RGP Rs. 8000)	Senior Scientist (RGP Rs. 9000)	01
3.	Programme Coordinator (RGP Rs. 8000)	Sr. Scientist & Head (RGP Rs. 9000)	01
4.	Scientist (RGP Rs. 7000)	Senior Scientist (RGP Rs. 8000)	05

Administrative staff

S. No.	Previous position	Present position	No. of Staff
1.	LDC	UDC	01

Technical staff

S. No.	Previous position	Present position	No. of Staff
1.	TO (T-5)	STO (T-6)	01
2.	Technical Assistant (T-3)	Sr. Technical Assistant (T-4)	02
3.	Sr. Technician (T-2)	Technical Assistant (T-3)	01

Probation clearance & confirmation

S. No.	Category	No. of Staff
1.	Administrative	01
2.	MTS	07

Relieving on promotion/ appointment/ transfer/ deputation/ resignation

S. No.	Category	No. of Staff
1.	Scientist	02
2.	Technical	01

Superannuation/ retirement

S. No.	Category	No. of Staff
1.	Technical	02
2.	MTS	07

15. Budget

Government Grant (January-December, 2025)

ICAR-CIAH, Bikaner

(₹ in Lakhs)

Head	RE
Grant in Aid - Salaries	1772.00
Grant in Aid - General (Pension & retirement benefits)	312.00
Grant in Aid General (excluding pension & retirement benefits)	400.00
Grant in Aid - Capital	10.00
Total	2494.00
SCSP Scheme	
Grant in Aid General (excluding pension & retirement benefits)	5.00
Grant in Aid - Capital	0.00
Total	5.00
TSP Scheme	
Grant in Aid General (excluding pension & retirement benefits)	50.00
Grant in Aid - Capital	0.00
Total	50.00

Under AICRP on AZF

(₹ in Lakhs)

Head	RE
Grant in Aid - Salaries	1200.00
Grant in Aid General (excluding pension & retirement benefits)	120.00
Grant in Aid - Capital	0.00
Total	1220.00
SCSP Scheme	
Grant in Aid General (excluding pension & retirement benefits)	30.00
Grant in Aid - Capital	0.00
Total	30.00
TSP Scheme	
Grant in Aid General (excluding pension & retirement benefits)	10.00
Grant in Aid - Capital	0.00
Total	10.00

Revenue Generation

(₹ in Lakhs)

S.No.	Head	Amount
1.	Sale of farm produce	15.69
2.	Interest on STD	5.39
3.	License fee	1.12
4.	Interest on loans and advances	0.92
5.	Miscellaneous (guest house, water & electricity charges, etc.)	7.19
Total		30.31

16. Seed and Planting Material (Jan.-Dec., 2025)

At ICAR-CIAH, Bikaner

a. Planting material sold

S. No.	Crop	No. of plants sold
Under Seed Project		
1.	Ber (Budded)	8
2.	Khejri (Budded)	33
3.	Mulberry (Thar Lohit)	412
4.	Mulberry (Thar Harit)	334
5.	Jamun (Seedling)	224
6.	Pomegranate	972
7.	Pomegranate (Sholapur Lal)	81
8.	Acid lime	2001
9.	Lasoda	772
10.	Karonda	1252
11.	Bael (Seedling)	340
12.	Guava	17
13.	Fig	27
14.	Rose	44
15.	Moringa	43
16.	Meetha Neem	42
17.	Budstick	92
18.	<i>Aloe vera</i>	2
19.	Cactus	410
20.	Boa gainvillea	886
21.	Nag Champa	65
22.	Kumut	133
23.	Ashwagandha	20
24.	Adusa	57
25.	Chandni	210
Total		8477

