वार्षिक प्रतिवेदन
ANNUAL REPORT
2023



भाकृअनुप – केन्द्रीय शुष्क बागवानी संस्थान
बीकानेर-334 006 (राजस्थान)
ICAR-Central Institute for Arid Horticulture
Bikaner-334 006 (Rajasthan)

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PREFACE

India has seen remarkable gains in horticultural crop production in recent years, with significant contributions from agroclimatic zones that are less-ecologically challenged. However, despite extreme conditions, the desert agro-ecosystem has also experienced notable expansion in area and an increase in horticultural production. This growth has contributed to improvements in food, nutritional, health, and livelihood security in the region. The development in horticulture and allied sectors has enabled the country to achieve self-reliance in food security.

The ICAR-Central Institute for Arid Horticulture (CIAH) in Bikaner, Rajasthan, along with its regional station in Vejalpur, Godhra, Gujarat, has been at the forefront of research and development in the arid and semi-arid regions of the country. Their pioneering work spans basic, strategic, anticipatory, and applied research on various aspects of fruits and vegetables. Over more than three decades, ICAR-CIAH has identified over 60 varieties of 30 diverse horticultural crops and has licensed technologies to various clients, paving the way for entrepreneurship in the field of arid horticulture. In 2023, the Institute Variety Identification Committee identified 13 varieties of nine crops. A watermelon variety, AHW/BR-37 (Thar Tripti), was identified for release in Agro-climatic Zone VII during the 41st Annual Group Meeting of AICRP - Vegetable Crops. The institute has also initiated research in close collaboration with NRCSS, Ajmer. Accelerated the efforts to optimize tissue culture protocol for mass propagation of date palm.

During the year, six technologies were commercialized based on the demand raised by firms during industrial meet organised by ITMU. Under the outreach programmes, 781 farmers got benefits of 17 different trainings conducted by the institute's scientists under SCSP Scheme. About 2600 farmers got benefits of various programs conducted under TSP. The institute facilitated the technology exposure visits to more than 6700 participants including farmers, students, start-ups, entrepreneurs, *etc*. on different occasions. Training cum demonstration on drone were organized in farmer's field. The KVK, Panchmahal significantly contributed to dissemination of technologies through OFT (06), FLD (12), method demonstration (66), training programmes (69), exhibition (06), field day (04), Kisan Mela (02) and celebration of national and international events (07) involving 4139 tribal farmers.



The institute also witnessed expansion of its infrastructures for high end research and services with the Post Entry Quarantine (PEQ) facility for date palm. Hon'ble Vice-President of India, Sh. Jagdeep Dhankhar inaugurated the newly constructed Trainees House in the gracious presence of Sh. Kailash Choudhary, Hon'ble Union Minister of State for Agriculture and Farmers Welfare and Dr. Himanshu Pathak, Secretary, DARE & Director General, ICAR, New Delhi on 27th September, 2023.

I place on record our sincere thanks to Dr. Himanshu Pathak, Secretary, DARE & Director General, ICAR for constant support and guidance. I also express my gratitude to Dr. A.K. Singh and Dr. T.R. Sharma who extended their guidance as DDGs (Horticultural Science). Thanks are also due to Dr. V.B. Patel, ADG (Fruits and Plantation Crops) who extended his support to the institute.

The institute is indebted to Chairpersons and members of different nodal committees (QRT, RAC, IRC, IMC, *etc*.) who have rendered their suggestions for the overall development of the institute. The institute is also thankful to all the Central and State Govt. Agencies which have provided assistance for undertaking different research and developmental activities.

My gratitude to all the staff and especially the publication committee for bringing out this important publication within the stipulated time.

Place: Bikaner

Dated : February, 2024

(Jagadish Rane)
Director
ICAR-CIAH

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EXECUTIVE SUMMARY

This chapter enumerates the salient achievements of ICAR-CIAH made in the year 2023.

Genetic Resources and Crop Improvement

ICAR-CIAH is recognized by the National Active Germplasm Site (NAGS) as the nodal centre for the management of arid fruit and vegetable plant genetic resources in the country. The institute have a total of 1733 viable germplasm of different arid fruit and vegetable crops. Maintained and conserved 1619 germplasm during the year 2023. Collected a total of 53 germplasm of different fruits and vegetables and conserved in field gene bank. Deposited 47 germplasm to ICAR-NBPGR comprising guava (23), lime (12), pomegranate (05) and vegetable cowpea (07).

During the year, identified thirteen promising varieties viz., Thar Gauri and Thar Bhavya (bael), Thar Vaibhav (citrus), Thar Rashmi (tamarind), Thar Prabha (wood apple), Thar Tejas (drumstick), Thar Varsha (spine gourd), Thar Dipti (ivy gourd), Thar Vinaya, Thar Lakshmi (dolichos bean) and Thar Prateeksha, Thar Deeksha, Thar Surya (yardlong bean) through IVIC. One variety of watermelon (AHW/BR-37, Thar Tripti) has been identified for release in Agro-climatic Zone VII (Semi-arid Lava Plateaux and Central High Lands) through AICRP (VC).

Among the three elite germplasm of *Ziziphus mauritiana*, the BCIAH-1 was found to be tolerant to low temperature with 18.3 g fruit weight and 18°B TSS. Screened 318 germplasm of ber against low temperature and observed that the Tikadi suffered the least damage and Thai ber was found to be highly sensitive to frost. In another investigation on the frost-sensitivity among 27 ber genotypes, the study revealed varying degrees of frost sensitivity indicating a genetic variation in the frost sensitivity pattern. Identified two distinct genotypes with contrasting features in response to the frost for further studies. Thai Ber suffered the most severe damage that ultimately led to complete drying of both the sylleptic and the proleptic shoots on the plants. Conversely, Tikadi remained unaffected, without any adverse effect of frost.

Evaluated 164 seed progenies of Jharber (*Z. nummularia*) for various horticultural traits and selected 15 elite type based on horticultural and biomass harvest potential. R21P1 and R26P2 were found most promising for processing attributes. Fruits of the genotype, R26P2 (CIAH ZN-02) could be harvested in the second to third week of November.

Attempted a total of 458 reciprocal crosses between Kathaphal and Thai ber to enhance genetic variability. Among the attempted crosses, only sixteen crosses were successfully resulted in fruit set, accounting for 3.5 per cent of the total attempted crosses. Eight intra-specific cross combinations between *Z. mauritiana* and *Z. nummularia* resulted in 5.57% ripened fruits. Other fruits developed only partially and dropped off 7-15 days after pollination. Three inter-specific cross combinations and 106 controlled pollination attempts resulted in 2 fruits (1.89%) that ripened to maturity. Maximum fruit set was recorded in *Z. mauritiana* var. Gola x *Z. nummularia* cross combination (11.43%).

Seventy pomegranate germplasm were evaluated under hot arid condition. The maximum number of fruits per plant was obtained in Bhagwa (72.33). The maximum TSS was recorded in Saih Sirin (18.05°Brix). The maximum fruit weight was recorded in Jalore Seedless (289.11 g). The rind colour of CIAH PG-1 was light red while, it was purple in CIAH PG-4. The rind anthocyanin content was significantly high in CIAH PG-4 (911.21 mg/kg) followed by Mridula (510.09 mg/kg) compared to Jalore Seedless (42.49 mg/kg). Aril colour was blood red in CIAH PG-1 and Mridula. CIAH PG-1 recorded the boldest aril with the highest weight (37.85 g/100 arils).

Attempted a total of 154 crosses among Jalore Seedless, Bhagwa, Mridula, CIAH PG-4 and AHPG C-1. The fruit set ranged from 11.11% to 30.30%. Maximum fruit set was recorded in cross of Jalore Seedless x Bhagwa (30.30%) while, it was minimum in cross of Mridula x Jalore Seedless (11.11%).

A total of 65 date palm genotypes were maintained and evaluated. From these, thirty-seven genotypes of diverse origins were characterized for 26 morphological traits. Among the male palms, CIAH-DP-M1 was found superior in production of pollen grain per plant.

Evaluation of sweet orange genotypes resulted in identification of four elite lines for specific traits like peel colour, maturity time, seeds number, sweetness, *etc.* The elite lines were CIAHSO-24/17, CIAHSO-22/15, CIAHSO-21/15 and CIAHSO-21/9. Among the 19 cultivars of sweet orange, Satgudi performed well under hot arid

environmental conditions. Also made inter-specific hybrids between Satgudi (sweet orange) and Red Ruby (grapefruit) to develop the desirable segregants for fruit size and flesh colour.

Among the 14 genotypes of aonla, CHESA-4 was found promising and produced the maximum yield per plant (52.10 kg) under rainfed semi-arid conditions. Twenty-one seedling germplasm were also maintained in field repository. The tree growth was observed semi-spreading (CHESA-1, CHESA-2 and CHESA-10), tall upright (CHESA-7 and CHESA-8), tall spreading (CHES-5 and CHESA-6) and semi-drooping in CHESA-4 under rainfed conditions of western India. The foliage density was observed dense and sparse in different genotypes.

In bael, recorded heavy bearing in B-14, B-15 and B-16 genotypes under hot arid conditions. Among the genotypes, B-11 produced fruits with better physical attributes in terms of fruit weight, fruit size and pulp weight. Based on the desirable horticultural traits identified CHESB-31 as elite bael genotype.

Among red fleshed guava, selected H-1 (CHESG-15 x Thai), H-2 (CHESG-15 x Thai) and CHESG-15 as superior genotypes whereas in white flesh segment, CHESG-38 and CHESG-39 were found superior.

Among the evaluated genotypes of acid lime, CHESL-15, CHESL-29 and CHESL-32 were found promising with respect to different horticultural traits. Among the 30 germplasm of Manila tamarind, the earliest flowering was observed in CHESM-4 with maximum fruit weight (30.25 g) and pulp (73.10%)

In evaluation of wood apple germplasm, CHESW-27 showed early bearing with green colour fruit at maturity. CHESW-29 showed very precoucious character *i.e*. bearing has initiated just in 3rd year of planting as erect terminal bearing. Thirty-six custard apple germplasm were evaluated and the maximum pulp content was noted in CHESCA-31 (68.22%). The CHESCA-44 and CHESCA-52 has yellow to pinkish yellow colour with TSS more than 28°Brix.

CHEST-11 of tamarind was found promising and regular bearer. It produced 50.98 kg fruit yield per plant, pulp content (53.0%) and TSS (70.0°Brix). In chironji genotypes, CHESC-2 produced fruits weighing 1.20 g with 23.20°Brix TSS, 12.20% total sugar and 48.0 mg/100g vitamin C. The CHESK-3 of karonda was found promising having red coloured fruits at the time of maturity.

Studied the Khejri Selection-3 for pod quality, sangri yield and picking intervals in response to the pruning practices of mother tree and in-situ bud-grafting performed for evaluation.

Selected trait specific genotypes of chilli *viz*., CIAH/CH-1 and CIAH/CH-2. Both the lines were found promising under heat stressed arid environment.

Recorded a wide range of variations with respect to pod shape, size and colour among 59 germplasm of Indian bean.

Identified two lines of cowpea viz., AHCP-1-4-1 (IC-0625644) and AHCP- 2-3 (IC-0628910) for photo-thermo insensitive. Both lines were able to flower and set pods at temperatures as low as 10°C during winter month (November) and as high as 46°C during summer months (April-June) under hot arid climate.

The trait specific genotype of cluster bean, AHG-23 (CIAH-23) produced pod yield of 135-210 q/ha. It was found suitable for rainfed cultivation under resource constraint hot arid environment and can also be cultivated during summer with minimal irrigation. Investigation on inheritance studied in F_2 population (267 plants) of watermelon (AHW/BR-22 x YF 5-2-7 F_2) was undertaken for leaf shape, fruit shape and flesh colour traits.

Seven round melon genotypes were studied for prioritized traits. The performance was found repeatedly very poor as summer season crop under hyper arid climate. Germplasm maintenance of bottle gourd (10-12 year old seeds) was performed. Out of 52 genotypes, the 28 germplasm lines performed well under field conditions and seed enhancement is materialized.

The trait specific elite germplasm of drumstick namely CHESD-34, CHESD-40, CHESD-42, CHESD-45, CHESD-50 and CHESD-52 were evaluated for important horticultural traits. The 26 gynoecious accessions of ivy gourd and 21 genotypes of spine gourd were evaluated for their different morphological and quality traits.

Identified promising genotypes of dolichos bean viz., CHESDB-10 (creamy whitish green pods) and CHESDB-40 (purple colour pods). In vegetable cowpea CHESVC-22, CHESVC-27, CHESVC-46, CHESVC-45 and CHESVC-20 (bush type) were found superior with respect to fresh number of pods and pod yield. CHESCB-60, CHESCB-59, CHESCB-25 and CHESCB-24 genotypes of cluster bean were found

superior for fresh number of pods and pod yield.

Biotechnological and Biochemical Studies

Analysed 77 abiotic stress responsive genes from different plant species including watermelon by PCR amplification in Tumba. Out of 77 selected genes, 23 genes were positively amplified in Tumba *(Citrullus colocynthis)* and further screened for their root tissue specific expression.

The DNA fingerprinting and molecular characterization of 11 watermelon genotypes including five advance breeding lines and six varieties were done using 34 SCoT markers. The molecular characterization of 9 ker germplasm was carried out utilizing 15 SCoT markers. All markers produced 84 alleles with mean of 5.6 alleles per marker among the tested ker genotypes which showed substantial level of polymorphism.

The highest protein content (18.79±0.17%) was observed in khejri pods (sangri) harvested at 15 days after fruit set. The protein content reached a minimum of 13.86±0.01% after 45 days of pod setting. Fiber content was considerably lower in initial pod developmental stages and varied from 13.55±0.48 to 11.77±0.04%. The maximum amount of phenols, flavonoids and total antioxidants was observed in sangri harvested at 10 and 15 days after fruit set.

Crop Production

The growth, yield attributes, and juice quality parameters of Kinnow mandarin fruit were significantly influenced by the rootstocks. The heaviest fruit weight was recorded on Pectinifera, which was at par with Rough Lemon and Sour Orange. However, the number of fruits and yield were relatively higher on Sour Orange and Rough Lemon. Preliminary experiments, revealed that plants raised on Pectinifera rootstock tend to have more accumulation of osmolytes during water stress experienced during summer.

Identified a range of promising citrus varieties for ensuring the availability of high-quality fresh fruit in the market for approximately 8-10 months of the year under arid conditions. It was possible due to inclusion of sweet orange varieties Satgudi, Mosambi, Jaffa, and Blood Red Malta, which lead to the extended duration of harvesting that spans from September to January. Additionally, newly identified genotypes like CIAHSO-21/9, CIAHSO-21/15, CIAHSO-22/15 and CIAHSO-24/17 have contributed to widening the harvesting window.

The physico-chemical characters of ber cv. Gola were found to be superior with the application of vermicompost (20 kg/plant)+biofertilizers. It gave higher fruit diameter (3.42 cm), pulp fresh weight (22.25 g), TSS (26.55°Brix) and vitamin C (212.50 mg/100g). This treatment resulted in higher yield (14.90 kg/plant), enzymes activity *i.e.* dehydrogenase (8.15 µg TPF g^{-1} dry soil h^{-1}), alkaline phosphatase (8.25 µg p-NP g^{-1} dry soil h^{-1}) and urease (395 µg NH3-1 g dry soil h^{-1}).

In an experiment, recorded the minimum fruit drop (94.10%) and sun scald (17.85%) with the highest fruit retention (5.50%) with grass mulch+NAA (15 ppm)+course cotton cloth in bael cv. Goma Yashi. The maximum fruit weight (1.35 kg), yield per plant (82.0 kg) and TSS (38°Brix) was recorded in bael cv. Goma Yashi by maintaining canopy at 3 m plant height with pruning of 25% annual growth extension under rainfed semi-arid conditions.

The optimal yield of coriander variety ACr-1 (8.28 t/ha) was achieved with the treatment comprising 0.5EC salinity, along with a combination of 50% FYM and 50% vermicompost supplemented by a foliar spray of micronutrient ($ZnSO_4$ @ 0.5%) and soil application of $FeSO_4$ @ 0.5%. The maximum yield of spinach variety Thar Hariparna was observed in the treatment of salinity 4 EC (IW)+100% NPK+FYM with a production of 202.15 q/ha. In radish experiment, it was observed that vegetative growth and yield remained relatively high even under high salinity conditions (4EC) when supplemented with 100% NPK (inorganic) along with FYM and yielded 219.8 q/ ha. The highest level of ascorbic acid (28.73 mg/100 g FW) was recorded in the treatment involving 0.5EC irrigation water combined with 100% NPK+FYM.

The soilrite media was found suitable for vegetative multiplication of ker with respect to sprouting, rooting and growth of cuttings made from apical shoots. The success has been achieved in the vegetative propagation of Gondi (*Cordia gharaf)* through semi-hard wood cutting using IBA and soilless media.

Among the pollination methods of date palm cv. Halaway, pollen suspension and dusting pollination methods exhibited the maximum fruit weight (9.3 and 9.8 g), fruit length (38.1, 37.8 mm) and fruit width (19.6, 19.7 mm). The maximum number of fruit retention at pea stage was recorded in the cotton bud (27.0%) and dusting method

(26.0%). The maximum fruit set was recorded in the pollen suspension (81.8%) followed by strand placement (79%) method. The pollen suspension method resulted in maximum bunch weight (7.5 kg/ bunch).

The seed hydro-priming studies in ridge gourd (Thar Karni) recorded the maximum seed germination in the seeds hydro-primed for 36 hours with most vigorous seedlings in terms of seedling vigour index-I (2011.62) and II (81.57).

Developed and validated a nursery raising technology for round the year vegetable seedling production in hot arid region. Cot-type iron frames were fixed on raised beds (50-60 m^2 plot area on a pair bed of 25 m x 01 m size). After seed sowing, the frames were covered with transparent polythene (120-200 gauge) and 40 mesh insect-proof nylon-net during winter and summer season, respectively to get healthy seedlings.

Crop Protection

Screened 32 germplasm of date palm for tolerance against Alternaria leaf spot caused by *Alternaria alternata.* Disease incidence (PDI) of Alternaria leaf spot ranged from 2.72 to 28.53%. The minimum disease incidence was recorded in Khuneizi (2.72%), Samran (4.62%), Bhukso (4.31%) and Chip-Chap (4.98%). It was found to be maximum in Medzool (28.53%) followed by Halawy (25.62%) and Nagal (20.48%) under field conditions. During the investigation, isolated phytopathogenic fungus causing dry root disease in vegetable cowpea and cluster bean. Isolated pure culture of fruiting bodies of native mushroom naturally occurring in hot arid region.

Post-harvest Management and Value Addition

The post-harvest treatment of melatonin concentration (200 and 500 µM/L) improved the percentage of firm fruits, delayed weight loss, reduce decay, extend freshness and prevent colour change from light green/ yellow to brown in ber cv. Gola stored at room temperature.

Snapmelon puree stored in refrigerated conditions retained significantly higher levels of ascorbic acid (11.31 mg/100g) and β-carotene (1.72 µg/100g) compared to stored at ambient conditions. Refrigeration also effectively preserved the total phenols, flavonoids and antioxidant properties of snapmelon puree. A protocol for extraction of bael pulp and its storage was developed. The bael pulp can be stored at 5°C temperature without compromising its quality for long period. Developed the processing methods for ker fruits through brining and freeing and recorded the storage life of 10-12 month in both the methods.

Agricultural Extension

The expansion in area and production of date palm and pomegranate cultivation in arid region was studied. Bikaner district ranked at first position in area (344 ha) of date palm followed by Jaisalmer (221 ha), Sri Ganganagar (198 ha), Barmer (168 ha) and Hanumangarh (153 ha). The maximum area under pomegranate was recorded in Barmer district (7813 ha) followed by Jalore (3194 ha), Bikaner (1636 ha), Jodhpur (394 ha), Jaisalmer (376 ha) and Pali (301).

The economic impact of date palm and pomegranate adoption was also assessed. With the increase in date palm area, the net income of all date palm growing farmers of the hot arid region of Rajasthan in 2023 was estimated as 11.60 crore. Likewise, net income of all pomegranate growing farmers of the hot arid region of Rajasthan increased from 13.23 crore/ year in 2017 to 16.10 crore/year in 2023.

कार्यकारी सारांश

इस अध्याय में भाकृअनुप-केन्दीय शुष्क बागवानी संस्थान, बीकानेर द्वारा वर्ष 2023 में की गई प्रमुख अनुसंधान उपलब्धियों का वर्णन किया गया है।

आनुवंशिक संसाधन एवं फसल सुधार

भाकृअनुप- केन्दीय शुष्क बागवानी संस्थान, बीकानेर को राष्ट्रीय सक्रिय जननद्रव्य स्थल (N A G S) के लिये देश में शुष्क फल और सब्जी पौधों के आनुवंशिक संसाधनों के प्रबंधन के लिए नोडल केंद्र के रूप में मान्यता प्राप्त है। संस्थान के पास विभिन्न शुष्क फल और सब्जी फसलों के कुल 1733 सक्रिय जननद्रव्य उपलब्ध हैं। वर्ष 2023 के दौरान 1619 जननद्रव्य का रखरखाव और संरक्षण किया गया। विभिन्न फलों और सब्जियों के कुल 53 जननद्रव्य एकत्र किए गए और प्रक्षेत्र जीन बैंक में संरक्षित किए गए। आईसीएआर-राष्ट्रीय पादप आनुवंशिक संसाधन ब्यूरो, नई दिल्ली, 47 जननद्रव्य जमा किए गए जिनमें अमरूद (23), नींबू (12), अनार (05) और सब्जी लोबिया (07) शामिल हैं।

वर्ष के दौरान, संस्थान स्तर पर 13 उन्नत किस्मों की पहचान की गई, जिनमे बेल की थार गौरी व थार भव्या, निबू की थार वैभव, इमली की थार रश्मी, कैंथ की थार प्रभा, सहजन की थार तेजस, ककोडा की थार वर्षा, कुंदरु की थार दीप्ति, सेम फली की थार विनय, थार लक्ष्मी व थार प्रतीक्षा तथा यार्डलॉन्ग बीन की थार दीक्षा व थार सूर्या की पहचान की गयी। तरबूज की एक किस्म (एएचडब्ल्यू/बीआर-37; थार तृप्ति) को एआईसीआरपी (सब्जी फसल) के द्वारा कृषि-जलवायु क्षेत्र VII (अर्ध-शुष्क लावा पठार और केंद्रीय उच्च भूमि) के लिये पहचान की गई।

बेर के तीन उत्कृष्ट जननद्रव्य में से, BCIAH-1 निम्न तापमान को सहन करने वाला पाया गया जिसके फलों का वजन 18.3 ग्राम और कुल घुलनशील ठोस पदार्थ 18° ब्रिक्स पाया गया। कम तापमान में बेर के 318 जननद्रव्यों का मुल्यांकन किया गया तथा पाया गया कि टिकड़ी को सबसे कम नुकसान हुआ है तथा थाई बेर पाले के प्रति अत्यधिक संवेदनशील पाया गया। पाले के प्रति संवेदनशीलता के एक अन्य अध्ययन में बेर के 27 प्रकारों में आनुवंशिक भिन्नता पाई गई एवं विभिन्न स्तरों का पता चला, जो पाले के प्रति संवेदनशीलता के प्रतिरूप में आनुवंशिक भिन्नता का संकेत देता है। आगे के अध्ययन के लिए पाले के प्रति प्रतिक्रिया में विपरीत विशेषताओं वाले दो अलग जननद्रव्यों की पहचान की गई। थाई बेर को सबसे अधिक नुकसान हुआ, जिसके कारण अंततः पौधों पर सिलेप्टिक और प्रोलेप्टिक दोनों टहनियां पूरी तरह सूख गईं।

विभिन्न बागवानी विशेषताओं के लिए झारबेर (*ज़िज़िफस न्यूमुलोरिया*) की 164 बीज संततियों का बागवानी गुणों के लिये मूल्यांकन किया गया तथा बागवानी और बायोमास फसल क्षमता के आधार पर 15 विशिष्ट प्रकारों का चयन किया गया। प्रसंस्करण विशेषताओं के लिए R21P1 और R26P2 को सबसे अधिक आशाजनक पाया गया। जननद्रव्यों, R26P2 (CIAH ZN-02) के फलों की कटाई नवंबर के दूसरे से तीसरे सप्ताह में की जा सकती है।

आनुवंशिक विभिन्नता बढाने के लिये काठाफल और थाई बेर के बीच कुल 458 पारस्परिक संकरण किये गये। किए गए पारस्परिक संकरणो में से, केवल 16 में सफलतापूर्वक फल स्थापित हुए, जो कुल प्रयास किए गए संकरण का 3.5 प्रतिशत था। *ज़िज़िफस मौरिटियाना* और *ज़िज़िफस न्यूमुलेरिया* के बीच आठ अंतर-विशिष्ट संकरण संयोजनों के 5.57% फल पके। अन्य फल केवल आंशिक रूप से विकसित हुए और परागण के 7-15 दिनों के बाद झड़ गए। तीन अंतर-विशिष्ट संकरण और 106 नियंत्रित परागण प्रयासों के परिणामस्वरूप 2 फल (1.89%) परिपक्व हुए। अधिकतम फल जमाव *ज़िज़िफस मौरिटियाना* प्रजाति गोला x *ज़िज़िफस न्यूमुलेरिया* संयोजन (11.43%) में दर्ज किये गये।

गर्म शुष्क परिस्थितियों में 70 अनार के जननद्रव्यों का मूल्यांकन किया गया। प्रति पौधे फलों की अधिकतम संख्या भगवा किस्म में (72.33) प्राप्त हुई। अधिकतम कुल घुलनशील ठोस पदार्थ साह सिरिन किस्म में (18.05° ब्रिक्स) दर्ज किया गया। अधिकतम फल वजन जालोर सीडलेस किस्म मे (289.11 ग्राम) दर्ज किया गया। CIAH PG-1 के छिलके का रंग हल्का लाल था, जबकि CIAH PG-4 में यह बैंगनी था। CIAH PG-4 (911.21 mg/kg) में छिलके में एंथोसायनिन की मात्रा काफी अधिक थी, उसके बाद जालोर सीडलेस किस्म में (42.49 mg/kg) तथा मृदुला किस्म में (510.09 mg/kg) पायी गयी। CIAH PG-1 और मृदुला में बीज का रंग रक्त जैसा लाल था। CIAH PG-1 किस्म में सबसे अधिक वजन (37.85 ग्राम/100 बीज) के साथ सबसे बडा बीज दर्ज किया गया।

जालोर सीडलेस, भगवा, मृदुला, CIAH PG-4 और AHPG C-1 के बीच कुल 154 संकरण बनाये गये। फलों का जमाव 11.11% से 30.30% तक रहा जो कि जालोर सीडलेस x भगवा में अधिकतम (30.30%) दर्ज किया गया, जबकि मृदुला x जालोर सीडलेस में सबसे कम (11.11%) पाया गया।

खजूर के कुल 65 जननद्रव्यों का रख-रखाव एवं मूल्यांकन किया गया। इनमें से विविध उत्पत्ति के 37 जननद्रव्यों को 26 रूपात्मक लक्षणों के लिए चित्रित किया गया। नर खजुर (CIAH-DP-M1) परागकण के उत्पादन में बेहतर पाया गया।

संतरा के जननद्रव्यों के मूल्यांकन के परिणामस्वरूप छिलके के रंग, परिपक्वता के समय, बीज की संख्या, मिठास आदि जैसे विशिष्ट लक्षणों के लिए चार विशिष्ट लाइनो की पहचान की गई जो कि CIAHSO-24/17, CIAHSO-22/15, CIAHSO-21/15 और CIAHSO-21/9 थीं। संतरा की 19 किस्मों में से, सतगुडी ने गर्म शुष्क पर्यावरणीय परिस्थितियों में अच्छा प्रदर्शन किया। फल के आकार और गूदे के रंग के लिए वांछनीय पृथक्करण विकसित करने के लिए सतगुडी (नारंगी) और लाल रूबी (ग्रेपफ्रुट) के बीच अंतर-विशिष्ट संकर भी बनाए गए।

आंवला के 14 जननद्रव्यों में से, CHESA-4 को आशाजनक पाया गया जिससे वर्षा आधारित अर्ध-शुष्क परिस्थितियों में प्रति पौधा अधिकतम उपज (52.10 किलोग्राम) पायी गयी। आवला के 21 जननद्रव्यों को प्रक्षेत्र में संरक्षित किया गया । पश्चिमी भारत की वर्षा आधारित परिस्थितियों में CHESA-4 में वृक्ष की अर्ध-फैलाव वृद्धि (CHESA-1, CHESA-2 और CHESA-10), लंबा सीधा वृद्धि (CHESA-7 और CHESA-8), लंबा फैलाव वृद्धि (CHES-5 और CHESA-6) और अर्ध-झुकाव (CHESA-4) देखा गया। विभिन्न जननद्रव्यों में पर्ण घनत्व घना और विरला देखा गया।

बेल में, गर्म शुष्क परिस्थितियों में बी-14, बी-15 और बी-16 जननद्रव्यों में अधिकतम फलन दर्ज किया गया। जननद्रव्यों में, बी-11 के फलों का वजन, आकार और गूदे के वजन में बेहतर भौतिक गुण वाले फल प्राप्त हुए। वांछित बागवानी लक्षणों के आधार पर CHESB-31 को उत्कृष्ट बेल जननद्रव्यों के रूप में पहचाना गया।

लाल गूदे वाले अमरूद में, H-1 (CHESG-15 x Thai), H-2 (CHESG-15 x Thai) और CHESG-15 को बेहतर जननद्रव्यों के रूप में चुना गया, जबकि सफेद गूदे वाले अमरूद में, CHESG-38 और CHESG-39 को बेहतर पाया गया।

नींबू के मूल्यांकन में, CHESL-15, CHESL-29 और CHESL-32 को विभिन्न बागवानी लक्षणों के संबंध में आशाजनक पाया गया। मनीला इमली के 30 जननद्रव्यों में से सबसे पहले फूल CHESM-4 में देखे गए, जिसमें अधिकतम फल का वजन (30.25 ग्राम) और गूदा (73.10%) पाया गया।

कैथ के जननद्रव्यों के मूल्यांकन में, CHESW-27 मे परिपक्वता के समय हरे रंग के फल के साथ प्रारंभिक फलन देखा गया। CHESW-29 ने बहुत ही विशिष्ट लक्षण प्रदर्शित किया है जिसमें रोपण के तीसरे वर्ष में ही शिर्ष फलन शुरू हो गया। सीताफल के 36 जननद्रव्यों का मूल्यांकन किया गया और अधिकतम गूदा CHESCA-31 (68.22%) में पायी गई। CHESCA-44 और CHESCA-52 में गुदे का रंग पीला से गुलाबी पीला पाया गया तथा साथ ही कुल घुलनशील ठोस पदार्थ (28° ब्रिक्स) पाया गया। इमली की CHEST-11 आशाजनक और नियमित फल देने वाली पायी गयी। इससे प्रति पौधे की उपज (50.98 किलोग्राम), गूदा की मात्रा (53.0%) और कुल घुलनशील ठोस पदार्थ (70° ब्रिक्स) पायी गयी। चिरोंजी के जननद्रव्यों में, CHESC-2 में 23.20° ब्रिक्स कुल घुलनशील ठोस पदार्थ, 12.20% कुल शर्करा और 48.0 mg/100g विटामिन C के साथ 1.20 ग्राम वजन वाले फल पाये गये।

करोंदा की CHESK-3 में परिपक्वता के समय लाल रंग के फल पाये गये। खेजडी की सांगरी की गुणवत्ता, उपज एवं तुडाई के अंतराल का मूल्यांकन करने के लिए खेजड़ी चयन-3 (मातृ पेड़ और इन-सीटू बड-ग्राफ्टिंग) पर छंटाई के उपरांत अध्ययन किया गया । मिर्च में विशिष्ट गुणो के लिये CIAH/CH-1 और CIAH/CH-2 का चयन किया गया । यह दोनों लाइनें गर्मी के शुष्क वातावरण में भी आशाजनक पाई गई।

सेम के 59 जननद्रव्यों के बीच फली के आकार, माप और रंग के संबंध में विविधताओं की एक विस्तृत श्रृंखला दर्ज की गई। लोबिया की दो प्रकाश असंवेदनशील लाईन (AHCP-1-4-1; IC-0625644 व AHCP-2-3; IC-0628910) की पहचान की गई। यह दोनों लाईने गर्म शुष्क जलवायु के तहत सर्दियों के महीने (नवंबर) के दौरान 10° सेल्सियस से कम तापमान और गर्मियों के महीनों (अप्रैल-जून) के दौरान 46° सेल्सियस तक के तापमान पर फूल और फलियाँ देने में सक्षम थीं।

ग्वार फली के विशिष्ट प्रकार (AHG-23; CIAH-23) से 135-210 क्विंटल प्रति हेक्टेयर फली की उपज प्राप्त हुई। यह कम संसाधन वाले गर्म शुष्क वातावरण व वर्षा आधारित खेती के लिए उपयुक्त पायी गयी जिनकी खेती गर्मियों के दौरान न्यूनतम सिंचाई के साथ भी की जा सकती है।

तरबूज के 267 पौधे F_2 (AHW/BR-22 x YF 5-2-7F_2) में पत्ती के आकार, फल के आकार और गूदा के रंग का अध्ययन किया गया। टिंडा के सात जननद्रव्यों में प्राथमिकता वाले लक्षणों का अध्ययन किया गया जिनका प्रदर्शन अत्यधिक शुष्क जलवायु में ग्रीष्मकाल के दौरान बार-बार बहुत खराब पाया गया। लौकी के विभिन्न जननद्रव्यों के 10-12 वर्ष पुराने बीजों का रखरखाव किया गया। इसके 52 जननद्रव्यों में से, 28 जननद्रव्यों ने क्षेत्र की परीस्थितियों के तहत अच्छा प्रदर्शन किया तथा इनके बीजों का रख-रखाव किया गया।

सहजन के विशिष्ट जननद्रव्य (CHESD-34, CHESD-40, CHESD-42, CHESD-45, CHESD-50 व CHESD-52) का महत्वपूर्ण बागवानी लक्षणों के लिए मूल्यांकन किया गया। कुंदरु के 26 व ककोडा के 21 जननद्रव्यों का मूल्यांकन उनके विभिन्न रूपात्मक और गुणवत्ता वाले लक्षणों के लिए किया गया।

सेम फली के दो उत्कृष्ट प्रभेदों की पहचान की गई, जिनमें CHESDB-10 (क्रिमी सफेद हरी फली) तथा CHESDB-40 (बैंगनी रंग की फली) सम्मिलित है । सब्जी लोबिया में CHESVC-22, CHESVC-27, CHESVC-46, CHESVC-45 और CHESVC-20 प्रभेद (झाड़ीनुमा) ताजा फलियों की संख्या तथा उपज के लिये अच्छे पाए गए। ग्वार फली के CHESCB-60, CHESCB-59, CHESCB-25 और CHESCB-24 जननप्रकार, ताजा फलियों की संख्या तथा उपज में अच्छे पाए गए।

जैव प्रौद्योगिकी और जैव रासायनिक अध्ययन

तुम्बा व तरबूज में पीसीआर विस्तारण द्वारा 77 अजैविक दबाव के लिये उत्तरदायी जीनों का विश्लेषण किया गया। तुम्बा (*सिट्रुलस कोलोसिंथिस*) में 77 चयनित जीनों में से, 23 जीनों में सकारात्मक विस्तारण पाया गया तथा उनकी जड़ ऊतक विशिष्ट अभिव्यक्ति के लिए आगे की जांच की गई।

तरबूज के 11 जननप्रकारों (5 अग्रिम पंक्ति व 6 किस्में) का 34 SCoT मार्कर से डीएनए फिंगरप्रिंटिंग और आणविक लक्षण वर्णन किया गया । केर में 15 SCoT मार्कर का उपयोग करके 9 जननद्रव्य का आणविक लक्षण वर्णन किया गया। केर जननद्रव्यों में सभी मार्कर ने 84 एलील का उत्पादन किया जिसमें प्रति मार्कर 5.6 एलील का औसत पाया गया तथा बहुरूपता का पर्याप्त स्तर प्राप्त हुआ।

खेजड़ी की फली (सांगरी) में फली लगने के 15 दिन बाद तुड़ाई से प्राप्त सांगरी में सबसे अधिक प्रोटीन (18.79±0.17%) पाई गई और 45 दिनों के बाद प्रोटीन की मात्रा न्यूनतम (13.86±0.01%) तक पहुंच गई। सांगरी के प्रारंभिक विकास में रेशा काफी कम (13.55±0.48 से 11.77±0.04%) पाया गया। फलन के 10 से 15 दिन बाद तुड़ाई की गई सांगरी में फिनोल, फ्लेवोनोइड और कुल एंटीऑक्सीडेंट की अधिकतम मात्रा पाई गई।

फसल उत्पादन

किन्नू मेंडरिन की वृद्धि, उपज और रस की गुणवत्ता के मापदंड मूलवृंत से काफी प्रभावित हुए। सबसे अधिक फल का वजन पेक्टिनिफेरा मूलवृंत से दर्ज किया गया, जो रफ लेमन और खट्टा ऑरेंज मूलवृंत के बराबर था। जबकि, फलों की संख्या तथा उपज खट्टा ऑरेंज और रफ लेमन पर अपेक्षाकृत अधिक थी। प्रारंभिक प्रयोगों से पता चला है कि पेक्टिनिफेरा मूलवृंत पर लगाये गए पौधों में गर्मियों के दौरान पानी की कमी के दौरान ऑस्मोलाइट्स का अधिक संचय होता है।

शुष्क परिस्थितियों में वर्ष के लगभग 8-10 महीनों के लिए बाजार में उच्च गुणवत्ता वाले ताजे फलों की उपलब्धता सुनिश्चित करने के लिए निंबु वर्गीय फलों की किस्मों की पहचान की गई। यह संतरा की किस्मों जैसे सतगुडी, मोसंबी, जाफ़ा और ब्लड रेड माल्टा को शामिल करने के कारण संभव हुआ, जिनसे उपलब्धता की अवधि सितंबर से जनवरी तक बढ़ गई। इसके अतिरिक्त, CIAHSO-21/9, CIAHSO-21/15, CIAHSO-22/15 और CIAHSO-24/17 जैसे नए जननप्रकार पहचाने गए जिन्होने उपलब्धता की अवधि को बढ़ाने में योगदान दिया।

बेर की गोला किस्म में वर्मीकम्पोस्ट (20 किग्रा/पौधा)+जैव उर्वरकों के प्रयोग से फलों के भौतिक-रासायनिक गुण बेहतर पाए गए। इससे फलों का व्यास (3.42 सेमी), गूदे का वजन (22.25 ग्राम), कुल घुलनशील ठोस पदार्थ (26.55°ब्रिक्स) और विटामिन सी (212.50 मिलीग्राम/100 ग्राम) पाया गया। इस उपचार के परिणामस्वरूप अधिक उपज (14.90 किग्रा/पौधा),एंजाइम गतिविधि जैसे डिहाइड्रोजनेज (8.15 µg TPF g^{-1} सूखी मिट्टी h^{-1}), क्षारीय फॉस्फेट (8.25 µg p-NP g^{-1} सूखी मिट्टी h^{-1}) और यूरिया (395 µg NH3-1 g सूखी मिट्टी h^{-1}) प्राप्त हुई।

बेल की किस्म गोमा यशी में घास मल्च+एनएए (15 पीपीएम)+मोटे सूती कपड़े के उपयोग से न्यूनतम फल गिरावट (94.10%), धूप से फलों का झुलसना (17.85%) तथा उच्चतम फल अवधारण (5.50%) दर्ज की गई। वर्षा आधारित अर्ध-शुष्क परिस्थितियों में 25% वार्षिक वृद्धि विस्तार की छंटाई के साथ 3 मीटर पौधे की ऊंचाई पर छत्रक बनाने से बेल की किस्म गोमा यशी में अधिकतम फल वजन (1.35 किग्रा), प्रति पौधा उपज (82.0 किग्रा) और कुल घुलनशील ठोस पदार्थ (38°ब्रिक्स) दर्ज किया गया।

धनिया की किस्म ACr-1 को 0.5EC लवणता वाले पानी के साथ 50% FYM और 50% वर्मीकम्पोस्ट के संयोजन तथा सूक्ष्म पोषक तत्व (ज़िंक सल्फेट @ 0.5%) के पर्णीय छिड़काव और 0.5% फेरस सल्फेट के मिट्टी में प्रयोग से इष्टतम उपज (8.28 टन/हेक्टेयर) प्राप्त की गई। पालक की किस्म थार हरीपर्ण की अधिकतम उपज को पानी की लवणता 4 EC (IW) + 100% NPK + FYM से 202.15 क्विंटल/ हेक्टेयर उत्पादन प्राप्त हुई। मूली के प्रयोग में, यह पाया गया कि पानी की उच्च लवणता की स्थिति (4EC) व 100% NPK (अकार्बनिक) का

प्रयोग गोबर की खाद के साथ करने पर वानस्पतिक विकास और उपज अपेक्षाकृत अधिक (219.8 क्विंटल/हेक्टेयर) पाई गई। मुली में एस्कॉर्बिक एसिड का उच्चतम स्तर (28.73 मिलीग्राम/100 ग्राम ताजा वजन) 0.5 ईसी सिंचाई जल को 100% एनपीके+गोबर की खाद के साथ मिलाकर किए गए उपचार से दर्ज किया गया।

केर के वानस्पतिक प्रवर्धन के लिये सोलराइट माध्यम को उपयुक्त पाया गया। आईबीए और मिट्टी रहित माध्यम का उपयोग करके अर्ध-कठोर लकड़ी की कटिंग से गोंदी के वानस्पतिक प्रवर्धन में सफलता प्राप्त की गई।

खजूर की हलावी किस्म की परागण विधियों में, पराग सस्पेन्शन और डस्टिंग परागण विधियों ने अधिकतम फल वजन क्रमश: (9.3 और 9.8 ग्राम), फल की लंबाई (38.1, 37.8 मिमी) और फल की चौड़ाई (19.6, 19.7 मिमी) से दर्ज की गई। फलों का सबसे अधिक प्रतिधारण (मटर के दाने के आकार की अवस्था) में फलों की अधिकतम संख्या रुई (27.0%) और डस्टिंग विधि (26.0%) में दर्ज की गई । पराग निलंबन (81.8%) और स्ट्रैंड प्लेसमेंट (79%) विधि में अधिकतम फलों का जमाव दर्ज किया गया। पराग निलंबन विधि से गुच्छे का अधिकतम वजन (7.5 किलोग्राम/ गुच्छा) प्राप्त हुआ।

तुरई (थार करणी) में बीज के हाइड्रो-प्राइमिंग (36 घंटे) से अधिकतम अंकुरण शक्ति सूचकांक-I (2011.62) और सूचकांक-II (81.57) दर्ज किया गया। गर्म शुष्क क्षेत्र में साल भर सब्जी पौध उत्पादन के लिए नर्सरी तैयार करने की तकनीक विकसित की गई। ऊंचे बेड पर खाट-प्रकार के लोहे के फ्रेम (25 मीटर x 01 मीटर आकार के जोड़े बेड पर 50-60 वर्ग मीटर क्षेत्र) पर बीज की बुवाई करके फ्रेम को सर्दी के मौसम में पारदर्शी पॉलिथीन (120-200 गेज) और गर्मी के मौसम में कीट-रोधी नायलॉन-जाल (40 मेस) से ढकने पर स्वस्थ पौध प्राप्त की गई।

फसल संरक्षण

खजूर के 32 जननद्रव्यों का अल्टरनेरिया पत्ति धब्बा रोग के प्रति सहनशीलता की जांच की गई। इस रोग का प्रकोप (PDI) 2.72 से 28.53% तक पाया गया। इस रोग का प्रकोप खुनेजी में 2.72%, सामरान में 4.62%, भुक्सो में 4.31% और चिप-चैप में 4.98% दर्ज किया गया। इसका प्रकोप अधिकतम मेडजूल (28.53%), हलावी (25.62%) तथा नागल (20.48%) पाया गया। अनुसंधान द्वारा सब्जी लोबिया तथा ग्वारफली में सूखी जड़ की बीमारी पैदा करने वाले फाइटोपैथोजेनिक कवक को पृथक किया गया। गर्म शुष्क क्षेत्र में स्वाभाविक रूप से पाए जाने वाले देशी मशरूम के फलने वाले निकायों के शुद्ध कल्चर को पृथक किया गया।

फसल कटाई के बाद प्रबंधन और मूल्यवर्धन

बेर की गोला किस्म के फलों की तुड़ाई के बाद कमरे के तापमान पर संग्रहित किया गया तथा फलों को मेलाटोनिन सांद्रता (200 और 500 µM/L) से उपचारित करने पर ठोस फलों के प्रतिशत में सुधार, वजन कम होने में देरी, सड़न मे कमी, ताजापन के समय मे वृध्धि तथा रंग के बदलाव को हल्के हरे/पीले से भूरे में परिवर्तन में सुधार दर्ज किया गया ।

काकडिया से तैयार हुई प्यूरी को रेफ्रिजरेटर में भंडारण करने से एस्कॉर्बिक एसिड (11.31 मिलीग्राम/100 ग्राम) और बीटा-कैरोटीन (1.72 माइक्रोग्राम/100 ग्राम) का स्तर अधिक एवं सार्थक पाया गया। काकडिया की प्यूरी को रेफ्रिजरेटर में भंडारित करने से इसके कुल फिनोल, फ्लेवोनोइड्स और एंटीऑक्सीडेंट गुण भी प्रभावी रूप से संरक्षित रहे। बेल के गूदे के निष्कर्षण और उसके भंडारण के लिए एक प्रोटोकॉल विकसित किया गया। बेल के गूदे को लंबे समय तक इसकी गुणवत्ता से समझौता किए बिना 5 डिग्री सेल्सियस तापमान पर संग्रहीत किया जा सकता है। ब्राइनिंग और फ्रीजिंग के माध्यम से केर फलों के लिए प्रसंस्करण विधियों का विकास किया गया और दोनों विधियों में 10-12 महीने का भंडारण दर्ज किया गया।

कृषि विस्तार

शुष्क क्षेत्र में खजूर और अनार की खेती के क्षेत्रफल और उत्पादन में विस्तार का अध्ययन किया गया। खजूर के क्षेत्रफल में बीकानेर जिला (344 हेक्टेयर) के साथ पहले स्थान पर रहा, उसके बाद जैसलमेर (221 हेक्टेयर), श्रीगंगानगर (198 हेक्टेयर), बाड़मेर (168 हेक्टेयर) और हनुमानगढ़ (153 हेक्टेयर) रहा। अनार के अंतर्गत अधिकतम क्षेत्रफल बाड़मेर जिले (7813 हेक्टेयर) में दर्ज किया गया, उसके बाद जालौर (3194 हेक्टेयर), बीकानेर (1636 हेक्टेयर), जोधपुर (394 हेक्टेयर), जैसलमेर (376 हेक्टेयर) और पाली (301) का स्थान रहा।

खजूर और अनार अपनाने के आर्थिक प्रभावों का भी आकलन किया गया। खजूर के क्षेत्रफल में वृद्धि के साथ, 2023 में राजस्थान के गर्म शुष्क क्षेत्र के सभी खजूर उत्पादक किसानों की शुद्ध आय 11.60 करोड़ होने का अनुमान लगाया गया। इसी तरह, राजस्थान के गर्म शुष्क क्षेत्र के सभी अनार उत्पादक किसानों की शुद्ध आय 2017 में 13.23 करोड़ प्रति वर्ष से बढ़कर 2023 में 16.10 करोड़ प्रति वर्ष हो गई।

1. INTRODUCTION

The ICAR-Central Indian 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 eco-system 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 01 October, 2000. The Krishi Vigyan Kendra (KVK) at Panchmahal was also established on 01st October 2005 by the ICAR under the administrative control of ICAR-CIAH, Bikaner. The KVK is located at Vejalpur on 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, multistory 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 Institute, Beechwal, Bikaner, Rajasthan

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 Beechwalcampus 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, MH, Raj., MP 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, office building and the experimental farm.