Under Institute		
1.	Khejri (Budded)	1334
2.	Aonla (Budded)	589
Total		1923

b. Vegetable seed produced and sold

S. No.	Crop & variety	Seed produced (kg)	Seed sold including previous stock (kg)
Under Seed Project			
1.	Kachari (Thar Kasturi)	63.0	57.0
2.	Sanpmelon (Thar Mahak)	60.0	54.0
3.	Cluster Bean (Thar Bhadavi)	225.0	215.0
4.	Bottle Gourd (Thar Samridhi)	4.30	3.80
5.	Palak (Thar Hariparna)	7.00	6.50
6.	Sponge gourd (Thar Tapish)	16.0	15.0
7.	Brinjal (Thar Rachit)	4.95	4.85
8.	Cowpea (AHCP-1-4-1 & AHCP-2-3)	16.50	16.0
Total		396.75	372.15
Under Institute			
1.	Ridge gourd (Thar Karni)	72.50	67.50
2.	Longmelon (Thar Sheetal)	3.60	3.00
Total		76.1	70.5

At CHES, Vejalpur, Godhra

Planting material produced and sold

S. No.	Name of crop	No. of plants produced	No. of plants sold
1.	Mango (Grafted)	4870	4313
2.	Mango (Seedling)	12235	-
3.	Aonla (Budded)	-	03
4.	Jamun (Grafted)	1239	1186
5.	Jamun (Seedling)	7270	-
6.	Karonda (Seedling)	1314	48
7.	Pomegranate	335	309
8.	Bael (Budded)	2578	2946
9.	Custard apple (Grafted)	527	622
10.	Lime (Seedling)	1790	1512

11.	Guava (Air layered)	1250	1200
12.	Moringa (Seedling)	2490	1235
13.	Chironji (Seedling)	25	20
14.	Karonda (Seedling)	1314	48
15.	Lasoda (Seedling)	-	58
16.	Rayan (Grafted)	05	02
17.	Tamarind (Seedling)	100	-
18.	Wood apple (Seedling)	140	07
19.	Kagzi lime (Air layered)	410	400
20.	Guava (Seedling)	350	-
Total		38242	13909

17. Varieties Notified During 2025

Varieties notified and recommended by SVRC



Non dessert melon-Kachri (Thar Kasturi)

Very early in harvesting and fruits are ready for picking in 65-70 days after sowing, Yields 95-100 q/ha. Fruits are small, egg shaped weighing 50-60 g. No disease and pest occurrence in hot arid climate. Recommended for commercial cultivation in Rajasthan.



Khejri (Thar Shobha)

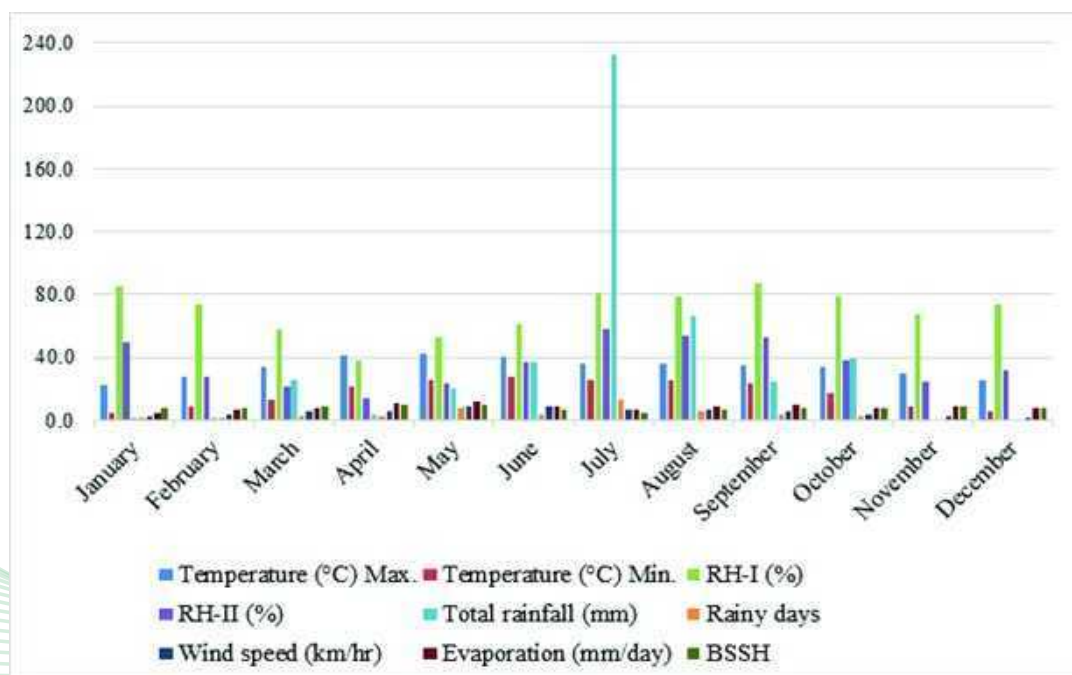
Early in harvesting. A 7-8 year old tree produced 4.25 kg/ tree Sangri (green pods) and 7.22-8.15 kg/ tree Loong (dry leaves). Tender pods at marketable stage are light green, straight, roundish-flat weighing 0.85 to 1.80 g. Tolerates extremes of high (48°C) and low (-4°C) temperature. No disease and pest occurrence in hot arid climate. Recommended for commercial cultivation in Rajasthan.