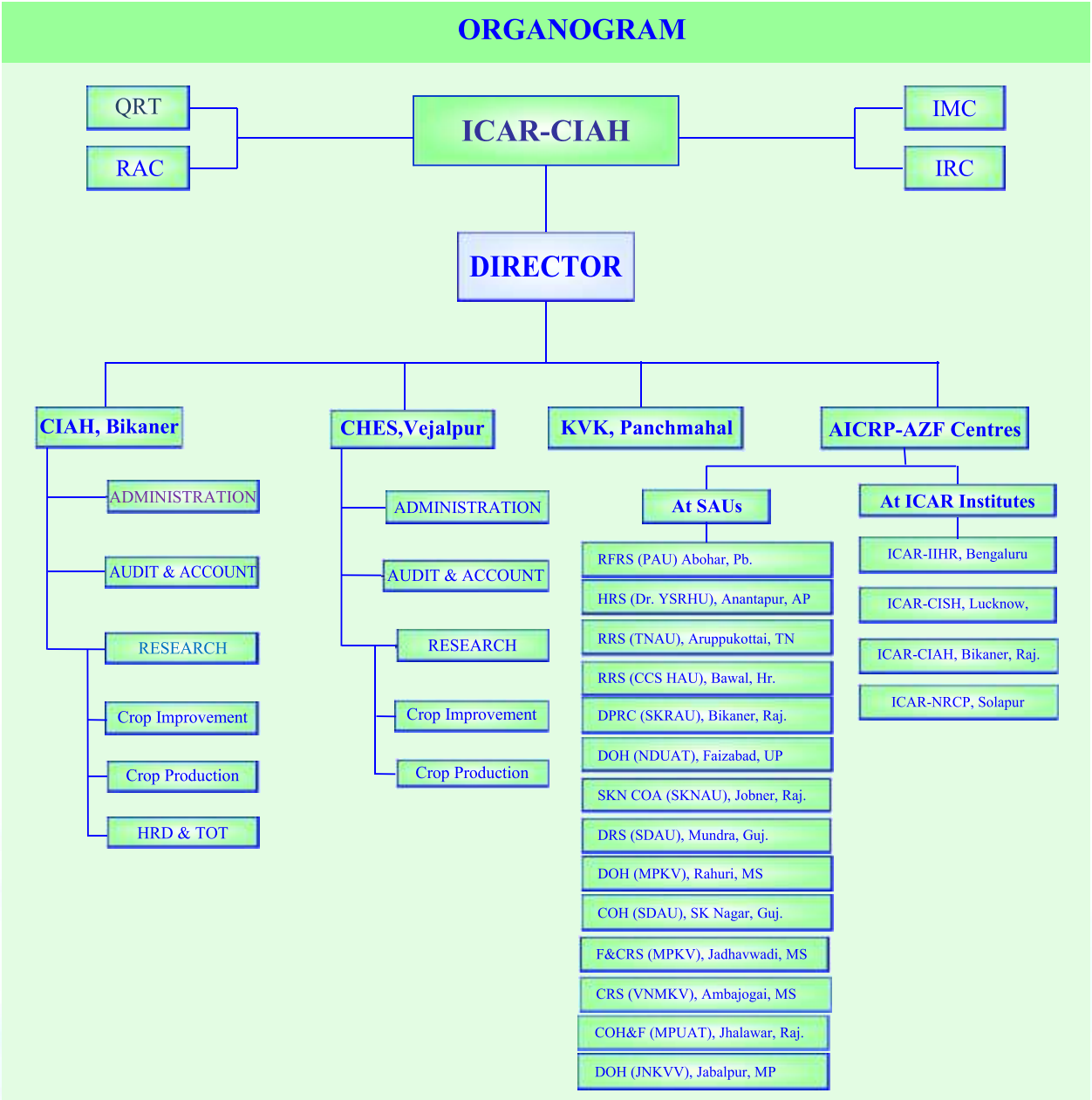
Krishi Vigyan Kendra (KVK), Panchmahal, Gujarat

KVK, Panchmahal was established in the year 2005 occupying an area of 20 ha. It is located at Vejalpur, Godhra-Vadodara Highway about 15 km away from the Godhra. 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 underexploited fruit crops. At present, the project has 18 Centres spread over 11 states of the country; 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 Genetic Resources

At ICAR-CIAH, Bikaner

Crop	Germplasm collected during 2023	Area explored/ Source Institute	Total viable germplasm as on 31.12.2023	No. of germplasm maintained during he year 2023
Fruit crops				
Ber (*Ziziphus* spp.)	03	Local Bikaner	372	340
Date palm (*Phoenix dactylifera*)	03	COE, Bhojka, Jaisalmer	65	65
Pomegranate (*Punica granatum*)	01	IIHR, Bengaluru	106	106
Gondi (*Cordia gharaf*)	02	Ajmer and Bikaner	02	02
Lasoda (*Cordia myxa*)	-	-	67	67
Phalsa (*Grewia subinaequalis*)	-	-	04	04
Ker (*Capparis deciduas*)	-	-	09	09
Karonda (*Carissa carandas*)	-	-	05	05
Mulberry (*Morus* spp.)	-	-	14	14
Manila tamarind (*Pithecellobium dulce*)	-	-	02	02
Wood apple (*Feronia limonia*)	-	-	03	-
Marula nut (*Sclerocarya birrea*)	-	-	01	01
Argon (*Argania spinose*)	-	-	01	01
Bael (*Aegle marmelos*)	-	-	21	21
Date palm (*Phoenix sylvestris*)	01	Banswara	01	01
Vegetable crops				
Dessert melons	-	-	125	125
Non-dessert melons	-	-	161	161
Gourds	-	-	60	60
Chilli (*Capsicum annuum*)	-	-	45	45
Tomato (*Solanum lycopersicum*)	-	-	14	14
Brinjal (*Solanum melongena*)	-	-	30	30
Cowpea and beans	-	-	35	35
Muskmelon (*Cucumis melo*)	-	-	60	60
Watermelon (*Citrullus lanatus*)	-	-	46	46
Sponge gourd (*Luffa cylindrica*)	-	-	16	16
Ridge gourd (*Luffa acutangula*)	-	-	20	20
Kheemp (*Leptadenia pyrotechnica*)	14	Bikaner	14	14

At CHES, Vejalpur, Godhra

Crop	Germplasm collected during 2023	Area explored/ Source Institute	Total viable germplasm as on 31.12.2023	No. of germplasm maintained during 2023	No. of germplasm deposited to NGB during 2023
Fruit crops					
Guava (*Psidium guajava*)	02	IIHR, Bengaluru	73	73	23
Bael (*Aegle marmelos*)	-	-	217	217	-
Ber (*Ziziphus mauritiana*)	-	-	43	43	-
Lime (*Citrus aurantifolia*)	02	IIHR, Bengaluru & Jalgaon	36	36	12
Aonla (*Emblica officinalis*)	-	-	28	28	-
Pomegranate (*Punica granatum*)	01	Valia, Bharuch	38	38	05
Jamun (*Syzygium cumini*)	01	IIHR, Bengaluru	72	72	-
Khirni (*Manilkara hexandra*)	-	-	30	30	-
Manila tamarind (*Pithecellobium dulce*)	02	Valia, Bharuch	30	30	-
Mahua (*Bassia latifolia*)	-	-	30	30	-
Phalsa (*Grewia subinaequalis*)	02	Dang	25	25	-
Custard apple (*Annona squamosa*)	09	Popatpura & Kalol, Panchmahal	75	75	-
Wood apple (*Feronia limonia*)	02	Panchmahal and Vadodara area, Gujarat	58	58	-
Tamarind (*Tamarindus indica*)	02	Dahod, Gujarat	30	30	-
Chironji (*Buchanania lanzan*)	-	-	30	30	-
Karonda (*Carissa carandas*)	-	-	40	40	-
Wild noni (*Morinda tomentosa*)	-	-	31	31	-
Lasoda (*Cordia myxa*)	1	Godhra, Gujarat	05	05	-
Tendu (*Diospyros melanoxylon*)	04	Ghughamba Taluka, Panchmahal	04	04	-
Palmyra palm (*Borassus* spp.)	03	Ghughamba and Vejalpur Taluka, Panchmahal	03	03	-

Vegetable crops					
Dolichos bean (*Lablab purpureus* var. *typicus*)	03	Panchmahal and Dahod (Gujarat)	60	11	-----
Vegetable cowpea (*Vigna unguiculata*)	01	Panchmahal (Gujarat)	70	15	07
Cluster bean (*Cyamopsis tetragonoloba*)	02	Haveri (Karnataka)	15	08	-
Ivy gourd (*Coccinia indica*)	-	-	28	28	-
Spine gourd (*Momordica dioica*)	-	-	25	25	-
Bottle gourd (*Lagenaria siceraria*)	-	-	07	07	-
Tomato (*Solanum lycopersicum*)	-	-	03	03	-
Pumpkin (*Cucurbita moschata*)	02	-	04	04	-
Cucumber (*Cucumis sativus*)	02	-	08	08	-
Okra (*Abelmoschus esculentus*)	08	Panchmahal and Dahod (Gujarat), CIAH, Bikaner, Ranebennur (Karnataka), IARI, New Delhi	08	08	-
Chilli (*Capsicum annuum*)	05	Panchmahal and Dahod (Gujarat), Ranebennur (Karnataka), IIHR, Bengaluru	05	05	-

2.2 Improvement in Fruit Crops

Evaluation of new ber genotypes

Three elite genotypes of *Ziziphus mauritiana* namely BCIAH-1, BCIAH-2 and BCIAH-3 were added in field gene bank for further characterization and evaluation. Among them, BCIAH-1 was found to be tolerant to low temperature with 18.3 g fruit weight and 18°B TSS. The BCIAH-2 and BCIAH-3 exhibited heavy fruit bearing and hard fruit texture traits, respectively. The fruit weight of BCIAH-2 was 10.2 g with 14°B TSS. Fruit weight and TSS of BCIAH-3 was found to be 22.8 g and 14°B, respectively.



BCIAH-1



BCIAH-2



BCIAH-3

Evaluation of ber for frost tolerance

To assess low-temperature impact on crop, 318 genotypes of ber (*Z. mauritiana* L.) were evaluated. The Thai ber was found to be highly sensitive to frost, while Tikadi suffered the least damage. Additionally, the observation categorized these germplasms into early, medium, and late categories based on their growth and fruit development before 16 January, 2023. In comparison to other germplasm, Tikadi, Gola, Thar Sevika, Banarsi Pewandi, Chhuhara, Kala Gola and Safeda Rohatak exhibited certain advantages and were usable, either as dried fruits or as animal feed, despite damage due to the frost.

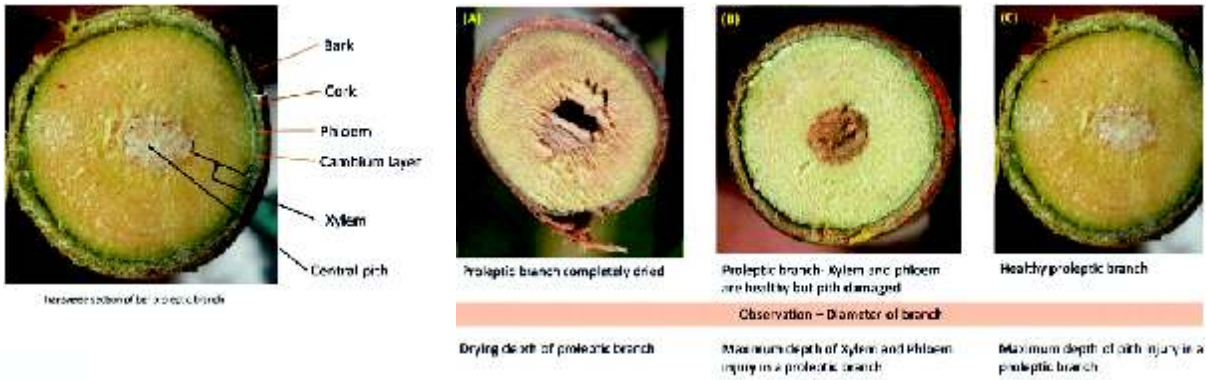


Banarsi Pewandi **Gola** **Tikadi**

Status of frost injury in ber genotypes during January, 2023

Evaluation of ber genotypes for frost sensitivity

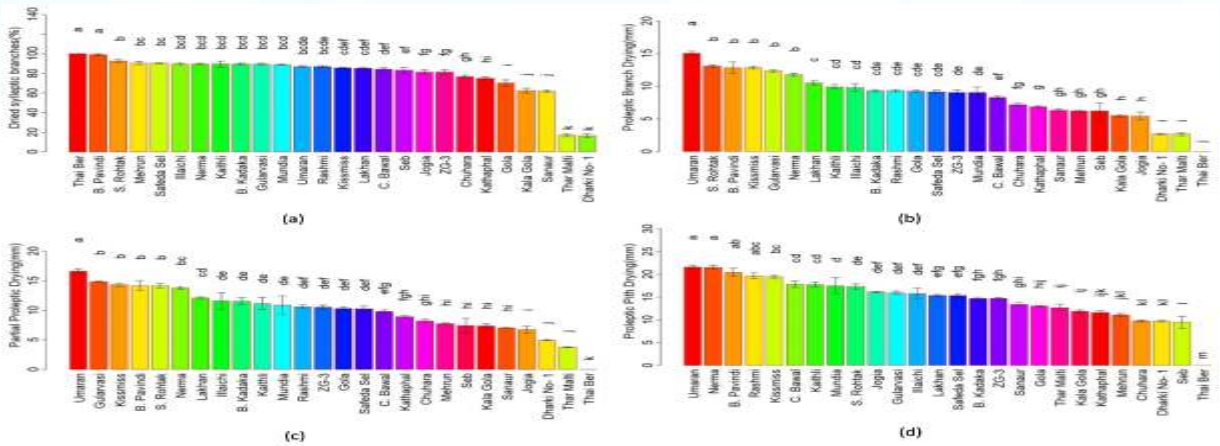
Ber can withstand extreme heat but is susceptible to frost and advective frost is a usual phenomenon in the hot arid region of western Rajasthan. Frost on the 13th and 14th of January 2023 adversely affected horticultural crops. Almost all fruit trees cultivated in the hot arid region of western Rajasthan were impacted by this frost, albeit, ber is the most heavily impacted economically as the time of frost coincided with the maturity of its fruit. To investigate the frost-sensitivity, 27 ber genotypes were selected. Three proleptic branches were chosen from each tree, specifically those within a diameter range of 28 to 32 mm for the present investigation. The sensitivity was assessed on the basis of number of sylleptic branches present on observed proleptic branch; Percentage of completely dried sylleptic branches on the proleptic branch (%); maximum diameter of dried sylleptic branch (mm); maximum depth of dried proleptic branch (mm); maximum depth of xylem and phloem damage/injury in a proleptic branch (mm); maximum depth of pith damage/ injury in a proleptic branch (mm).



Anatomy of frost damaged proleptic branch of ber

The investigation revealed varying degrees of frost sensitivity among different ber genotypes, indicating a genetic variation in the frost sensitivity patterns within the stem anatomy of the ber plant. Despite significant differences observed in the number of sylleptic shoots across genotypes, ranging from 20 (Thai Ber) to 62 (Illaichi), no noticeable relationship was found between the number of sylleptic shoots and the frost sensitivity exhibited among the various ber genotypes. Two distinct genotypes with contrasting features in response to the frost were identified for further studies. Thai ber suffered the most severe damage that ultimately led to complete drying of both the sylleptic and the proleptic shoots on the plants. Conversely, Tikadi remained unaffected, without any adverse effects of the frost. However, the remaining 25 genotypes displayed varying degrees of sensitivity to the frost, each exhibiting different levels of damage in response to the frost. Proportion of dried sylleptic branches per proleptic branch was substantially less in Dharki No. 1 (16%)

and Thar Malti (17%) on the other hand the damage was more than 90 per cent in Safeda Selection, Mehrun, Safeda Rohtak, and Banarasi Pavindi. Dharki No.1 and Thar Malti were found least sensitive to frost damage and can promise to serve as promising genetic stock with respect to stem tolerance to frost.



(a) Percentage of completely dried sylleptic branches on the proleptic branch; (b) maximum depth of dried proleptic branch (mm); (c) maximum depth of xylem and phloem damage/ injury in a proleptic branch (mm); (d) maximum depth of pith damage/ injury in a proleptic branch (mm)

Evaluation of Jharber germplasm for processing and value addition

Jharber (*Z. nummularia*) is one of the most important and perennial component of traditional native farming system of hot arid region. With khejri planting models, 164 seed progenies of jharber plantation (4m x 4m) has been under evaluation for various horticultural traits since 2009. From, 2021, the established jharber progenies were studied for post-harvest uses of fruits. Based on horticultural and biomass harvest potential, the 15 elite were selected for detailed studies. On the basis of fruit quality, yield and period of fruit availability and bearing regularity two genotypes; R21P1 and R26P2 were found most promising for processing attributes. R21P1 (CIAH ZN-01) being an early genotype, could be harvested from 25 October to 10 December. Ripened fruits are oblong round and deep red in colour. Fruit weight, TSS and acidity of fruits ranged from 0.90-0.96 g, 24.6-26.8°Brix and 0.64-0.76%, respectively. The average fruit length and width were 11.52 mm and 11.44 mm, respectively. The fruits of the genotype, R26P2 (CIAH ZN-02) could be harvested in the second to third week of November. The fruit length and width of fruits were 11.52 mm and 11.44 mm respectively. Fruit weight, TSS and acidity ranged between 1.10-1.26 g, 24.8-26.2°Brix and 0.54-0.59%, respectively.



CIAH ZN-01



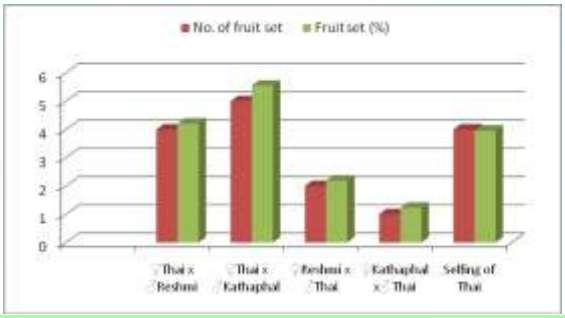
Fruits of CIAH ZN-01



Fruits of CIAH ZN-02

Hybridization in ber

The main objectives of hybridization was to enhance specific traits related to TSS from the donor parent Reshmi and fruit shape-colour characteristics from the donor parent Kathaphal, aiming to incorporate these attributes into the Thai ber variety. A total of 458 crosses were attempted with Thai ber as one of the parent. Among these attempts, only sixteen crosses were successfully resulted in fruit set, accounting for 3.5 per cent of the total attempted crosses.



Fruit set (number & per cent) status from different cross combinations

Intra-specific and inter-specific hybridization in *Ziziphus* species

Breeding in *Ziziphus* species through hybridization is limited due to its small sized flowers, cross incompatibility, low fruit set and poor retention. To check cross compatibility and creation of variability in *Ziziphus* species, the intra and inter-specific hybridization among the cultivars of *Z. mauritiana* and between the ber/ *Ziziphus* species namely *Z. mauritiana* and *Z. nummularia* was attempted.

Eight intra-specific cross combinations and 287 controlled pollination attempts made during 2023 resulted in 16 fruits (5.57%) that ripened to maturity. Other fruits developed only partially and dropped off 7-15 days after pollination. Maximum fruit set was recorded in Gola x Banarasi Pewandi cross combination (28.95%) followed by Gola x Reshmi (25%) and Thar Sevika x Goma Kirti (21.62%) cross combination. Meanwhile, three inter-specific cross combinations and 106 controlled pollination attempts resulted in 2 fruits (1.89%) that ripened to maturity. Maximum fruit set was recorded in *Z. mauritiana* var. Gola x *Z. nummularia* cross combination (11.43%).

Evaluation and characterization of pomegranate germplasm

Seventy-pomegranate germplasm were evaluated for growth and fruit quality attributes under hot arid condition. The fruit quality attributes were recorded during *mrig bahar*. The maximum plant height (266 cm) was recorded in Uthkal followed by Yercaud (261 cm). The maximum canopy spread (258 cm N-S and 252 cm E-W) was also recorded in Uthkal followed by Yercaud (257 N-S and 250 cm E-W). Uthkal and Yarcud were found very vigorous in growth habit. Growth behaviour varied as evergreen, semi deciduous and deciduous.

The maximum number of fruits per plant was obtained in Bhagwa (72.33) which were at par with Saharanpur (71.50), Jalore Seedless (70.83) and followed by Mridula (62.0), Jodhpur Red (60.50) and Jalore Red (57.33). Number of cracked fruits per plant was varied significantly among different germplasm and recorded maximum (21.0) in Saharanpur followed by Jodhpur Red (12.50), Mridula (11.50). Very less number of cracked fruits per pant was observed in sour type deciduous germplasm like Sur Sukker (2.0), Gul-e-Shah Rose Pink (2.50), Gul-e-Shah (2.67) and Gul-e-Shah Red (3.0). Significantly maximum fruit weight was recorded in Jalore Seedless (289.11 g) which found at par with G-137 (276.69 g) and Jodhpur collection (267.48 g). Recorded light green, yellowish green, light yellow, yellow, light red and red rind colour among different germplasm.

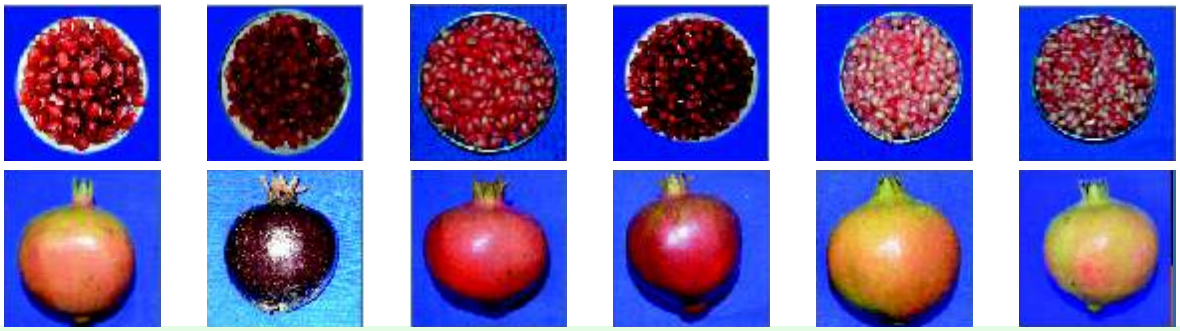
Matured fruits were harvested during November-December and analyzed for different bio-chemical quality attributes. The maximum TSS was recorded in Saih Sirin (18.05°Brix) followed by Jalore Seedless (17.50°Brix), G-137 (17.12°Brix), Mridula (16.71°Brix), Ganesh (16.33°Brix) and Bhagwa (16.29°Brix). The minimum juice acidity was recorded in Jalore Seedless (0.40%) followed by Ganesh (0.49%), Mridula (0.51%), G-137 (0.53%) and Bhagwa (0.59%).

Evaluation of pomegranate germplasm for rind and aril quality attributes

Six pomegranate lines were evaluated for rind and aril quality attributes. The rind colour of CIAH PG-1 was light red while it was purple in CIAH PG-4 in contrast to Bhagwa which was red and Mridula which was dark red. The rind colour was yellow with red tinge in Jalore Seedless and Ganesh. The rind anthocyanin content was significantly high in CIAH PG-4 (911.21 mg/kg) followed by Mridula (510.09 mg/kg) compared to Jalore Seedless (42.49 mg/kg). Aril colour was light pink in Jalore Seedless and Ganesh while it was blood red in CIAH PG-1 and Mridula. Arils were dark purple in CIAH PG-4. The juice anthocyanin content was significantly high in CIAH PG-1 (285.34 mg/kg) compared to Ganesh (63.09 mg/kg) and was almost at par with Mridula (298.17 mg/kg). CIAH PG-1 recorded the boldest aril with the highest weight (37.85 g/100 arils).

Evaluation of pomegranate germplasm for rind and aril quality attributes

Genotypes	Rind colour	Rind anthocyanin (mg/kg)	Aril colour	Juice anthocyanin (mg/kg)	100 aril weight(g.)	TSS (°B)	Acidity (%)
CIAH PG-1	Light red	198.37	Blood red	285.34	37.85	15.12	3.77
CIAH PG-4	Purple	911.21	Light purple	196.10	27.23	13.24	0.81
Bhagwa	Red	138.65	Pink	235.48	32.42	16.81	0.63
Mridula	Dark Red	510.09	Blood red	298.17	29.58	16.89	0.50
Jalore Seedless	Yellow with red tinge	42.49	Light pink	79.52	34.29	17.27	0.40
Ganesh	Yellow with red tinge	62.50	Light pink	63.09	31.06	16.43	0.58
SEm±	-	1.48	-	2.9	0.8	0.06	0.04
CD at 5%	-	4.51	-	8.83	2.44	0.19	0.12



CIAH PG-1 CIAH PG-4 Bhagwa Mridula J. Seedless Ganesh

Aril and rind colour variation among different pomegranate germplasm

Evaluation of pomegranate germplasm for bioactive compounds

Recorded significant variation in bioactive compounds like phenols, flavonoids, anthocyanin and total antioxidant activity among 60 germplasm. The phenols content ranged from 0.87-4.86 mg GAE/g being the maximum in CIAH PG A-12. The flavonoids content varied from 0.012-0.052 mg CTE/g that was significantly the maximum in KS-1 (0.052 mg CTE/g). The anthocyanin content ranged from 0.85-298.17 mg/l and recorded maximum in Mridula. The total antioxidant activity varied from 1.08-11.17 mg AAE/g among the germplasm and recorded maximum in KS-1.

Breeding of pomegranate under hot arid region

During 2023, a total of 154 crosses were attempt among Jalore Seedless, Bhagwa, Mridula, CIAH PG-4 and AHPG C-1 of pomegranate to develop the hybrids resistant to fruit cracking coupled with superior quality traits. All the pomegranate cultivars used in hybridization were found to be cross compatible. Fruit set in different cross combinations ranged from 11.11% to 30.30%. Maximum fruit set was recorded in cross Jalore Seedless x Bhagwa (30.30%) while it was minimum in cross of Mridula x Jalore Seedless (11.11%). The earlier developed 57 progenies developed from different cross combinations were maintained and evaluated under field conditions.



Emasculated flower bud



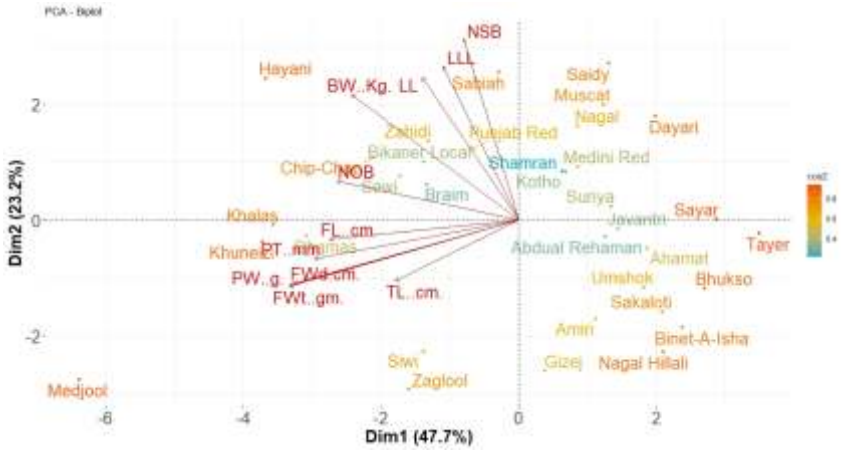
Hybrid progenies

Mutation breeding in pomegranate

In order to create variability in Jalore Seedless, mutation breeding was initiated. The chemical mutagen (EMS) has been used at different concentrations.

Evaluation of date palm genotypes

A total of 65 date palm genotypes existing in national field repository were maintained and evaluated for flowering, fruiting and yield attributes. From these, thirty-seven genotypes of diverse origins were characterized for 26 morphological traits. Principal component analysis (PCA) indicated that the characters *viz*., leaflet length, number of thorns/ rachis, number of bunch/ plant, stalk length, number of strands/ bunch, strands length, bunch weight, fruit weight, fruit and stone sizes, pulp stone ratio, TSS, and yield/ plant, were highly divergent. The correlation coefficient analysis revealed the existence of strong associations among vegetative traits.



Principle component analysis (PCA) of date palm vegetative traits



Variability in date palm fruits

Evaluation of male date palm

The quality and quantity of pollen grains is crucial for successful fruit setting, to ensure high quality of fruits and productivity. Therefore, nine elite male date palm seedlings were evaluated focusing on inflorescence and pollen traits such as spathe emergence, time taken for opening of spathe, size of spathe, weight of spadix, weight of spathe, weight of inflorescence, pollen weight per spathe, number of strands per spathe, number of flower per spathe, length of strands, length of peduncle and pollen grain production per plants. Among the evaluated genotypes, CIAH-DP-M1 was found superior to other genotypes with respect to all the parameters including quantity and quality of pollens.

Evaluation of sweet orange genotypes

Evaluation of sweet orange genotypes resulted in identification of four elite lines for specific traits as peel colour, maturity time, seeds number, sweetness, *etc*.

Characteristics	CIAHSO-24/17	CIAHSO-22/15	CIAHSO-21/15	CIAHSO-21/9
Time of harvest	10 Dec. to 5 Jan.	December	December	Mid January
Fruits shape	Round to oblong	Oblong	Round	Oblong with ridged apex
Rind colour	Orange colour developed from base to apex	Green	Green	Green
Fruit weight (g)	210-253	272-311	237-263	266-306
Rind thickness (mm)	3.60-5.32	4.31-5.56	4.57-4.78	5.39-5.94
Juice (%)	42-49	40-47	37-45	40-46
TSS (°Brix)	10.1-11.5	8.2-8.87	8.9-9.3	8.0-8.33
Ascorbic acid (mg/100 ml fresh juice)	80-136.5	100.8-129.1	88-145.1	81-96
Acidity (%)	0.19 - 0.21	0.14-0.20	0.22-0.38	0.25-0.35
Number of seed/ fruit	2-6	3-6	5-6	2-8
Yield per plant during 3rd fruiting year (kg)	45-50	60-70	60-65	50-58



CIAHSO-24/17 | CIAHSO-22/15 | CIAHSO-21/15 | CIAHSO-21/9

Inter-specific hybridization between Satgudi x Red Ruby

Among the 19 cultivars of sweet orange, Sathgudi performed well under arid environmental conditions, with some limitations like fruit size and flesh colour. Therefore, attempt has been made to develop inter-specific hybrids between Sathgudi (sweet orange) and Red Ruby (grapefruit) to develop the segregants having traits of interest. The 38 percent fruit setting was obtained from the total attempted crosses (60). Out of them, eight fruits were successfully harvested and raised the seedlings. Thirty five seedlings were shifted in the polybags for final transplanting in the field.



F_1 population of inter-specific hybrid derived from Sathgudi x Red Ruby

Evaluation of Pilu and Gondi

Surveyed the different area to explore the promising genotypes of Pilu (*Salvadora oleoides*) and Gondi (*Cordia gharaf*). Identified one promising genotype of Pilu and three of Gondi in Bikaner district while one genotype of Gondi in Ajmer district.



Salvadora oleoides

Significant variations have been observed in various identified genotypes of *Cordia gharaf* in terms of leaf size, petiole length, fruit weight, fruit size, fruit shape, and fruit total soluble solids (TSS) content. Among these traits, the most considerable variations were observed in fruit weight, fruit surface area, and fruit TSS content. Fruit weight across different identified genotypes ranged from 0.78 g (CIAH-CG-4) to 1.40 g (CIAH-CG-3). Similarly, fruit surface area varied from 3.62 cm^2 (CIAH-CG-5) to 5.14 cm^2 (CIAH-CG-3), while fruit TSS content ranged from 20.58°B (CIAH-CG-3) to 31.81°B (CIAH-CG-5).



Variability in *Cordia gharaf*

Evaluation of aonla genotypes

During the year, evaluated 14 genotypes for growth, flowering and fruiting characters at CHES, Vejalpur. Twenty-one seedling germplasm were also maintained in field repository. The tree growth was observed semi-spreading (CHESA-1, CHESA-2 and CHESA10), tall upright (CHESA-7 and CHESA-8), tall spreading (CHES-5 and CHESA-6) and semi-drooping in CHESA-4 under rainfed conditions of western India. The foliage density was observed dense and sparse in different genotypes. Among the 14 genotypes, the maximum plant height (4.45 m) was recorded in CHESA-4 followed by CHESA-7 (4.40 m). CHESA-4 was found promising and produced the maximum yield per plant (52.10 kg) under rainfed semi-arid conditions.



CHESA-4: A promising genotype

Evaluation of bael for fruit traits

During the year, a total of 18 genotypes were evaluated for physical characteristics of bael fruits at CIAH. Recorded heavy bearing in B-14, B-15 and B-16 genotypes under hot arid conditions. Among the genotypes, B-11 produced fruits with better physical attributes in terms of fruit weight, fruit size and pulp weight. The maximum pulp recovery, minimum number of seeds and fibre content was recorded in B-2.

Variability studies in bael

Out of 217 genotypes including 18 varieties at CHES, Vejalpur observed the flowering and fruiting in 201 genotypes. In addition, 121 seedling germplasm were also maintained. The genotypes exhibited wide range of variability in terms of yield/ plant (73.15-158.20 kg), fruit weight (0.60-2.45 kg), fruit length (7.42-22.12 cm), fruit circumference (24.00- 53.50 cm), shell thickness (1.45-3.15 mm), seed number/ fruit (65.30-267.34), number of seed sacs (10.50-16.80), seed weight (0.10-0.18 g), shell weight (105.15-435.10 g) and pulp weight (0.35-2.10 kg).

Variation was also recorded in chemical composition of fruits including TSS in pulp (34.10-42.50°Brix),TSS in mucilage (42.00-55.20°Brix), acidity (0.33-0.61%), vitamin C (13.15-24.70 mg/100g), total phenol content (1700-2815 mg/100g) and total sugar (14.15-19.53%). Genotypes showed wide variation in ripening period (February to June).

Based on the fruiting pattern and quality attributes, the genotypes CHESB-31, CHESB-42, CHESB-48 CHESB-59, CHESB-60, CHESB-62, CHESB-69, CHESB-71, CHESB-73, CHESB-77 and CHESB-78 were found superior.



Variability in fruit shape and size of bael genotypes

CHESB-31: Based on the desirable horticultural traits identified CHESB-31 as elite bael genotype. It was collected from Nimadi, Jaipur, Rajasthan in 2012-13. The 11 year old plants produced 107.75 kg yield per plant. Fruit weight 1.48 kg, fruit size 12.05 cm x 18.10 cm, fruit girth 50.10 cm, shell thickness 0.2 cm, total number of seed 92.23, total seed weight 23.40 g, fibre weight 48.42 g, shell weight 250.60 g, locules in cross section 15-17, TSS pulp 36°B, acidity (0.37%) and vitamin C (20.50 mg/100g) pulp were recorded. It took 300 days from fruit setting to ripening. It possess distinct character like peripheral locule arrangement and attractive flattened round fruit shape with attractive lemon colour after ripening. Fruits are highly suitable for value added products like *sharbat, murabba* and powder.



CHESB-31: Transverse section



CHESB-31: Ripened fruit

Evaluation of red fleshed guava germplasm

A total of 43 red fleshed guava genotypes were evaluated for tree growth, yield and fruit quality traits. CHESG-16 was found to be most vigorous as evident from tree height (4.68 m), spread (5.60 x 6.02 m) and stem girth (19.80 cm). CHESG-15 produced the highest number of fruits/ tree (408) and yields (76.95 kg). The maximum fruit weight was observed in H-2 (268.52 g) followed by H-1 (236.48 g). CHESG-30 showed the maximum fruit length (9.35 cm) followed by CHESG-32 (9.21 cm). The minimum 100 seed weight was observed in Hyb. 4/3 (0.97 g) followed by CHESG-15 (0.99 g). The highest TSS was recorded in CHESG-16 (14.51°Brix) followed by Bhavnagar-2 (14.50°Brix) and CHESG-15 (14.07°Brix). The maximum ascorbic was observed in CHESG-15 (283.89 mg/100 g) followed by CHESG-21 (278.66 mg/100 g) and H-1 (278.19 mg/100 g). H-1 recorded the highest total sugar (10.07 %) followed by Bhavnagar-2(9.97%). The highest TSS: acidity ratio was found in CHESG-31 (28.79) followed by Bhavnagar-2 (28.43).

H-1 (CHESG-15 x Thai): The plants are vigorous in growth habit with prolific bearing like Thai (66 kg/ tree during 5th year). Fruits are round, medium to big in size (250-280 g) with smooth, yellowish green peel and red pulp. It is high in TSS (14°B), acidity (0.55%) and ascorbic acid (278 mg/100 g). It is suitable for table and processing purpose. Keeping quality of fruit is good at ambient storage (6-7 days).

H-2 (CHESG-15 x Thai): Upright in growth habit, prolific bearer in bunches like mother plant (71 kg/ tree during 5th year). Fruits are round, medium to big in size (250-300 g) with smooth, yellowish green peel and light red pulp. It have good blend of TSS (11.50°B) and acidity (0.45%) and contains ascorbic acid above 200 mg/100 g pulp. It is suitable for table purpose with good keeping quality at ambient storage (4-5 days).

CHESG-15: Trees are moderately tall with spreading loose canopy. It bears heavily in bunches. Fruits are round; medium in size weighing 180-200 g. Fruit peel colour is yellowish green with deep red pulp colour. At mature ripened stage fruit pulp is firm with medium number of small sized seeds, having pleasant aroma and good taste with TSS: acidity ratio of around 28. It ripens early in the season *i.e.* in the second week of November. Yield potential is high (76 kg/tree in 7th year).



H-1 (CHESG-15 x Thai)



H-2 (CHESG-15 x Thai)



CHESG-15

Evaluation of white fleshed guava germplasm

Evaluated 26 white fleshed guava genotypes for growth, yield and fruit quality characteristics, genotypes CHESG-29 recorded the maximum plant height (4.65 m), plant spread (4.75 x 5.15 m) and stems girth (20.25 cm). The fruit weight ranged between 118.35 g in MPUAT-1 to 250.50g in CHESH-6/24. The maximum fruit length was recorded in CHESG-11 (11.25 cm) while the minimum in Dhawal (5.95 cm). The fruit width varied from 6.05 cm in MPUAT-1 to 7.70 cm in CHESH-6/24. The maximum number of fruits/ tree was observed in MPUAT-1 (325) followed by CHESG-38 (260). Similarly, the maximum fruit yield/ tree was recorded in CHESG-38 (48.70 kg) followed by Thai (38.50 kg). The highest pulp thickness was observed in Thai guava (1.70 cm) and least in CHESG-5 (1.25 cm). Minimum 100 seed weight was found in Shweta (1.22 g). The maximum TSS was recorded in CHESG-39 (14.45°Brix) followed by MPUAT-2 (13.50°Brix). The maximum ascorbic acid (292.55mg/100 g) was found in CHESG-39. Dhawal recorded the highest total sugar (9.88%) while CHESG-29 recorded the minimum total sugar (6.65%). The pectin content ranged between 0.88% in CHESG-1 to 1.55 in VNR Bihi-1.

CHESG-38: Medium in tree vigour with compact semi-spreading canopy. Fruits are round, bigger in size weighing 220-240 g and yield 48 kg/ tree during 7th year. Fruit peel and pulp is whitish yellow in colour. Keeping quality is good at ambient storage (5 days). At ripened mature stage fruit pulp is firm with less seeds of small size, having pleasant aroma and good taste. Fruit pulp is rich in pectin (1.28%), TSS (13.55°B) and total sugar (9.52 %).

CHESG-39: It is having medium spreading canopy and bears near the trunk and in the periphery of canopy. Fruits are round, medium in size weighing around 170-190 g and yield 38.60 kg/ tree during 6th year. Fruit peel is yellow in colour with white pulp. Ridges are prominent around pedicel end with rough peel. Fruit pulp is rich in pectin (1.40%), TSS (14.45°B) and total sugars (9.80%).



CHESG-38



CHESG-39

Performance of promising pink fleshed guava F_1 hybrid selections

Amongst newly selected pink fleshed promising F_1 hybrid selections, H-4/11-21 had comparatively taller plant height (4.17 m) while least plant height was recorded in H-2/28 (2.90 m). However, H-15/36-21 (3.40 m) and H-4/19-21 (4.27 m) produced widest canopy north-south and east-west directions respectively. H-4/11-21 recorded the highest trunk diameter (9.90 cm) in comparison to others. The yield was high (18.40-10.89 kg/ tree) in comparison to Lalit (9.29 kg/ tree). Number of fruit/ tree differed significantly and varied from 46 to 103. The fruit weight varied from 152.33-559.95 g as compared to Lalit (149.38 g). TSS ranged from 10.20-13.83°B, acidity from 0.36-0.53% and ascorbic acid from 108.52-206.25 mg/100g.



View of F_1 guava selections planted on July 07, 2021

Evaluation of acid lime germplasm

Among the evaluated genotypes, CHESL-15, CHESL-29 and CHESL-32 were found promising with respect to different horticultural traits.

CHESL-15: It mostly bears inside the canopy and has spreading growth habit. Fruits are almost free from citrus canker. Produced yield 58 kg/ plant during 7th year. Fruit weight is 40g with fruit size of 46.37 mm x 43.08 mm. Fruit axis is solid, with 10 segments. Peel thickness is 1.49 mm and total number of seed/ fruit 8-9. Fruit juice 51.40%, TSS 7.86°Brix, acidity 6.87% and ascorbic acid 38.20 mg/ 100 ml. Keeping quality is good at ambient storage (8-10 days) with attractive yellow smooth peel.

CHESL-29: It is tall growing having spreading canopy with less thorn density. The incidence of citrus canker is less. It is cluster bearer. The fruit weight is 40.45 g having fruit size of 43.72 x 38.39 mm. Produced 53.0 kg/ plant during 7th year. Fruit juice 52%, TSS 6.8°Brix, acidity 6.60% and ascorbic acid 41.67 mg/100 ml. Keeping quality is good at ambient storage with attractive yellow smooth peel.

CHESL-32: It mostly bears inside the canopy in clusters. The growth habit is spreading, high yielder, having big fruit size with high juice content (49%). Yield per plant is 45 kg during 6thyear. Fruit weighs 40 g. Fruit juice contains TSS 9°Brix, acidity 8.15% and ascorbic acid 35 mg/100 ml.

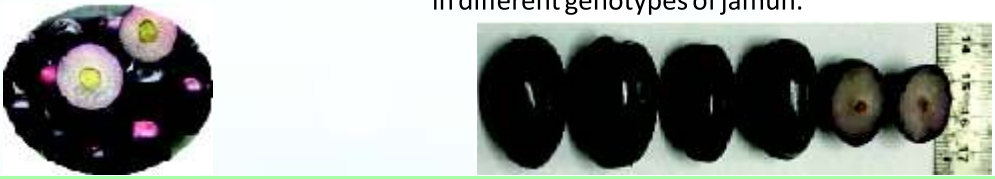


CHESL-15 CHESL-29 CHESL-32

Evaluation of jamun germplasm

Maintained a total of 72 germplasm of jamun in the field gene bank. Twenty promising genotypes were evaluated for growth, flowering, fruiting and fruit quality attributes. Maximum panicle length was recorded in CHESJ-30 closely followed by CHES-32 and CHESJ-35. Peak period of ripening was recorded in the month of May-June in all the genotypes. Fruit yield was noted to be the highest in CHESJ-30. Fruit pulp and TSS was also found the highest in CHESJ-30.

Growth habit was recorded as spreading, upright and semi-spreading and upright. Ripening was attained from third week of May to 4th week of June. The fruit yield varied from 18.50 to 48.50 kg/ plant under rainfed semi-arid conditions. The fruit weight ranged between 9.00-19.25 g, pulp weight (9.31-16.35 g), pulp content (75.45-92.82%), TSS (12.50-16.60°Brix), acidity (0.35-0.43%), total sugar (8.12-12.20%) and vitamin C (39.90-45.74 mg/100g) in different genotypes of jamun.



CHESJ-30 CHESJ-71

Evaluation of Manila tamarind germplasm

A total of 30 germplasm has been established in the field gene bank. The peak period of flowering was noted in January-February in all genotypes. Earliest flowering took place in CHESM-4, while it was noted at the last in CHESM-12. The maximum panicle length, fruit weight (30.25 g) with 73.10 percent pulp was recorded in CHESM-4, while maximum TSS was recorded in CHESM-12 (24.50°Brix).

Varietal trial on tamarind

Ajanta recorded higher plant height (6.47 m); spread (EW 6.37 m & NS 6.16 m), seed weight (6.35 g) and shell weight (5.16 g) while Goma Prateek recorded higher pod yield (31.83 kg/ tree), pod weight (21.27 g), pod length (14.94 cm) and pulp content (51.02 %). Pratisthan recorded the lowest tree height (5.07 m) while PKM-1 recorded the lowest plant spread (EW 4.98 m & NS 4.89 m), pulp recovery (34.70 %) and Red type recorded the lowest yield (12.47 kg/tree). Whereas Goma Prateek the highest (TSS 66.17°Brix), PKM-1 recorded the maximum acidity (13.19%) while least TSS (57.78°Brix) and acidity (9.99%) recorded with Red type. Based on yield and quality attributes, Goma Prateek may be recommended for cultivation in Gujarat.