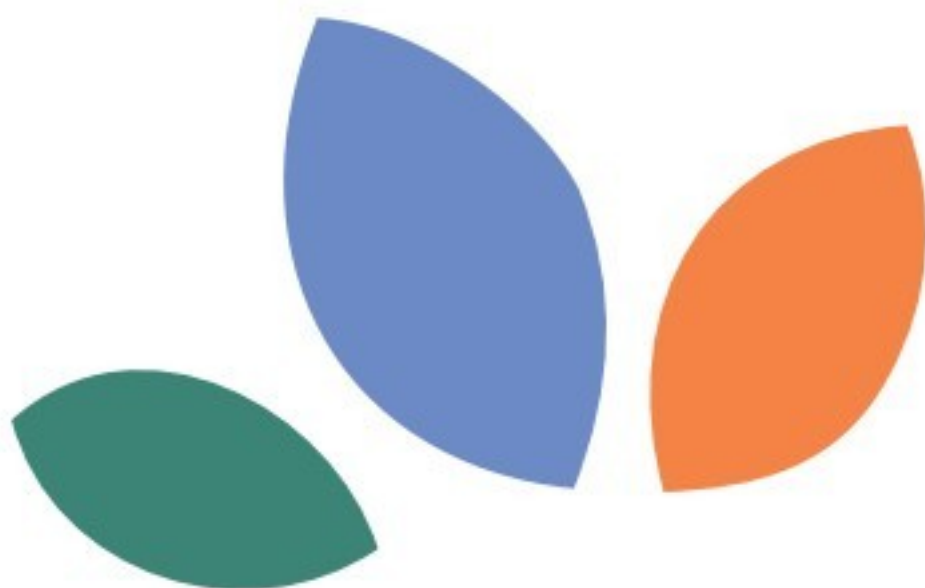
18. Meteorological Data

Monthly weather data from January 2025 to December 2025*

Month	Temperature (°C)		Relative humidity (%)		Total rainfall (mm)	Rainy days	Wind speed (km/ hr)	Evaporation (mm/day)
	Max.	Min.	RH-I	RH-II				
January	22.8	4.9	85.4	49.8	1.0	1.0	2.3	4.7
February	27.3	8.7	73.8	27.1	1.0	1.0	3.5	6.6
March	33.4	13.4	57.8	21.5	25.4	2.0	5.1	7.6
April	41.7	21.0	38.2	14.0	3.8	3.0	5.7	11.2
May	42.2	26.0	53.1	23.5	20.0	8.0	8.5	11.6
June	40.6	27.2	61.4	37.3	36.8	4.0	8.8	9.2
July	36.1	25.8	80.7	57.9	232.3	13.0	6.4	6.4
August	35.7	25.8	79.0	53.8	66.2	6.0	6.8	8.3
September	34.9	23.1	87.1	52.5	24.6	4.0	5.1	9.3
October	33.5	16.9	79.0	37.6	39.4	2.0	3.1	7.8
November	29.9	8.6	67.8	24.2	0	0.0	2.4	8.5
December	25.2	5.6	73.9	31.7	0.0	0.0	1.9	7.3
Average	33.6	17.3	69.8	35.9	450.5	44.0	5.7	8.2

*Data received from Agricultural Research Station (SKRAU), Bikaner





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