Tamarind varieties A. Goma Prateek, B. PKM-1

Varietal trial in Jamun

CISHJ-37 resulted in higher plant height (7.17 m) and stem girth (63.12 cm) while Goma Priyanka produced higher plant spread (N-S 6.73 m and E-W 7.03 m), fruit weight (17.86 g), pulp weight (15.17 g), pulp content (84.85%), TSS (15.93°Brix), acidity (0.50%) and fruit yield (39.44 kg/ plant) followed by CISHJ-37 (36.39 kg/ plant and 14.97 g fruit weight). The minimum fruit weight (8.76 g), pulp weight (7.95 g), seed weight (0.82 g), yield (11.68 kg/ plant) and higher pulp content (91.13%) were observed in CISHJ-42.



Fruits of Goma Priyanka

Evaluation of wood apple

A total of 18 genotypes were evaluated for qualitative and yield characters. Genotype CHESW-10 produced flat shaped fruits which are very attractive and much liked by consumers. It has high fruit pulp (59.42%) and TSS than other genotypes which are desirable characters for processing purpose. CHESW-27 showed early bearing with green colour fruit at maturity which gives more freshness character of fruit than others. CHESW-29 showed very precaucious character, bearing of fruit has initiated just in 3rd year of planting as erect terminal bearing. It showed very early maturity and fruits mature in last week of September.



CHESW-10



CHESW-27

Evaluation and characterization of custard apple

Thirty six custard apple germplasm were evaluated for qualitative and quantitative characters. Significant variation was found for fruit weight (138.15-338.32 g), fruit length (5.32-7.36 cm), fruit diameter (4.02-8.11 cm), pulp weight (48.30-230.30 g), rind weight (42.28-133.30 g), pulp content (36.23-67.41%), rind thickness (2.43-5.42 mm), fruit pulp colour (creamy white to dull white), fruit core length (1.33-3.46 cm), pulp texture (soft to gritty), total sugars (12.29-17.87%), reducing sugars (11.35-14.80%), ascorbic acid (14.83-39.18 mg), number of flakes (28.87-82.20), number of flakes with seed (37.25-85.22), firmness of flesh (firm to medium), TSS (22.27-30.25°Brix), acidity (0.22-0.62%), pulp aroma (mild-strong), eating quality (good and very good), shelf-life (3-5 days) and yield (15.37-29.58 kg/ tree). Among the evaluated germplasm, CHESCA-13, CHESCA-23 and CHESCA-27 were found superior in respect of fruit quality and yield characters under rainfed conditions of hot semi-arid ecosystem.

The newly established germplasm block of custard apple was also evaluated for morphological and fruit characters. The plant root stock and scion diameter varied from 28.30 to 50.62 cm and 26.18 to 57.65 cm, respectively. The plant height recorded from 1.02 to 4.58 m. The fruit weight, pulp content and TSS ranged from 135.42 to 318.20 g, 39.25 to 68.22% and 23.26-32.35°Brix, respectively. The maximum pulp content was noted in CHESCA-31 (68.22%). The seed number/ fruit varied from 38.12 to 78.34 among the genotypes. The CHESCA-44 and CHESCA-52 has yellow to pinkish yellow colour with TSS more than 28°Brix.



CHESCA-23



CHESCA-44



CHESCA-52



CHESCA-13

Evaluation of Ramphal

Eighteen genotypes of Ramphal were maintained under field conditions. The fruiting has been observed in only one CHESR-1 genotype which produced flowering in the month of October and obtained 18 fruits. Plant is erect, grow up to height 4.5 m with a rounded or spreading crown, and trunk and stems are cylindrical, with lenticels and very short coffee-coloured hairs. The leaves are alternate, oblong or narrow lanceolate, size 15-20 cm x 2-4.2 cm, with 10-17 conspicuous pair veins. It has long, narrow, glabrous leaves, and compact fruit unlike custard apple with TSS 17.25°Brix.

Maintained and evaluated Red Sitaphal

In Red Sitaphal, 19 genotypes were maintained and evaluated. Fruiting and flowering was observed in all genotypes in the month of August and fruits matured during November to December. Plants showed spreading growth habit. The plant height varied from 3.02 to 5.28 m. The fruit weight and TSS ranged from 137.42 to 348.25 g and 20.26-24.35°Brix, respectively. Pulp content varied from 55.25 to 69.22% being maximum CHESCA-12 (69.32%) followed by CHESCA-16 (68.22%). The seed number/ fruit varied from 39.18 to 68.54.



CHESRCA-12



CHESRCA-16

Evaluation and selection of promising tamarind

A total of 30 genotypes of tamarind (*Tamarindus indica*) were maintained in a field gene bank at the station. CHEST-10 has been identified as variety with name Thar Rashmi at institute level. CHEST-11 genotype has been identified promising under rainfed semi-arid conditions of western India.

CHEST-11: It has semi-spreading growth habit, thick trunk and drooping branches. Peak period of ripening time was last week of March. It recorded 50.98 kg fruit yield per plant, pulp content (53.0%) and TSS (70.0°Brix). It is a regular bearer genotype of tamarind.



Tamarind CHEST-11

Selection of promising chironji genotype

Thirty genotypes of chironji (*Buchanania lanzan*) were maintained and evaluated for growth, flowering, fruiting and fruit quality attributes. The peak period of flowering and fruit set in chironji was recorded in the month of February and March, respectively. Among the evaluated genotypes, CHESC-2 has been found promising.

CHESC-2: It is having up right growth habit. Peak period of ripening time was May. It recorded 1.20 g fruit weight, 23.20°Brix TSS, 12.20% total sugar and 48.0 mg/100g vitamin C. Kernel protein was recorded 32.0%.

Evaluation and maintenance of karonda genotypes

A total of 40 genotypes of karonda (*Carissa carandas*) were maintained in the field gene bank. Among the evaluated genotypes, Konkan Bold recorded maximum fruit weight (14.0 g) and TSS (10.20°Brix) but fruit yield was 8 kg per plant only. However, minimum acidity (0.40 %) was recorded in Konkan Bold. Maximum fruit yield (16.0 kg/ plant), fruit weight (5.0 g) and TSS (10.20°Brix) was recorded in CHESK-3 closely followed by CHESK-15. The CHESK-3 was found promising having red coloured fruits at the time of maturity.

2.3 Improvement in Vegetable Crops

Evaluation and maintenance of vegetables

During the period, regular monitoring of arid vegetable genetic resources (500 lines) stored in the gene-bank facilities which mainly consisted of dessert melons (125), non-dessert melons (161), gourds (60), chillies (45), tomato (14), brinjal (30), cluster bean, cowpea and beans (35) was done for their safe conservation at ICAR-CIAH, Bikaner. In addition, the perennial germplasm of khejri, sehjan, guarpatha, kundru, kakoda, phog, meetha-neem and other native crop-plants of vegetable significance were maintained in the field repository. Under maintenance of breeding lines, mateera AHW-RSS-1 (unique genotype for high seed content) was sown on 14 July 2023 using 12 years old stored seed. The seeds germinate promptly (4 DAS) with good seedling vigour, and normal plant growth and fruit yield was obtained. First harvesting of tender fruits (*loiya* for vegetable culinary) and ripen fruits (seed yield) was recorded at 42 and 65 days after sowing, respectively. The crop was evaluated with prioritized traits and seed enhancement is done for breeding use and obtaining IC number. Likewise, velvet bean (AHVB-1), paan-methi (AHLM-1), brinjal (05 lines) and bottle gourd (52 genotypes) were studied for seed enhancement. A total 52 Indian bean genotypes (landraces, pre-breeding lines and varieties) stored under deep-freeze facilities from the year 2002 to 2012 at CIAH were studied for seed storage behavior and supplied to the institute crop-curator for maintenance and evaluation (as primary germplasm/ breeding material of research use). Indian bean germplasm and varieties can be stored safely for breeding uses and seed production for about 10 years using gene-bank standard packaging material and storage under -20°C deep-freeze and refrigerator facilities. However, seed production for varietal maintenance work should be done at 5-7 years' interval.



Fruiting in mateera AHW-RSS-1 line



Ripen fruit and mature seeds

Fruiting and mature seed quality of mateera genotype, AHW-RSS-1

Maintenance and evaluation of khejri germplasm

Fourteen elite genotypes identified by CIAH from 2000-2005 and collected clonally for *ex situ* conservation in khejri germplasm plot were maintained with good management practices. Khejri variety Thar Shobha and Thar Amruta studied in reference to training-pruning/ lopping practices, and growth, pod yield and bio-mass production over the years under rainfed conditions. Khejri Selection-3 studied for pod quality, sangri yield and picking intervals in response to the pruning practices of mother tree and *in-situ* bud-grafting performed for evaluation.

Two-hectare production site area of khejri planting models was maintained for nature's resilient farming approaches studies. The annual plant growth and bio-mass harvest component data were recorded in the native crop-plant species of horticultural significance. Phog was studied in response to the training-pruning and management practices for monsoon support bio-mass harvest including vegetable-use phogla. During 2023, seed generated progeny saplings of CIAH-PHOG-1 (IC-0642468) with two years of establishment as block plantation of 4m x 4m (July 2021) was studied for annual growth in response to training-pruning practices.

The seedling plantations of native crop-plant species such as ker, jharber, rohida, lasora, kumat, phog, kheemp and khejri were studied as inter-crop/boundary side plantations, with HBCPSMA concept to promote desert horticulture under rainfed situations and nature's resilient production protocols. For inter-crop studies, gundi seedling plantations established (July 2022) with khejri based production system.



Khejri var. Thar Shobha plant of about 15 years of growth with annual pruning practices



Seed propagated progeny of phog



Phog progeny in response to training-pruning

Evaluation of chilli genotypes

During 2023, chilli (*Capsicum annum* L.) breeding material (>48 nos.) consisting advance breeding lines, germplasm and commercial check varieties were evaluated for growth, flowering and quality green chilli harvest. Single plant selections (>80 nos.) followed by selfing were also done for the targeted traits. CIAH/CH-1 and CIAH/CH-2 were found promising as well as trait-specific under heat stressed arid environment.

CIAH/CH-1: Plants are dwarf in nature, having intermediate plant growth habit, dense branching habit, small sized with lanceolate shaped dark green leaves, Flowers are small having white corolla. It produces green, shiny, small to medium sized (fruit length: 5.23-8.68 cm, fruit diameter: 0.98-1.25 cm and fruit weight: 3.69-5.88 g) pendent positioned fruits having excellent shelf life. It can tolerate high temperature under field conditions.



Dwarf chilli stature (CIAH/CH-1)

CIAH/CH-2: Medium heighted plants exhibiting erect plant growth habit, intermediate branching habit, ovate shaped green leaves, Flowers are medium having blue corolla. Fruits are pendent in position, medium to large in size (fruit length: 7.47-11.78 cm, fruit diameter: 1.03-1.78 cm & fruit weight: 5.61-9.85 g), having unique purple colour at outer surface of fruit pericarp which make this a trait specific genotype. Fruits are rich in anthocyanin content (62.05-69.92 mg/100g FW).



Purple chilli (CIAH/CH-2) rich in anthocyanin

Evaluation of tomato genotypes

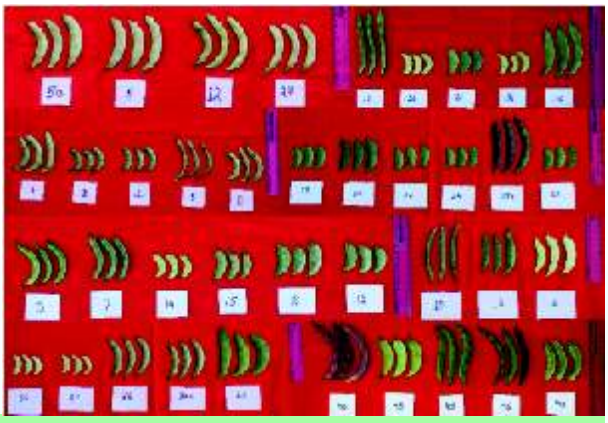
During rainy season of 2023, field evaluation of tomato (*Solanum lycopersicum* L.) germplasm along with commercial varieties/ lines was done. Most of the genotypes exhibited very poor performance except AHSL-1. A wide range of diversity was recorded with respect to plant height (42.87-126.53 cm), days to 50% flowering (35.76-51.38), days to first marketable harvest (92.56-151.16). Number of clusters/ plant, fruits/ cluster fruit length, fruit diameter and fruit weight were ranged between 4.65-41.12, 1.33-5.72, 1.37-4.35 cm, 1.75-6.42 cm and 3.78-74.81 g, respectively. Quality parameters like TSS and acidity also exhibited variability (2.4-6.2°Brix and 0.12-0.54%, respectively) among the genotypes. Single plant selections (>10) were also done to develop breeding lines.



Diversity among tomato genotypes

Evaluation of Indian bean germplasm

During rainy-winter season of 2023, 59 germplasm of Indian bean (*Lablab purpureus*) were evaluated for vegetable pod quality and performance under hot arid environment. The diverse material consisted of land-races, lines, varieties and entries from CIAH, Bikaner (32), CHES, Vejalpur (07) and AICRP-Vegetable Crops (20). Out of 59 germplasm, 12 germplasm did not germinate. The germplasm was evaluated for agro-morphological characters and categorized to isolate potential material for use in hybridization breeding. Recorded a wide range of variations with respect to pod shape, size and colour.



Variability in pod attributes among Indian bean germplasm

Identification of photo-thermo insensitive genotypes of cowpea

Two lines, viz., AHCP-1-4-1 (IC-0625644) and AHCP- 2-3 (IC-0628910) were identified photo-thermo insensitive as these were able to flower and set pods at temperatures as low as 10°C during winter months (November) and as high as 46°C during summer months (April-June) under hot arid climate.

The AHCP-1- 4-1 is vegetable pod quality line and suitable as irrigated crop. It has the yield potential of 132-174 q/ ha. The line AHCP-2-3 is multiple use and tender pods as vegetable quality variety and suitable as rainfed crop. It has yield potential of 124-168 q/ha under rainfed conditions. Both are early maturing and took 46.5-58.2 and 40.5-48.7 days for first harvesting of tender pods, respectively. Observing normal reproductive behaviour both under low and high temperatures, pollen viability study was conducted. Both the genotypes had normal pollen behaviour and pollen tube germination. The genotype AHCP-1-4-1 had 83.72 and 88.24% pollen viability at 11°C and 46°C temperature, respectively.

The genotype AHCP-2-3 had 81.58 and 85.71% pollen viability at 11°C and 46°C temperature, respectively. Thus, the cowpea genotypes *viz.*, AHCP-1-4-1 and AHCP-2-3 have tolerance to changing photoperiods and temperature as suggested by profuse growth, good pollen viability, normal pollen tube germination and good pod set even at variable day length and extremes of temperature. During rainy season of 2023, seven AICRP (VC) entries were also evaluated under cowpea (bush) AVT-II varietal trial which also consisted of two entries AHCP-1-4-1 and AHCP-2-3 from CIAH, Bikaner. The entry 2021/COPBVAR-7 recorded the maximum pod yield followed by entry 2021/COPBVAR-5. Seven more entries were evaluated under cowpea (bush) IET varietal trial consisting Thar Jyothi.



AHCP-1-4-1



AHCP-2-3





Field view of trials

Performance studies of vegetable cluster bean

The identified trait specific genotype of cluster bean, AHG-23 (CIAH-23), evaluated and characterized for yield of vegetable quality pod during summer and rainy season in 2023. It is a treat specific genotype selected from native germplasm and bears medium size sickle shaped pods suitable for fresh and hydrated vegetable use quality. The genotype is suitable for rainfed cultivation under resource constraint hot arid environment and can

also be cultivated during summer with minimal irrigation. Based on performance over the years and environments, its marketable pod yield potential is 160-250 g per plant and 135-210 q/ ha. The genotype has the potential for photo-thermo insensitive traits and two-season cultivation for producing vegetable quality pods. In addition to above, five AICRP (VC) entries were also evaluated under cluster bean IET varietal trial during rainy season of 2023, which also consisted of entry Thar Bhadavi from CIAH, Bikaner. The entry 2023/CLBVAR-1 recorded the maximum pod yield followed by entry 2023/CLBVAR-6.





Cluster bean (AHG-23)

Evaluation and characterization of sponge gourd germplasm

During the rainy season of 2023, evaluated and characterized 16 germplasm of sponge gourd for horticultural traits and maintained through inbreeding. Recorded a wide range of genetic variability with respect to flowering, fruit, and yield and seed traits. Among the evaluated genotypes, selected AHSG-23 having unique seed trait *i.e.* white coloured seeds. It produced 50% female flowering in 48-52 DAS. The fruit length, fruit weight and fruit diameter varied from 30.4-33.2 cm, 122.4-126.6 g and 3.9-4.2 cm, respectively.



Sponge gourd (AHSG-23)

Evaluation and domestication of *Jhaar karela*

Jhaar karela or Balsam apple (*Momordica balsamina* L.) is a neglected and lesser known crop of Cucurbitaceae family known for its medicinal properties. Evaluation of a purified line (CIAHMB-1; IC-0644742) has been undertaken during rainy season of 2023 for its domestication and commercialization. The crop was raised on drip system on trellis. It took days 35-40 days to produce 50% female flowering on 8-10 node. The number of primary branches ranged from 24-32 and vine length 1.8-2.1 m at last harvesting. The fruit weight, fruit length and fruit diameter ranged from 6.6-8.0 g, 3.0-4.1 cm and 2.0-2.4 cm, respectively. The total fruiting duration varied from 80-90 days. It recorded yield of 1.2-1.5 kg marketable fruits per plant.



Profuse fruiting in *Jhaar karela*







Leaf, flower and seed traits of *M. charantia* and *M. balsamina*

Performance evaluation of F_1 hybrids of muskmelon

Evaluated the performance of different F_1 hybrids of muskmelon, developed by utilizing a monoecious line (AHMM/BR-8) as female parent. The crop was raised during the rainy season of 2023. Among the F_1 hybrids, AHMM/BR-8 x Punjab Sunehri performed best with respect to fruit weight (0.90-1.10 kg), flesh thickness (1.9-2.6 cm) and TSS (11-11.8%). The fruit length and fruit diameter varied from 14.4-15.8 cm and 14.8-15.7 cm, respectively. It produced round fruits having green sutures and netting on rind with salmon orange flesh.



AHMM/BR-8 x Punjab Sunehri F_1

Inheritance studies and generation advancement in watermelon

During rainy season of 2023, raised the F_2 population (267 plants) of cross combination AHW/BR-22 x YF 5-2-7. The data on leaf shape, fruit shape, flesh colour and combination of thereof were recorded. It is evident from the results that 144 plants produced lobed leaves with round shaped-red fleshed fruits, 47 plants were having lobed leaves with round shaped-yellow fleshed fruits, 32 plants were having non-lobed leaves with round shaped-red fleshed fruits, 22 plants were having lobed leaves with long shaped-red fleshed fruits, 10 plants were having non-lobed leaves with round shaped-yellow fleshed fruits, 08 plants were having non-lobed leaves with long shaped-red fleshed fruits, 03 plants were having lobed leaves with long shaped-yellow fleshed fruits and only one plant had non-lobed leaves with long shaped-yellow fleshed fruits. The segregation ratio of F_2 plants not fitted well in the expected ratio of 27:9:9:9:3:3:3:1 as lobed leaf, round fruits, red flesh colour (LRR), lobed leaf, round fruits, yellow flesh colour (LRS), non-lobed, round fruits, red flesh colour (NLRR), lobed leaf, long fruits, red flesh colour (LLR), non-lobed, round fruits, yellow flesh colour (NLRS), non-lobed, long fruits, red flesh colour (NLLR), lobed leaf, long fruits, yellow flesh colour (LLS) and non-lobed, long fruits, yellow flesh colour (NLLS), respectively. Performed selfing in 267 plants and selection has been made from F_2 population based on fruit shape (long), flesh colour (yellow) coupled with high TSS and harvested the F_3 seeds. The resultant seed of selected trait specific 03 plants were raised (357 plants) during rainy season of 2023 for further generation advancement and selection. Selfing was done in all plants and selected trait specific fruits (long fruit shape with yellow flesh, high TSS) and harvested the F_4 seed of individual selected 64 plants for further evaluation and generation advancement.



F_2 population Selection from F_2 population



Selections from F_3 population

Seed enhancement and performance studies

During the rainy-winter season of 2023, five pre-breeding lines of brinjal (CIAH-2, CIAH-12, CIAH-16, CIAH- 22/a¸ CIAH-67) which were developed for different culinary purposes at CIAH during 2012 were studied for seed storage behavior with gene-bank standards. Brinjal germplasm and varietal seed can be stored safely for about 10 years and crop recorded good vigour, growth, fruit yield and quality seed harvest. Based on the overall performance, brinjal line CIAH-12 and CIAH-16 were found to be the most promising for high quality fruit harvest. The thorny genotype CIAH-22 compared for fruit quality and yield attributes. It bears oblong-round fruits of attractive bluish-purple colour and has thorns on stem, leaves and fruit calyx. In addition, AICRP (VC) entries of cowpea (7) and brinjal (13) were assessed for fruit yield potential as AVT-II trials, and over the year's performance under hot arid climate. Both the trials consisted of two entries each from CIAH *i.e.* cowpea (AHCP-1-4-1 and AHCP-2-3) and brinjal (Thar Rachit and CIAH-22) as developed for unique traits and better yield under abiotic stressed conditions.



Variability in trait specific brinjal breeding lines



Thorny genotype of brinjal, CIAH-22

Breeding for high temperature tolerant and fruit quality in round melon

During the summer season of 2023, seven round melon (*Praecitrullus fistulosus*) genotypes which consisted of institute breeding lines and AICRP (VC) entries including check were sown on 15th February, 2023 and studied for prioritized traits. The performance of round melon genotypes was found repeatedly very poor as summer season crop under hyper arid climate. During the rainy season, two advanced breeding material developed at the institute were sown with the on-set of monsoon rains (14th July, 2023) and observations were recorded on vine growth, fruiting pattern, fruit and yield components, and further the material advanced. Besides, an AVT-II yield evaluation trial was conducted to evaluate 05 entries including suitable checks to identify high yielding genotype. 2020/RMVAR-2 (20.77 q/ ha) recorded maximum tender fruit yield in the trial.

Breeding for high temperature tolerant and marketable yield in long fruited bottle gourd

During 2023, the gene-bank stored seeds of 10 to 22 years old of bottle gourd (52 genotypes) which consisted basic germplasm, generated germplasm, pre-breeding lines and varieties were studied for storage behavior, seedling vigour, re-generation cycle and evaluated as rainy-winter season experiment. About 50 percent genotypes which were over 15 years old stored seeds depicted very poor germination and/or failed to germinate, and exhibited poor growth for crop evaluation except germplasm AHLS-17 and AHLS-24. Germplasm maintenance is materialized with 10-12 years old genotype seeds and that were mostly pre-breeding material from deep-freeze stored conditions. Out of 52 genotypes, the 28 germplasm/ lines performed well under field conditions and seed enhancement is materialized for maintenance, and evaluated for growth, maturity, fruit and seed component characters. Two advanced breeding lines were also compared with Thar Samridhi and national checks.



Mature fruit variability in bottle gourd

Evaluation of drumstick

The elite germplasm of drumstick (*Moringa oleifera)* namely CHESD-34, CHESD-40, CHESD-42, CHESD-45, CHESD-50 and CHESD-52 were evaluated for important horticultural traits. CHESD-34 is medium dwarf tree, soft skinned purple colour pods at tender stage suitable for processing, medium length pods rich in magnesium and zinc content. The highest antioxidant potentiality in leaves and pod were measured in CHESD-45 and CHESD-34, respectively.

Evaluation of bottle gourd crosses

The promising accessions of bottle gourd *viz*., LS-20-1 x LS14-1, LS-28 x LS-20-2, LS3 x LS-2, LS42 x LS32-2 and Baina along with varieties (Thar Avani, Thar Samridhi, Pusa Sandesh and Arka Bahar) were evaluated for different horticultural traits. The line LS-28 x LS-20-2 (long type) recorded total number of fruits per plant and yield per plant 19 and 15.4 kg, respectively.

Generation advancement in pumpkin

Two promising lines of pumpkin in mini-box type segment (local type) were advanced to F_3 and F_4 generation. Also analyzed for different biochemical composition, antioxidants activity and nutritional contents.

Evaluation of cucumber

Seven germplasm cucumber (*Cucumis sativus*), CHES C-1 to CHES C-7, were evaluated for generating preliminary data for their growth, yield and quality parameters. The selfing was done for further multiplication and evaluation of the germplasm in next growing season. The promising lines of cucumber CHES C-1, CHES C-2 CHES C-3 and CHES C-4 were advanced to F_2 generation and F_3 generation.



Elite cucumber germplasm

Evaluation of ivy gourd

The 26 gynoecious accessions of ivy gourd (*Coccinia grandis*) were evaluated to assess the genetic divergence through principal component and cluster analysis. High PCV and GCV were recorded for NFFP (25.13 and 22.20), PL (23.14 and 20.69), FD (24.01 and 21.46), AFW (22.98 and 20.13), NFPY (26.38 and 24.40), FYP (37.57 and 31.29), FY (35.55 and 33.20), AsC (28.65 and 27.73), Ac (24.32 and 21.06), TSS (37.23 and 35.94), DPPHL (20.71 and 20.38), FRAPL (21.08 and 20.92), TPF (20.81 and 20.45) respectively. High heritability coupled with high genetic advance as per cent of mean was observed for VL, IL, NFFP, FL, PL, FD, AFW, NFPY, FYP, FY, AsC, Ac, TSS, TPL, TFL, CUPRACL, DPPHL, FRAPL, TPF, TFF, CUPRACF, DPPHF, CUPRACF and DPPHF. The FYP showed significant positive correlation with VL (0.6833), IL (0.2991), NFFP (0.8107), FD (0.5245), AFW (0.6766), NFPY (0.7659), ASC (0.4611), TSS (0.5004) and TPF (0.4281). The estimates of genetic parameters revealed scope for further improvement of fruit yield by selection. The eight principal components PC-I to PC-VIII had eigenvalues >1 and it accounts 85.02% of the total variation for 26 gynoecious accessions of ivy gourd. The eigen values of PC-I comprised 5.775% of total variation followed by PC-II (4.250%), PC-III (3.175%), PC-IV (2.588%), PC-V (1.828%), PC-VI (1.447%), PC-VII (1.179%) and PC-VIII (1.013%). The cluster VI and cluster I have the highest mean values for most of traits under study. Thus, genotypes from the distinct cluster like cluster VI and I should be used for selection of parents and varietal improvement.

Evaluation of spine gourd

Twenty one genotypes of spine gourd (*Momordica dioca*) were evaluated for their different morphological and quality traits. Based on their performance; three accessions were found elite namely CHESSG-1, CHESSG-11 and CHESSG-15. CHESSG-11 recorded round oblong fruit shape, natural dark green colour, styler end deeply pointed with average fruit weight (30.5 g) and fruit yield (2.59 kg per plant). CHESSG-15 recorded conical shape small sized fruit, very small and soft (feathery) spines, and soft seeded with average fruit weight (5.5 g) and length of fruit (2.3-2.8 cm).

The correlation coefficients among 23 different traits of spine gourd gynoecious accessions were calculated and summarized by using the BLUPs. The traits contribution to principal components for growth, yield and yield attributing characters positively contributed towards the PC-I were tender fruit weight, mature fruit weight, ripen fruit weight, marketable fruit yield per plant, marketable fruit yield per hectare, number of seed per fruit, fruit length, fruit diameter, inter-nodal length, fruit pedicel length, leaf width, leaf length and vine length. Out of three clusters, cluster III found the largest with 10 genotypes followed by cluster II with 07 genotypes and cluster I having 04 genotypes. The highest inter cluster value (8.73811) was observed between cluster II and III followed by cluster III and cluster I (8.738105) which indicates wider genetic base among the genotypes studied.

Evaluation and performance of promising genotypes of dolichos bean

CHESDB-10 (IC-631577): This is an elite genotype of Indian bean. The pods are very attractive creamy whitish green in colour. The pods are broad, having an average pod length of 16.0 cm and pod girth of 6.2 cm with pod weight of 11.5 g. The fresh creamy white broad pods were harvested at 99 to 100 days after sowing. The total number of fresh pods per plant was 750-1200 with an average yield of 6.5-7.5 kg/plant. It performed excellent under rainfed semi-arid conditions.



Broad pod bearing pattern in CHESDB-10

CHESDB-40 (IC-631579): The pods are light purple in colour. The pods are sickle shaped having pod length of 15.5 cm and pod girth of 4.0 cm with pod weight of 7-7.5 g. The fresh pods were harvested at 95 to 97 days after sowing. The total number of fresh pods per plant was 900-1400 with yield of 7.0 to 8.5 kg/ plant. This genotype possess resistance against dolichos bean yellow mosaic virus disease under field conditions.



Pod bearing pattern in CHESDB-40

Evaluation and performance of promising genotypes of vegetable cowpea

The promising genotypes were evaluated along with check varieties for their morphological, yield and quality attributes under rainfed semi-arid conditions at CHES, Vejalpur. Among them, the genotypes; CHESVC-22, CHESVC-27, CHESVC-46, CHESVC-45 and CHESVC-20 (bush type) were found superior with respect to fresh number pods and pod yield.

CHESVC-22 (IC-649017): The pods are attractive red in colour. The pods are long having pod length of 36.8 cm and pod girth of 2.6 cm with pod weight of 13.2 g. The fresh tender red pods were harvested at 64-65 days after sowing.

CHESVC-45 (IC-649019): The pods are attractive red in colour and cluster bearing genotype with four pods per cluster. The pods are medium long having pod length of 31.0 cm and pod girth of 2.5 cm with pod weight of 9.2 g. The fresh tender pods were harvested at 60-62 days after sowing.

CHESVC-27 (IC-649018): It is a unique genotype having green with brown patches (variegated) pod colour. The pods are medium long having pod length of 32.0 cm and pod girth of 2.8 cm with pod weight of 22.0 g. The fresh tender red colour pods were harvested at 55-60 days after sowing. It is performing well under semi-arid conditions with yield of 2-2.5 kg/ plant.

CHESVC-20 (IC-631588): This genotype is a bush and photo insensitive type. It is having short stature (bushy growth habit) grows up to 40-50 cm height. Pods are pale green in colour, having pod length of 17.50 cm and pod girth of 2.3 cm with pod weight of 5.8 g and days taken for first flowering is 43-45 days. The total number of pods per plant varies 120-130 with fresh pod yield of 0.8-1 kg/ plant.



CHESVC-20: Dwarf stature and photo-insensitive

Evaluation and performance of promising genotypes of cluster bean

The Cluster bean genotypes along with check verities were evaluated for their morphological, yield and quality attributes under rainfed semi-arid conditions at CHES, Vejalpur. Among them, the genotypes like CHESCB-60, CHESCB-59, CHESCB-25 and CHESCB-24 were found superior with respect to fresh number of pods per plant and pod yield.

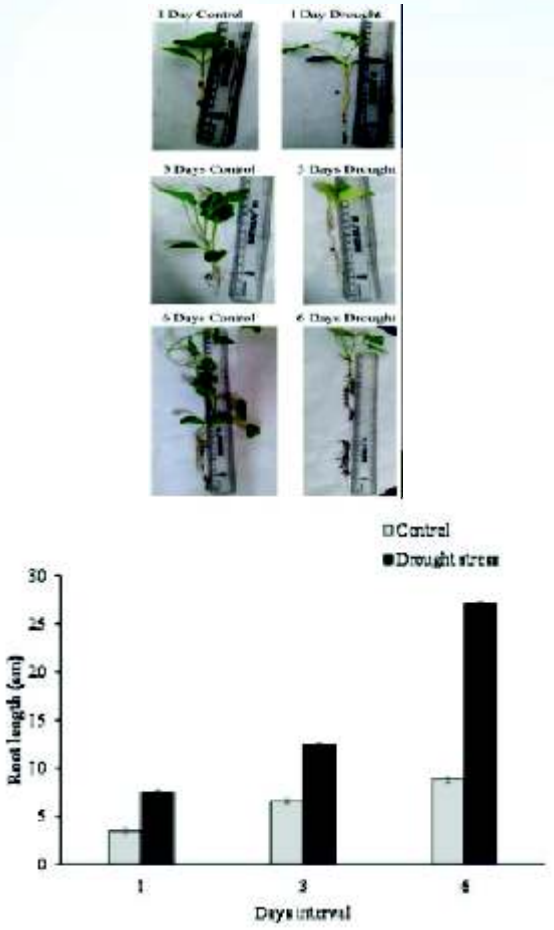
CHESCB-25: It is an elite genotype having single stem growth behaviour. The pods are small with green coloured pods, having pod length of 11.0 cm and pod girth of 2.5 cm with pod weight of 3.93 g. The total number of fresh pods per plant varies 280-320 with an average yield of 1.2 kg/ plant.

CHESCB-24: It is also an elite genotype with excellent pod quality having light green colour pods with smooth surface. It is having pod length of 11.02 cm and pod girth of 2.8 cm with pod weight of 3.12g. The total number of fresh pods per plant varies 300-320 with an average yield of 1 kg/ plant.

2.4 Biotechnological and Biochemical Studies

Identification of root-specific genes responding drought stress in Tumba

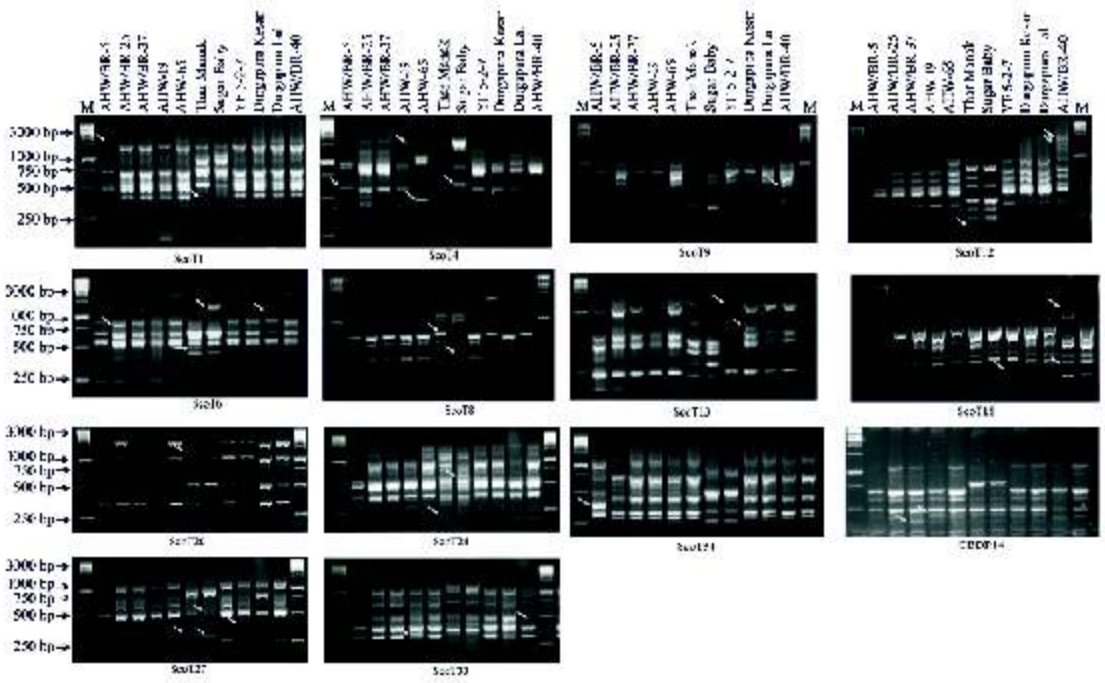
The gene expression study was undertaken to understand the mechanism of drought stress tolerance by correlating its root morphology in Tumba (*Citrullus colocynthis*). The 77 abiotic stress responsive genes from different plant species including watermelon were analysed by PCR amplification in Tumba. Out of 77 selected genes, 23 genes were positively amplified in Tumba which all were belongs to watermelon and were further screened for their root tissue specific expression. Eleven genes out of 23 were shown root and root hair specific expression collectively. Thus, these genes may consider possible candidate root specific genes. Additionally, 23 genes were analysed at expression level using semi-qRT-PCR during drought stress condition under 1, 3 and 6 days interval. All the genes were differentially expressed as compared to corresponding control. The five genes namely ClaTLP09, ClaTLP19, ClaERF84, ClaERF100 and ClaERF115 were up-regulated. The expression of these genes was correlated with root length due to drought stress in Tumba. The result was found positively correlated with root length during stress treatment in Tumba. Thus, the identified five genes based on their expression also correlated with root length could be the potential candidate genes which may responsible for root development during drought stress in Tumba plant.



Variation in root length during drought stress conditions

DNA fingerprinting of watermelon genotypes

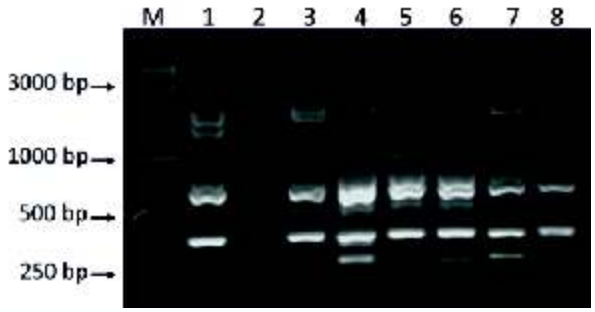
DNA fingerprinting and molecular characterization of 11 watermelon genotypes including 5 advance breeding lines (AHW/BR-5, AHW/BR-25, AHW/BR-37, AHW/BR-40 and YF 5-2-7) and six varieties (AHW-19, AHW-65 and Thar Manak, Durgapura Kesar, Durgapura Lal and Sugar Baby) was done. Thirty four SCoT markers were used for PCR profiling on genomic DNA of watermelon cultivars. All 34 SCoT markers were produced 197 polymorphic alleles with range of 3 to 7 alleles per locus. The PIC value was ranged from 0.44 to 0.72 with an average value of 0.58. Similarly, the expected heterozygosity (*He*) level was observed in a rage of 0.09 to 0.61 with an average of 0.34. Out of 34 SCoT markers, the SCoT 23 and SCoT 24 were not produced substantial level of polymorphism among the genotypes, however, SCoT 19 an SCoT 20 marker has given the best result in terms of polymorphism among the 11 genotypes.



DNA Fingerprinting of watermelon genotypes (The white arrows indicate the varietal-specific bands)

Molecular characterization of ker genotypes

DNA was extracted from elite ker germplasm using CTAB method. Fifteen SCoT markers namely, SCoT 1, 2, 3, 4, 5, 6, 7, 8, 13, 14, 15, 16, 17, 18 and SCoT 19 were used to characterize them at molecular level. All 15 SCoT markers were produce 84 alleles with mean of 5.6 alleles per marker among the tested nine ker genotypes which were showed substantial level of polymorphism to differentiate the genotypes to each other.



DNA profiling of ker by SCoT 19 marker

Proximate and biochemical profiling of khejri pods *(Sangri)*

The present study was conducted to estimate the biochemical parameters in various pod developmental stages. All biochemical parameters were studied in 80% methanolic extract of *sangri* powder. The data presented in table, indicates that protein content in khejri (*Prosopis cineraria*) pods exhibited significant variation across all developmental stages. The highest protein content (18.79±0.17%) was observed at Stage III followed by Stage I (17.02±0.19%) and Stage IV (16.72±0.01%). Notably, a substantial decrease in protein content was observed after Stage IV, specifically in Stage VI, where the protein content reached a minimum of 13.86±0.01% after 45 days of pod setting. Dietary fibres are key component of healthy food and play an important role in gut health. Significant variation also noticed in fibre content between different pod developmental stages. Fiber content was considerably lower in initial pod developmental stages and varied from 13.55±0.48 to 11.77±0.04% between Stage I and IV. Data also demonstrate that the maximum amount of phenols, flavonoids and total antioxidants was observed in *sangri* harvested at 10 and 15 days after fruit set. In later stages of pod development these parameters were reduced significantly and found minimum in matured or ripe pods. In case of total sugars, in initial developmental stages it was considerably minimum and gradually enhanced in later stages of maturity. Khejri pods can serve as a valuable raw material for the synthesis of functional foods by the pharmaceutical industry. Simultaneously, they offer an alternative and lucrative source of income for farmers, complementing their traditional consumption as a vegetable.

Biochemical profiling of khejri pods at different developmental stages

Pod maturity stage	Phenolics mg (GAE/g)	Flavonoids mg (Cat.E/g)	TAA CUPRAC mg (AAE/g)	TAA DPPH mg (AAE/g)	TAA FRAP mg (AAE/g)	Total sugars (mg/g)	Reducing sugars (mg/g)
10 days (Stage I)	175.83^{a}	3.153^{a}	174.68^{a}	97.47^{a}	59.22^{a}	113.41^{e}	63.94^{a}
15 days (Stage II)	167.37^{a}	2.913^{b}	167.963^{a}	92.78^{a}	59.20^{a}	159.59^{d}	60.17^{a}
20 days (Stage III)	155.85^{b}	2.467^{c}	128.87^{b}	75.45^{b}	58.44^{a}	178.3^{c}	53.88^{b}
25 days (Stage IV)	118.91^{c}	1.763^{d}	101.76^{c}	52.38^{c}	55.16^{b}	231.5^{b}	32.12^{c}
30 days (Stage V)	55.39^{d}	1.21^{e}	64.61^{d}	23.98^{d}	32.49^{c}	256.64^{a}	5.93^{d}
45 days (Stage VI)	50.42^{d}	1.127^{e}	54.44^{d}	22.24^{d}	31.65^{c}	270.09^{a}	5.53^{d}
CD (0.05)	11.292	0.157	20.125	7.879	1.973	15.391	4.767



Khejri pod developmental stages used for phytochemical analysis

Antioxidant analysis studies in bottle gourd

The correlation coefficients among 6 antioxidant and 8 nutritional content in bottle gourd varieties calculated by using the best linear unbiased predictor (BLUP). Among antioxidants in the present study, a strong positive correlation was found in CUPRAC with DPPH (r=1.00; P≤0.01). High magnitude and non-significant correlation was found in TF with CUPRAC and DPPH (r=+0.96). Similarly, high magnitude and non-significant correlation links were noticed between FRAP and ViC (r=+0.84). Among nutritional traits, a strong positive and significant correlation was found between Ca and Fe (r=1.00; P≤0.05). High magnitude and non-significant correlation was found between Mg and Mn (r=+0.96); K with Fe (r=+0.99) and Ca (r=+1.0); Cu with Fe (r=+0.99), Ca (r=+0.98) and K (r=+0.96). Non-significant positive correlation in S were linked with Fe (r=+0.79), Ca (r=+0.83), K (r=+0.87) and Cu (r=+0.69). Non-significant negative correlation was noticed in S with Mn (r =-0.99) and Mg (r =-0.92).

Antioxidant and nutritional profiling of bottle gourd var. Thar Avani

The study has been conducted at CHES, Vejalpur under rainfed semi-arid conditions. The correlation coefficients among antioxidants, nutritional and physiological traits of bottle gourd var. Thar Avani were investigated and summarized by using the BLUPs. A strong positive correlation was found in CUPRAC with DPPH (r=1.00; P≤0.01). High magnitude and non-significant correlation was found in TF with CUPRAC and DPPH (r =+0.96). Among 29 physiological traits in bottle gourd varieties, highly significant correlation in FL and FW with FG and NFMF, respectively (r=+1.00; P≤0.05) were observed. Likewise, FW with FL (r=+1.00; P≤0.001). High magnitude and significant correlation was found between IL and LPL (r=+1.00; P≤0.01). The most important component (PC I) accounted for 2.82E+01 of the eigen value of various traits *viz.*, TF, P, Mg, Mn, LL, LW, LPL, IL, NFMF, NFFF, DFFA, NFFP, FL, FG, PdL and FW contributed significantly towards variation and remaining

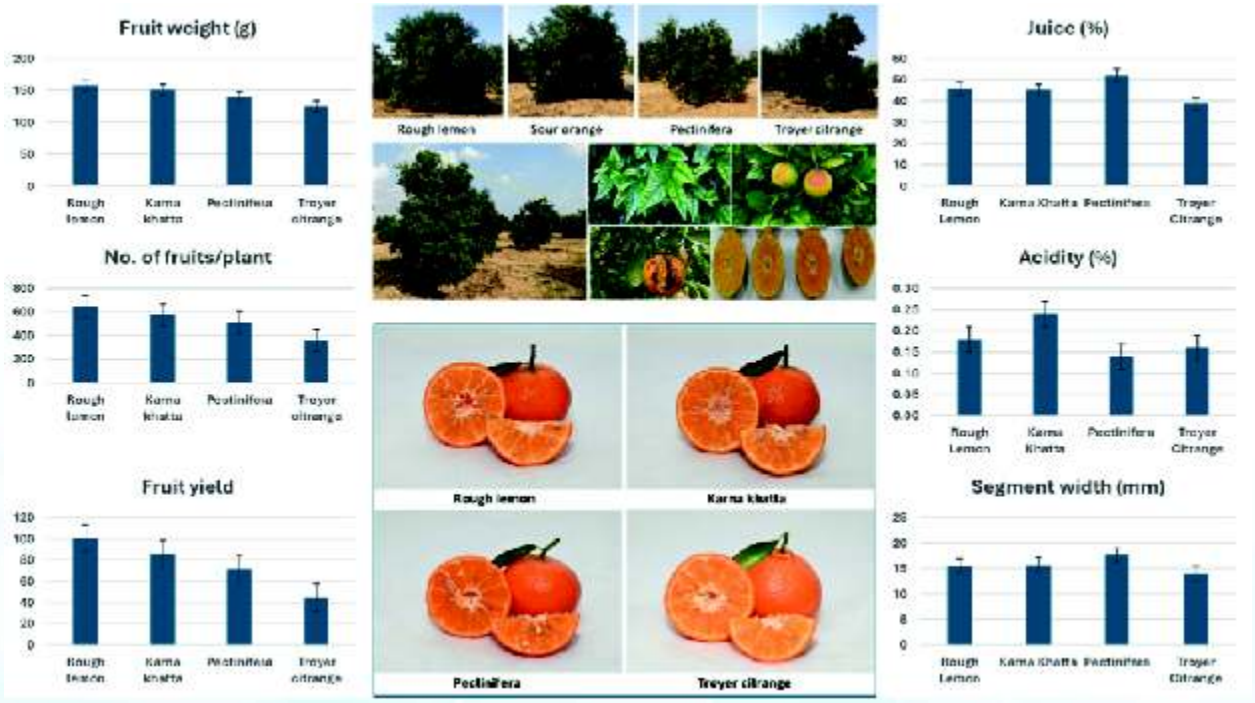
contributed negatively in PC I. High PCV and GCV were recorded for the TF (24.5398 and 25.1457), LPL (32.812 and 33.0797), IL (26.4953 and 26.6832), NFFF (44.5599 and 45.3748), DFFA (23.9766 and 24.1199), NFFP (60.336 and 61.3191), NMFP (26.8572 and 27.2372), FL (30.2802 and 31.4789), FG (50.0635 and 50.2592), FW (66.1507 and 66.3744), NFP (66.752 and 68.1876), FYP (37.6462 and 38.6746), FYH (37.6464 and 38.6749), SYP (74.9487 and 76.552) and SYH (74.9489 and 76.5522).

2.5 Crop Production

Impact of rootstocks on plant growth, fruit quality and performance of Kinnow mandarin in hot arid region

The growth, yield attributes, and juice quality parameters of Kinnow mandarin fruit were significantly influenced by the rootstocks. The heaviest fruit weight was recorded on Pectinifera, which was at par with Rough Lemon and Sour Orange. However, the number of fruits and yield were relatively higher on Sour Orange and Rough Lemon. Conversely, fruit quality parameters such as juice percentage, total soluble solids (TSS), ascorbic acid content, juice pH, and segment width were superior on Pectinifera, with the least seed weight. Troyer Citrange rootstock exhibited die-back and symptoms of micronutrient deficiency due to graft incompatibility. The maximum incidence of canker was reported on Sour Orange and Rough Lemon, with the least occurrence on Pectinifera. Additionally, alternate bearing was observed in Kinnow grafted on Sour Orange. Preliminary experiments revealed that plants raised on Pectinifera rootstock tend to have more accumulation of osmolytes during water stress experienced during summer.

The growth, yield attributes, and juice quality parameters of Fremont mandarin fruit were significantly influenced by the rootstocks. Freemont mandarin raised on Pectinifera rootstock was found at par to the same raised on other rootstocks with respect to quality parameters including juice percentage, total soluble solids (TSS), and had significantly less acidity. Further, Fremont raised on Pectinifera rootstocks exhibited the highest compatibility index, a dwarfing canopy structure, early fruit harvesting, deepest orange-saffron rind colour, and no incidence of canker or nutrient deficiency compared to commercial and other rootstocks. This combination of rootstock and scion can be highly promising for promotion of high density planting in the citrus orchards.

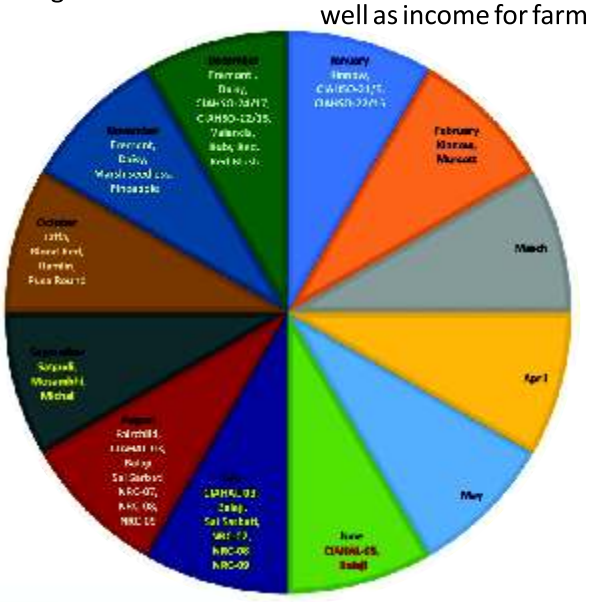


Effect of rootstocks on yield attributes and fruit quality of Fremont mandarin

The field experiment conducted on Mandarin cv. Daisy grafted on six rootstocks revealed significant impacts of rootstocks on plant growth, fruit yield, and juice quality parameters. Fruit growth parameters, such as fruit weight of Daisy raised on the Pectinifera was at par with Rangpur Lime and Karna Khatta rootstock. However, fruits of Daisy raised on Pectinifera were superior to other with respect to fruit juice quality, including juice %, TSS, and acidity (%). In addition, Pectinifera rootstock could impart notable tolerance to canker, sun scald, fruit cracking, and infestation by fruit-sucking moth. In contrast, Rough Lemon rootstock exhibited the maximum occurrences of these maladies among all rootstocks.

Sustainable citrus production module for the round the year fresh fruit availability

Citrus cultivation has emerged as a crucial and lucrative agricultural endeavour, renowned not only for its economic benefits but also for the nutritive value of the fruit. Recognizing its significance, the institute has been actively involved in the introduction and evaluation of various citrus species and their cultivars since 2015. Rigorous studies have been conducted to identify cultivars suitable for the challenging arid climatic conditions with the focus on adaptability, growth, yield, and fruit quality attributes. As a result of these efforts, a range of promising citrus varieties have been identified for ensuring the availability of high-quality fresh fruit in the market for approximately 8-10 months of the year under arid conditions. It was possible due to inclusion of sweet orange varieties Satgudi, Mosambi, Jaffa, and Blood Red Malta, which lead to the extended duration of harvesting that spans from September to January.Additionally, newly identified genotypes like CIAHSO-21/9, 21/15, 22/15, and 24/17 have contributed to widening the harvesting window. For mid-November to mid-December, cultivars Fremont and Daisy have been recognized. For January to February, Kinnow and Murcott have proven successful, while acid lime is suitable for harvesting from June to August. This expanded harvesting period not only helps avoid market glut for Kinnow but also provides fresh fruit with distinct and acceptable fruit quality profiles, that promises enhanced scope for fruit processing enterprises as well as income for farmer.



Options for promotion of processing industries in arid zone with availability of citrus fruits from February to May

Production system management in ber under hot arid ecosystem

An experiment was conducted to evaluate the impact of various training systems on different varieties of ber (*Zizyphus mauritiana*) trees focusing on optimizing fruit yield in orchards. It was observed that the Y shape training system showed comparatively better results, while the espalier system exhibited the lowest performance in achieving the target observations related to growth, flowering, and fruit set and yield attributes. The experiment also encountered challenges related to low temperature causing significant damage to the crops. Thai variety showed the highest susceptibility to damage followed by Thar Sevika, Goma Kirti and Gola. Additionally, among the different varieties of ber trees studied, Goma Kirti stood out by exhibiting better growth and fruit set compared to the other varieties under the different training systems.





Production system management in ber

Effect of organic manures on growth, yield and fruit quality of ber

The effect of organic nutrition in improving yield and quality of ber cv. Gola was studied at ICAR-CIAH, Bikaner. The treatments were control, FYM (40 kg/ plant), vermicompost (20 kg/ plant), FYM (40 kg/ plant) + biofertilizers, vermicompost (20 kg/ plant) + biofertilizers and crop residue (20 kg/ plant) + Decomposer. All organic manures was found to be effective in improving quality of fruits as well the yield, soil microbial population and enzyme activity in soil as compared to control. FYM or vermicompost and their combination with biofertilizers resulted higher fruits as well the yield, soil microbial population and enzymes activity in soil. The physico-chemical characters of ber were found to be superior with vermicompost + biofertilizers followed by FYM + biofertilizers as compared to others. Application of vermicompost + biofertilizers gave higher diameter, volume, pulp fresh weight, stone fresh weight, TSS, vitamin C and acidity which were 3.42cm, 23.50ml, 22.25g, 1.19g, 26.55%, 212.50mg/100g and 0.38%, respectively. Higher yield (14.90 kg/ plant), enzymes activity *i.e.* dehydrogenase (8.15 µg TPF g^{-1} dry soil h^{-1}), alkaline phosphatase (8.25 µg p-NP g^{-1} dry soil h^{-1}) and urease (395 µg NH_3^{-1}g dry soil h^{-1}) and microbial population (bacterial, fungal and actinomycetes population) were recorded in the same treatment.

Soil and water conservation studies in ber

An experiment was conducted on 8 year old plants of ber at ICAR-CIAH, Bikaner. There were 14 treatments which consisted of different combinations of NPK 100% RDF, NPK 100% RDF+30 kg FYM, NPK 100% RDF+60 kg FYM, NPK 100% RDF+60 kg FYM+mulching with black polythene, NPK 100% RDF+60 kg FYM+mulching with crop residues, NPK 100% RDF+30 kg FYM+ kaolin 3% (two spray), NPK 100% RDF+30 kg FYM+ kaolin 6% (two spray), NPK 100% RDF+30 kg FYM+ kaolin 6% (two spray), NPK 100% RDF+30 kg FYM+K_2SO_4 100 ppm (two spray), NPK 100% RDF+30 kg FYM+ K_2SO_4 200 ppm (two spray), NPK 100% RDF+30 kg FYM+ salicylic acid 200 ppm (two spray), NPK 100% RDF+30 kg FYM+thiourea 500 ppm (two spray), NPK 100% RDF+60 kg FYM + *Aloe vera* jel spray and NPK 50% RDF+50% canopy reduction. Application of NPK 100% RDF+60 kg FYM+mulching with crop residues gave higher yield attributes *i.e.* fruit length (3.68 cm), fruit diameter (3.32 cm), fruit weight (21.68 g), fruit volume (21.68 ml), pulp thickness (1.28 cm), stone weight (1.98 g), pulp weight (20.46 g) and fruit quality attributes *i.e.* acidity (0.22%), TSS (19.64%), total sugar (9.68%), reducing sugar (5.86%), non-reducing sugar (3.86%) and ascorbic acid (96.76 mg/100 g). The maximum microbial population (bacterial, fungal and actinomycetes) of soil during growth period of ber and enzyme activity of soil during December month (dehydrogenase, alkaline phosphatase and urease) was also recorded in the treatment NPK 100% RDF+60 kg FYM+mulching with crop residues.

Fruit drop and sunscald management in bael cv. Goma Yashi

The nine treatment combinations were imposed in bael cv. Goma Yashi to manage fruit drop and sunscald at CHES, Vejalpur. Recorded the minimum fruit drop (94.10%) and sun scald (17.85%) with the highest fruit retention (5.50%) with grass mulch+NAA (15 ppm)+course cotton cloth followed by grass mulch+NAA (15 ppm)+ascorbic acid (95.53, 22.18 and 4.47%) and grass mulch+$ZnSO_4$ (1000 ppm)+coarse cotton cloth (97.50%, 25.35% and 2.50%). However, the maximum fruit drop (98.0%) and sunscald affected fruits (48.87%) with minimum fruit retention (2.0%) were recorded in control. Qualitative attributes in terms of TSS (38.0°Brix), total sugar (17.03%) and vitamin C (21.12 mg/100g) were recorded in grass mulch+NAA 15 ppm+coarse cotton cloth, however, these parameters were recorded the lowest in control.



Fruit drop after setting



Fruit drop in bael

Canopy management in bael cv. Goma Yashi

Various pruning treatments (2.5 m plant height+25% AGE, 2.5 m plant height+50% AGE, 2.5 m plant height+75% AGE, 3 m plant height+25% AGE, 3 m plant height+50% AGE and 3 m plant height+75% AGE and control: no pruning) were tried in bael cv. Goma Yashi during 2022-23 at CHES, Vejalpur. The maximum number of shoots (4.50) was recorded with treatment 3 m plant height+25 per cent AGE). However, the length of shoot (38.10 cm) was recorded maximum in treatment 3 m plant height+50 per cent AGE. The comparatively higher yield per plant was recorded with 3 m plant height+25% AGE (82.0 kg) followed by 2.5 m plant height+25% AGE (75.15 kg), whereas the lowest yield per plant was observed with 2.5 m height+75% AGE (60.50 kg) under rainfed semi-arid conditions. Fruit weight (1.35 kg), fruit size (15.20 x 13.42 cm) and TSS (38°Brix) was recorded the maximum in the plants in which height was maintained at 3 m and pruned at 25 per cent annual growth extension (AGE).



Bud emergence after pruning in bael

INM in bael cv. Goma Yashi

Experiment on integrated nutrient management (INM) was conducted in bael cv. Goma Yashi involving various treatment combinations of mulches, biofertilizer and fertilizers. The maximum plant height (5.05 m) was recorded with the application of standard dose of NPK followed by grass mulch+FYM+neem cake+50% recommended dose of NPK+*Azotobactor*+VAM culture (4.90 m) followed by grass mulch+FYM+25% recommended dose of NPK+*Azotobactor*+PSB culture and it was recorded minimum in FYM @ 20 kg/ plant (4.0 m). The plant spread (4.75 m), stem girth (32.45 cm) and fruit retention (31.32 fruits/ plant) was found the maximum with grass mulch+FYM+neem cake+50% recommended dose of NPK+*Azotobactor*+VAM culture under rainfed semi-arid conditions. Results of the study revealed non-significant differences for fruit weight and size, but exhibited significant variation in quality attributes in terms of TSS in pulp and mucilage and vitamin C.

Effect of organic manure and mulching material on cluster bean crop as intercrop

Field trial was conducted at ber block during *kharif* season and cluster bean as intercrop utilizing organic manure and mulching material as organic/ natural sources.Recorded the maximum plant height at harvest (74.5 cm), number of branches per plant (8.23), dry matter accumulation (7.26 g) and number of pods per plant (47) in cluster bean as compared to control. Significant difference was exhibited with integrated nutrient management on yield and yield attributes of cluster bean crop. The treatment *i.e.* organic manure (FYM) application gave significantly higher yield (8.47 q/ ha.) over the control *i.e.* no FYM (6.34 q/ ha.). Similarly the use of mulching as INM exhibited higher yield parameters (8.37 q/ ha.) as compared to no mulching (7.24 q/ ha.). The initial soil samples were taken and analysed soil pH (7.9), EC (0.30 dSm^{-1}) and bulk density (30, 1.49 g/cm^3).



Cluster bean as intercrop in ber orchard

Effect of micronutrients on green leafy vegetables

Several field experiments were undertaken to study the impact of saline water in conjunction with various combinations of FYM and vermicompost as soil amendments coupled with foliar and soil application of micronutrients.

Coriander: The optimal yield of coriander (*Coriandrum sativum*) variety ACr-1 was achieved with the treatment comprising 0.5EC salinity, along with a combination of 50% FYM and 50% vermicompost supplemented by a foliar spray of micronutrient ($ZnSO_4$ @ 0.5%) and soil application of $FeSO_4$ @ 0.5%. This treatment resulted in a production of 8.28 tonnes per hectare surpassing other treatments. Specifically, the treatment involving 0.5EC salinity, 50% FYM, 50% vermicompost, and the foliar application of micronutrient exhibited the highest plant height (29.03 cm), number of primary branches at harvest (4.30) and leaf area (67.95 cm^2) at 45 days leaf harvest. The application of micronutrient contributed to improved root and shoot development, enhanced water uptake and efficient nutrient transportation. The combination of 50% FYM, 50% vermicompost and micronutrient application performed well across all salinity levels.

Optimisation of saline water use for vegetable cultivation

Spinach: The maximum yield of spinach (*Beta vulgaris*) variety Thar Hariparna was observed in the treatment of salinity 4 EC (IW)+100% NPK+FYM with a production of 202.15 q/ ha. This treatment out performed other treatments indicating the significance of the interaction between salinity levels and the application of 100% NPK fertilizer along with FYM. The study highlighted a significant effect of salinity levels on yield parameters and the treatment of 4 EC (IW)+100% NPK+FYM showed promising results across different salinity levels.

Radish: In radish (*Raphanus sativus*) experiment, it was observed that vegetative growth and yield remained relatively high even under high salinity conditions (4EC) when supplemented with 100% NPK (inorganic) along with FYM and yielded 219.8 q/ha. The highest level of ascorbic acid (28.73 mg/100 g FW) was recorded in the treatment involving 0.5EC irrigation water combined with 100% NPK+FYM. Additionally, noteworthy level of ascorbic acid (26.24 mg/100 g FW) was observed in treatments with 2EC irrigation water+100% NPK+FYM (26.28 mg/100 g FW) and 4.0 EC irrigation water+100% NPK+FYM.

Ker multiplication using apical shoots

The apical shoots were selected for making cuttings of about 30 cm in length. The prepared cuttings were planted in soil, clay, vermiculite and soilrite in various proportions. Five cuttings in each pot with five replications and twelve cuttings in each root trainers with three replications were planted during September 2023. From the results, it is inferred that soilrite media found suitable with respect to cutting sprouting, rooting and growth of ker cuttings.

Vegetative multiplication of Gondi *(Cordia gharaf)*

Different vegetative propagation means were tried for the propagation of *Cordia gharaf*. The success has been achieved in the vegetative propagation through semi-hard wood cutting using IBA and soilless media. During the investigation, it was observed that over-callusing hindered the proper process of rooting. Due to over-callusing the cuttage resulted in high mortality even after 30-35 days of growth.



Callus initiation



Over-callusing



Adequate callusing



Propagated saplings of Gondi

Efficient pollination methods in date palm

Pollination method play a very important role in the fruit set, quality and yield attributes of date palm. Therefore, the effect of different pollination method (pollen dusting, strand placement, cotton plug and pollen suspension) were used for pollination in cultivar Halawy. Among the pollination methods, pollen suspension and dusting pollination methods exhibited the maximum fruit weight (9.3 and 9.8 g), fruit length (38.1, 37.8 mm) and fruit width (19.6, 19.7 mm). The maximum number of fruit retention at pea stage was recorded in the cotton bud (27.0%) and dusting method (26.0%). The maximum fruit set was recorded in the pollen suspension (81.8%) followed by strand placement (79%) method. The pollen suspension method resulted in maximum bunch weight (7.5 kg/bunch). Thus, it is concluded that pollen dusting and pollen suspension techniques are the best methods to pollinate date palm cultivar Halawy due to ease in pollination and cost-effectiveness.



Pollination through dusting



Pollination through suspension

Pollen viability studies in date palm

A pollen viability test was conducted on various male date palm genotypes to evaluate the reproductive potential. The freshly harvested pollen of six promising male date palms *viz*., CIAH-DP-1, CIAH-DP-2, CIAH-DP-4, CIAH-DP-5, CIAH-DP-6 and Ghanami was analyzed for pollen viability through staining with 1% acetocarmine. Pollen grains looking normal and stained red were considered viable, whereas weakly stained or colourless were recorded as non-viable. It is revealed that an impressive 90% of fresh pollen samples exhibited viability.

Phog plantation for conservation and horticultural utilization

Phog (*Callgonum polygonoides*) is multiple-function desert flora and have horticultural significance. It is abiotic stresses tolerating perennial shrub of sand-dunes eco-system and well-known for its energy rich fuel-wood, leaf-fodder (*Lhassu*) and flower-buds (*Phogla*). It is the most extinct flora of the Indian *Thar* Desert, and ICAR-CIAH took its conservation and horticultural promotion research studies. Studied the seed propagated progeny saplings of CIAH-PHOG-1 as block plantation (4m x 4m) for growth and bio-mass harvest to standardize package of practices to promote nature's resilient farming.

Khejri based native crop production system: A model for sustainable round the year income

Khejri (*Prosopis cineraia*) is an important integral part of traditional farming system of hot arid region of Thar Desert. A two-hectare area of sand dunes ecosystem was developed into a sustainable crop production site by integrating native annual and perennial horticultural crops with khejri var. Thar Shobha as main component under complete rain fed conditions. The native crops are khejri, ker, jharber, lasoda, phog, bordi as perennial component and kachri, mateera, kakadia and tumba as seasonal crops. Ten years long studies suggest that this crop production model can provide round the year income to the farmers in the form of fruits, vegetables, fodder, and fuel wood and also support livestock rearing under resource poor conditions. In January-February, this production system provides jharber fruits, fodder and fuel wood from both crops jharber and khejri. Subsequently, phogla, bordi, ker fruits and sangri obtained from phog, ker, bordi and khejri trees in March-April months. In May-June, fruits of lasoda and ker can be harvested and *khokha* also obtained from khejri. In July-August, farmers can receive income from selling of Thar Shobha bud sticks and tender mateera fruits (*loiya*) and vegetable type cluster bean. Annual and perennial vegetables *viz.,* mateera, kachri, kakadia and ker fruits are harvested in September-October from this crop production model. In November-December, farmers can receive income from jharber and tumba fruits, phog fodder and fuel wood. In essence, this successful conversion of sand dunes into

sustainable crop production models highlights the potential of integrating native horticultural crops in the hot arid regions. Not only does it provide a diverse source of income for farmers throughout the year, but it also extends valuable ecosystem services. This innovative approach serves as a promising model for transforming challenging environments into productive and sustainable agricultural landscapes.



Khejri based native production system

Effect of seed hydro-priming on germination and vigour of ridge gourd

The seed hydro-priming studies have been done in ridge gourd (Thar Karni). The treatments comprised of hydro-priming for 6 hr (T_1), 12 hr (T_2), 18 hr (T_3), 24 hr (T_4), 36 hr (T_5) and no hydro-priming *i.e.* control (C). The maximum water uptake (47.66%) was found in seeds hydro-primed for 36 hours and it was the lowest in non-hydro-primed seeds. The maximum seed germination was also recorded in seeds hydro-primed for 36 hours. Similarly, the tallest and most vigorous seedlings in terms of seedling vigour index-I (2011.62) and II (81.57) was observed in 36 hours hydro-primed seeds. Thus, 36 hours of seed hydro-priming was found to be effective for increasing germination and seedling growth in ridge gourd.

Surface covering protective vegetable nursery technology

Extreme high and low temperature condition of arid region is the major hindrance for raising of vegetable nursery in time with common practices of nursery. In this context, the institute has developed a technology for round the year vegetable seedling production. It is local fabrication, simple, cost-efficient and an excellent mechanism to escape from the severity of temperature. Cot-type iron frames were fixed on raised beds (50-60 m^2 plot area on a pair bed of 25 m x 01 m size). After seed sowing the frames were covered with transparent polythene (120-200 gauge) and 40 mesh insect-proof nylon-net during winter and summer season, respectively.



Healthy nursery raising of tomato and chilli

Vegetable nursery technology validation

Validation of the technology "Surface covering protective vegetable nursery scheme/ technology" was done at KVK, Sardarshahar, Churu on 29 November, 2023. Raised bed of having dimensions of 15 m x 90 cm x 15 cm (length x width x height) was prepared. Lines (2-4 cm deep) were made (by use of pencil thickness twig or wire) at 8-10 cm apart and perpendicular to the length of bed. Seeds of brinjal (Thar Rachit) were treated with fungicide and single seed was sown at 1-2 cm distance. First watering was done with the use of rose-cane. After that, two drip lateral pipe lines were laid down in parallel fashion on nursery bed followed by covering with half circular rings and polythene sheet. Proper soil moisture was maintained through drip system operating 1.0-1.5 hours thrice a week. Two inter-culture operations and hoeing were done at 12-15 days' interval.



Disease free nursery raising of brinjal

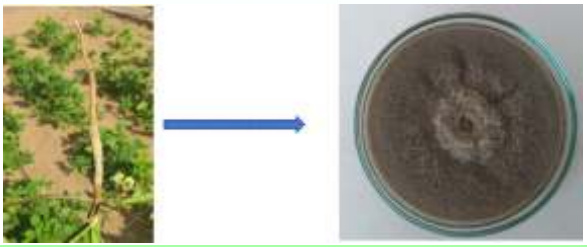
2.6 Crop Protection

Date palm germplasm screened against Alternaria leaf spot disease

Screening of 32 date palm germplasm for tolerance against Alternaria leaf spot caused by *Alternaria alternata* has been carried out at Date palm Germplasm Block of the institute. Symptoms were observed as small light, circular and dark gray to brownish spots. Later on, these spots increased in size and became irregular, black to straw colored, and coalesced. Disease incidence (PDI) of *Alternaria* leaf spot was found ranging from 2.72 to 28.53% in different date palm germplasm. Its minimum disease incidence (<5.0% PDI) was recorded in Khuneizi (2.72%), Samran (4.62%), Bhukso (4.31%) and Chip-Chap (4.98%). The maximum disease incidence (28.53% PDI) was found in Medzool followed by Halawy (25.62%) and Nagal (20.48%) under field conditions.

Isolation of the phytopathogenic fungus

During the investigation observed dry root disease in vegetable cowpea and cluster bean. The infected plants exhibited drying of roots. The xylem tissues were found discoloured with dark brown fungal mycelium growth. The pure culture of the associated fungus was isolated from the freshly infected roots. The fungus produced dark brown mycelium on the PDA, which identified as *Macrophomina* spp.



Dry root rot symptoms on cluster bean and morphology of isolated pathogen

Isolated pure culture of "Native mushroom"

The fruiting bodies of native mushroom were collected naturally occurring in hot arid region. The immature fruiting bodies were surface sterilized and the spore mass was inoculated on different culture media, *viz*., PDA, YME, OMA, *etc*. Initially the mycelium grows in white fluffy growth after three day and produce diverse morphology on different media. On PDA it produced orange and YMEA it produced purple coloured when see from the reverse side of the petri plate.



Growth of pure culture on media

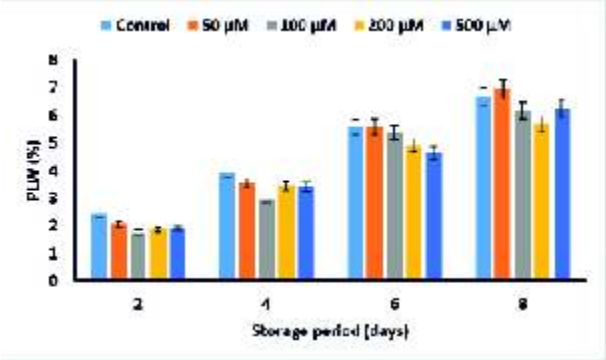
2.7 Post-Harvest Management and Value Addition

Effect of post-harvest melatonin treatment on ber

This study was conducted to investigate the effect of post-harvest melatonin treatment on visual appearance, quality characteristics, antioxidants capacity and physicochemical changes in ber cv. Gola stored at room temperature for 8 days. The fruits were treated for 10 minutes in 0 (control, distil water), 50, 100, 200 and 500 µM/L melatonin aqueous solutions after harvest. Physical, biochemical and antioxidants activity was observed

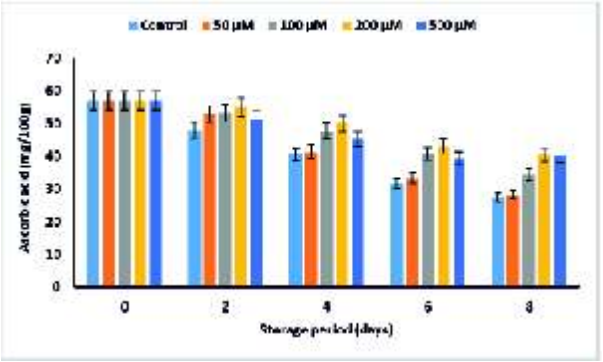
at 2 days' interval for the period of 8 days.

Physiological loss in weight (PLW%): Melatonin treatment significantly inhibited weight loss as compared to control. At the end of storage period, minimum weight loss (5.67%) was observed in fruit treated with 200 µM/L melatonin and maximum PLW (6.93%) was recorded in control.



Changes in PLW (%) in ber

Ascorbic acid content (mg/100g): The lowest mean ascorbic acid content (27.36 mg/100g) was observed in control at the end of storage. The ascorbic acid content was significantly higher in 100, 200 and 500 µM/L melatonin treated fruits. However, non-significant difference observed between control and 50 µM/L melatonin treated fruits.



Changes in ascorbic acid content

Changes in TSS (°Brix) and titrable acidity (%): Rapid rise in TSS was observed in untreated fruit samples during 2nd and 4th day, after thar TSS was decreased in control. However, in melatonin treated samples gradual increase in TSS was reported. In titratable acidity, non-significant difference was reported during first two days of storage however, at 4th and 8th days significant difference was noticed in titrable acidity between control and melatonin treated samples. The relatively lower TSS and higher acidity showed that melatonin treatment could delay the process of fruit senescence during storage at room temperature by preserving characteristics flavour and taste of ber fruit. The results showed that post-harvest treatment with a melatonin concentration (200 and 500 µM/L) improved the percentage of firm fruits, delayed weight loss, reduce decay, extend freshness and prevent colour change from light green/ yellow to brown. Melatonin treatment suppressed changes in total soluble solids (TSS) and titratable acidity of ber fruits compared with the control. In addition, fruits soaked with melatonin showed improved antioxidant capacity through increased ascorbic acid content, phenols and flavonoids.

Optimization of process for long term storage of snapmelon puree

This study aimed to develop a process for extracting snapmelon puree and evaluate its biochemical and microbial quality during extended storage at both ambient and refrigerated conditions. The results revealed that puree stored in refrigerated conditions retained significantly higher levels of ascorbic acid (11.31 mg/100g) and β-carotene (1.72 µg/100g) compared to puree stored at ambient conditions. Refrigeration also effectively preserved the total phenols, flavonoids content and antioxidant properties. After 240 days of storage, the refrigerated samples retained better values for total phenolic content (TPC), total flavonoid content (TFC), and total antioxidant activity (CUPRAC) than that of stored at ambient condition with the magnitude of 0.338 vs 0.226 mg GAE/g, 0.695 vs 0.514 mg cate/g, and 0.409 vs 0.146 mg AAE/g, respectively. It was also found that total and reducing sugars increased in ambient conditions, whereas refrigerated storage prevented a rise in both sugars during storage.



Snapmelon pulp



Snapmelon ketchup

Furthermore, microbial growth was notably slower in refrigerated puree. After 240 days of storage, total plate count and yeast/ mould count was observed 103.19% and 56.71% higher, respectively in ambient and refrigerated conditions. By the end of the storage period, the microbial load in both storage conditions met the standards set by the Food Safety and Standards Authority of India (FSSAI), and the puree was deemed suitable for further processing into ketchup and sauces. The study demonstrated that snapmelon puree can be stored for up to 8 months with acceptable quality under both ambient and refrigerated conditions.

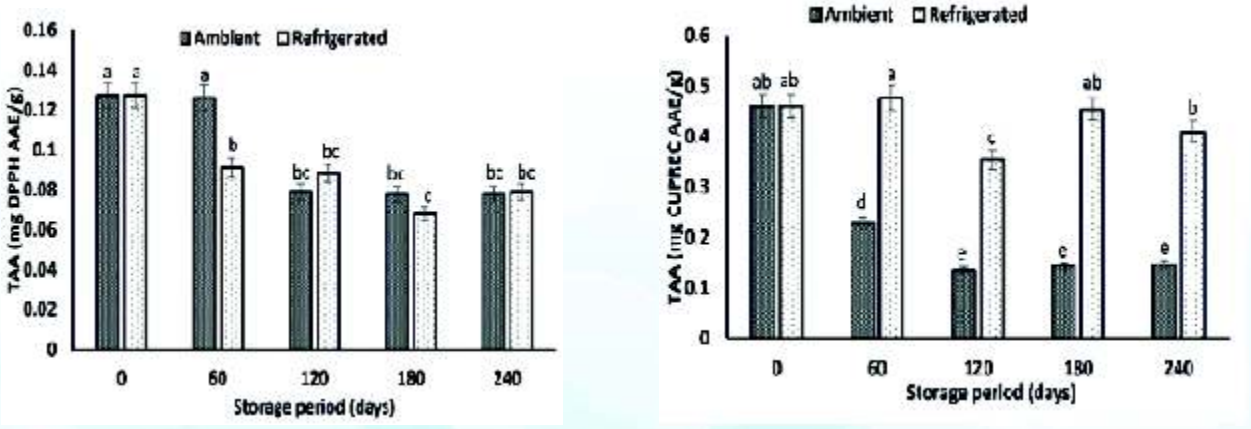
Changes in biochemical parameters of snapmelon during storage

Storage conditions	Storage duration (days)	TSS (°Brix)	Titrable acidity (% citric acid)	Ascorbic acid (mg/100g)	β-Carotene (µg/100g)
Ambient	0	4.53±0.02^{c}	0.52±0.01^{a}	17.49±0.08^{a}	2.65±0.03^{a}
	60	4.60±0.06^{c}	0.54±0.03^{a}	12.58±0.10^{c}	1.82±0.06^{c}
	120	5.00±0.04^{a}	0.54±0.02^{a}	11.52±0.06^{cd}	1.48±0.04^{cd}
	180	5.10±0.02^{a}	0.53±0.01^{a}	9.38±0.08^{d}	1.29±0.02^{e}
	240	5.03±0.05^{a}	0.53±0.05^{a}	7.04±0.012^{e}	0.85±0.01^{b}
Refrigerated	0	4.53±0.02^{c}	0.52±0.01^{a}	17.49±0.08^{a}	2.65±0.03^{a}
	60	4.60±0.01^{c}	0.51±0.01^{a}	17.06±0.12^{ab}	2.39±0.07^{ab}
	120	4.73±0.03^{b}	0.53±0.03^{a}	15.14±0.06^{b}	2.17±0.03^{b}
	180	4.80±0.05^{b}	0.53±0.02^{a}	12.80±0.05^{c}	1.94±0.06^{c}
	240	4.83±0.02^{b}	0.53±0.01^{a}	11.31±0.09^{cd}	1.72±0.02^{c}

Data expressed as mean ± standard deviation of triplicates. Means within the same column have no common superscripts are significantly different at $p<0.05$.

Changes in total antioxidant activity in snapmelon puree during storage

Total antioxidants activity (TAA) was estimated in terms of CUPRAC (Cupric reducing antioxidants capacity), and DPPH (2, 2-diphenyl-1-picrylhydrazyl) during storage. TAA by CUPRAC method was significantly reduced in ambient stored samples during initial 60 days period. Thereafter, it remained stable throughout the storage period. In refrigerated puree, TAA was significantly declined till the 120 days of storage followed by significant increase at 180 and 240 days. TAA estimated in terms of DPPH method showed significant decline during initial 60 days in both storage conditions. Thereafter, it remained stable with non-significant differences throughout the storage period, except at 180 days. It is evident from the data that storage conditions have practically no effect on TAA assessed in terms of DPPH. However, strong effect of storage temperature was observed for TAA analyzed by CUPRAC method. This is probably because the TAA values are not related to a single compound or class of compound but to a synergism between the antioxidant activities of different classes of compounds.



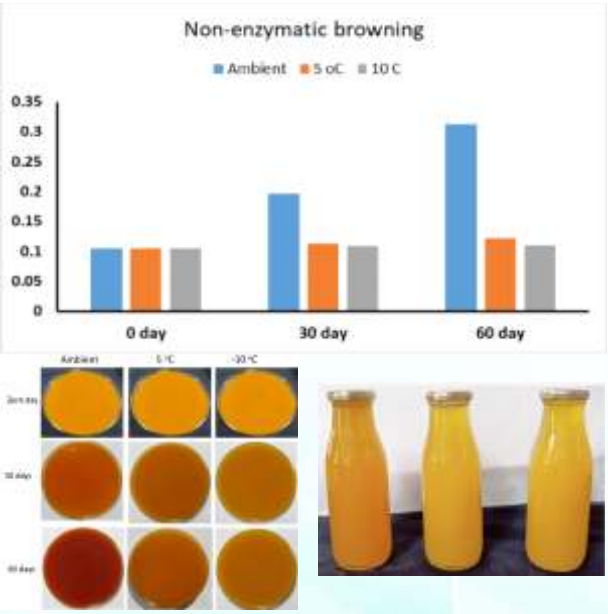
Changes in total antioxidant activity in snapmelon puree during storage

Protocol developed for bael pulp extraction and storage

Bael variety, Goma Yashi stands best for processing due to high pulp, excellent colour and exquisite flavour. To enhance its processing potential, a protocol has been standardized for ripening, pulp extraction, preservation and storage. To investigate the storage life, pulp was packed in food grade plastic boxes and stored at three temperature conditions *viz.,* ambient, 5°C and -10°C. The observations were recorded at 30 days interval. After 60 days of storage, TSS and total phenolics were slightly enhanced in pulp stored at ambient conditions while in low temperature these parameters remain quite stable. Similarly, non-enzymatic browning (NEB) was significantly enhanced in ambient conditions as compared to pulp stored under low temperature. However, non-significant difference in sensory characters was noticed in pulp stored at 5°C and -10°C. Therefore, bael pulp can be stored at 5°C temperature without compromising its quality for long period.



Various steps involved in bael post-harvest handling



Colour and NEB changes in bael pulp stored at different temperatures

Development of innovative processing methods for Ker fruits

The tender, green, immature ker fruits (*Capparis decidua*) at pea size stage (horticultural maturity) found most desired for culinary exploitation but are not palatable due to acrid taste and required primary processing (de-bittering) for consumption or value addition. The traditional method of removing the fruit acridity is time consuming and cumbersome which resulted in significant loss in quality and medicinal properties. Therefore, innovative quick process for removal of bitterness and preservation have been developed. Lactic acid fermentation process has been standardized for quick removal of fruits acridity which includes dipping of fresh fruits in water with additives immediately after sorting/ grading.

After de-bittering, alternative preservation method, *i.e.*, brining and freezing were standardized for long-term fruits preservation. Preservation through brining was carried out by dipping primary processed fruits in 5% salt solution and packing in glass or food grade plastic bottles. Potassium metabisulphite 200 ppm was added in salt solution to check microbial growth during storage. In frozen storage, primary processed fruits are blanched in hot water for 2 minutes, air dried and packed in food grade polybags and kept for storage at -5°C temperature in freezer. The storage life in both the methods was 10-12 months.



Flow chart 1 : Preservation through brining



Flow chart 2 : Preservation through freezing

Technology for economic utilization of residual sugar syrup

Candy is key processed product of aonla. During candy preparation process large quantity of sugar syrup remains as residue which is discarded at the end by the processors. It causes economic loss to the industries particularly small-scale cottage industry because they have poor infrastructure for proper utilization of residue syrup. Therefore, a

technology of aonla squash and RTS preparation was standardized by utilizing residue sugar syrup obtained as biproduct from candy processing. This technology ensures economic utilization of residue sugar syrup which may results into increase in profitability of small-scale processors.



Aonla squash made from residue sugar syrup

2.8 Agricultural Extension

Area and production of pomegranate and date palm in hot arid regions of Rajasthan

At present the area as well as production of date palm is in Bikaner district (344 ha) followed by Jaisalmer (221 ha), Sri Ganganagar (198 ha), Barmer (168 ha) and Hanumangarh (153 ha). The area and production under date palm was found lowest in Sikar and Jhunjhunu district of hot arid region of Rajasthan. The area and production under improved variety of pomegranate in different districts of hot arid region of Rajasthan were also collected and documented. The present situation with respect to area under pomegranate was observed highest in Barmer district (7813 ha) followed by Jalore (3194 ha), Bikaner (1636 ha), Jodhpur (394 ha), Jaisalmer (376 ha), Pali (301) and others. The lowest area was observed in district like Churu, Sikar, Sri Ganganagar and Nagaur. The trend of production (highest-lowest) was also observed more or less same as the trend of area (expansion of area) in deferent districts (hot arid region of Rajasthan) of as above.

Economic impact of adoption of date palm

- Cost of establishment of orchard per ha ranged Rs. 1.3-1.39 lakh.
- Total cost of cultivation (per ha/ year) ranged Rs. 1.5-2.41 lakh (up to fruiting).
- Total yield (per ha) fluctuated/ ranged 5.8-7.8 tons (10-12 years old orchards).
- Selling price of quality fresh date fruits fluctuated between Rs. 38-62 per kg.
- It was assessed/ estimated that the total gross income of all date palm growing farmers of the hot arid region of Rajasthan ranged between Rs. 3.80 crore/ year in 2003 which was increased to 14.94 crore in 2017 and 16.60 crore in 2023.
- As per assessment/ estimate of net income of all date palm growing farmers of the hot arid region of Rajasthan revealed range between Rs. 2.40 crore/ year in 2003 which was increased to 10.30 crore/ year in 2017 and 11.60 crore/ year in 2023.

Economic impact of adoption of pomegranate

- Cost of establishment of orchard per ha ranged Rs. 1.35-1.52 lakh.
- Total cost of cultivation (per ha/ year) was ranged Rs. 1.38-1.89 lakh (up to fruiting).
- Total yield (per ha) fluctuated/ ranged 3.4-7.7 tons (4-8 years old orchards).
- Selling price of quality fresh fruits of pomegranate fluctuated between Rs. 30-60/- kg.
- It was assessed/ estimated that the total gross income of all pomegranate growing farmers of the hot arid region of Rajasthan ranged between Rs. 8.80 crore/ year in 2003 which increased to 18.68 crore/ year in 2017 and 23.22 crore/ year in 2023.
- As per assessment/estimate of net income of all pomegranate growing farmers of the hot arid region of Rajasthan revealed range between Rs. 6.10 crore/ year in 2003 which was increased to 13.23 crore/ year in 2017 and 16.10 crore/ year in 2023.

Socio-economic impact as a result of adoption of improved production technologies of date palm and pomegranate

Impact in terms of social changes

- Increasing flow of farmers from laggardism to innovatism (18-30%).
- Close interaction and intimacy among the farmers increased to exchange inputs/ technologies with respect to adoption of date palm and pomegranate (24-32%).

- Increased the commodity interest groups in social system (8-12%).
- Increased the cosmopolitism and scientific orientation of the farmers (17-28%).
- The windfall profit (advantage earned by first adopter) farmers (21-31%).

Impact in terms of agro-ecological changes

- Farmers (38-52%) were of the opinion that after adoption of date palm and pomegranate crops, a significant reduction was occurred in soil erosion and shifting sand dunes/ sand in the crop fields.
- The overall the micro-climate of the area/ crop fields became mild and pleasant.

Impact in terms of change in cognitive behaviour

- Increased the knowledge, awareness and interest among >55% farmers with substantial earning of money in business mode at national and even at international level.

3. EXTERNALLY FUNDED PROJECTS

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: Different salinity levels of water were significantly affected the different growth and yield parameters. The significantly maximum canopy volume (4.40m^3) was recorded in T_1 (EC 0.75 dSm^{-1}) treatment which was at par with T_2 (EC 1.75 dSm^{-1}) treatment (4.2 m^3) as against minimum canopy volume recorded in T_6 (EC 6.00 dSm^{-1}) treatment (3.20 m^3). The significantly maximum fruit yield/ plant (16.64 kg) was observed in T_1 (EC 0.75 dSm^{-1}) treatment which was at statistically par with T_2 (EC 1.75 dSm^{-1}) treatment (16.05 kg) as compared to minimum fruit yield/ plant recorded in T_6 (EC 6.00 dSm^{-1}) treatment (14.06 kg/ plant), respectively. The reduction in fruit yield may be attributed to reduction in canopy volume, number of fruits per plant and fruit weight.

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

Funding agency: PPV&FRA, New Delhi

Achievements: During summer season of 2023, conducted the DUS testing of 08 entries of watermelon (22 Wm H1 Hybrid, 2879/2943/H Candidate Hybrid, 22 Wm H2 Hybrid, 2879/2943/H F_1 Hybrid SMG, WM 22 H3 Candidate Hybrid, WM 22 H3 F_1 Hybrid SMG, WM 22 H1 Candidate Hybrid, WM 22 H2 Candidate Hybrid) under the category of candidate hybrids. In muskmelon, received 03 entries under the category of candidate hybrids (MM 22 H2 Candidate Hybrid, MM 22 H2 F_1 Hybrid SMG, MM 22 H4 Candidate Hybrid), 02 entries under farmer variety category (22MuFV1, 22 MuFV2) and 03 entries under typical category (22 MM-1 Typical, 22 MM-2 Typical, 22 MM-3 Typical). All entries of muskmelon were evaluated for DUS testing as per DUS descriptors during the summer season of 2023. The seed of all reference varieties of watermelon and muskmelon has been maintained for the use in DUS testing.

Project: DUS Nodal Centre for Ber

Funding agency: PPV&FRA, New Delhi

Achievements: Twenty-five references, 85 example varieties, and 21 new characterized ber genotypes have been maintained in the field gene bank. In reference (25), example (85) and new (21) ber varieties have been maintained in the field. DUS parameters were studied along with flowering, fruit set pattern as well as low temperature injury levels.

Project: DUS Co-nodal Centre for Aonla

Funding agency: PPV&FRA, New Delhi

Achievements: A total of 14 varieties (Chakaiya, Banarsi, Francis, Krishna, Kanchan, NA-10, Anand-1, Anand-2, NA-7, NA-6 Goma Aishwarya, BSR-1, Laxmi-52 and BSR-2) are being maintained as reference varieties at CHES. One farmer genotype of aonla is being characterized as per DUS guidelines.

Project: DUS Nodal Centre for Date palm

Funding agency: PPV&FRA, New Delhi

Achievements: The reference varieties *viz*., Halawy, Khalas, Khadrawy, Shamran, Zahidi, Braim, Chip-chap, Sewi, Khuneizi, Bint-a-Isha, Medjool, Hayani, Khairpur Pakistan, Medini, Saidy, Sabiah, Bikaner Local, Panjab Red, Muscut, Tayer, Migraf, Hamara, Saddami, Dayari, Gulchatti, Hillali, Nagal, Sayer, Umshok, Nagal Hilali, Sakloti, Javantri, Suria, Khasab, Abdul Rehman, Hatemi, Bhukso, Kotho, Amiri, Ahmat were maintained at the centre. The observation of plant morphological, fruiting, quality and yieldattributing parameters, respectively were recorded as per the DUS descriptors.

Project: DUS Nodal Centre for Bael

Funding agency: PPV&FRA, New Delhi

Achievements: Nineteen reference varieties (Goma Yashi, Thar Divya, Thar Neelkanth, Thar Srishti, Thar Prakriti, Thar Shivangi, Thar Gauri, Thar Bhavya, CISH-B-1, CISH-B-2, NB-16, NB-17, NB-5, NB-7, NB-8, NB-9, NB-10, Pant Aparna, Pant Shivani, Pant Sujata and Pant Urvashi) were maintained in field repository as reference variety at CHES for testing of farmer's variety. Three farmer's bael genotypes were registered 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 Goma Prateek, Pratisthan, T-263, PKM-1, Ajanta, DTS-1, Red Type, Sweet Type, Bantoor, Urigum and CHEST-10 were maintained for DUS testing of farmer's variety. Ten reference varieties/ genotypes of chironji namely Thar Priya, CHESC-1, CHESC-2, CHESC-3, CHESC-4, CHESC-5, CHESC-6 CHESC-8, CHESC-9, CHESC-10 were maintained in the field repository of CHES for DUS testing of varieties.

Project: DUS Co-nodal Centre for Jamun

Funding agency: PPV&FRA, New Delhi

Achievements: Six candidate/ reference varieties (Goma Priyanka, Konkan Bahadoli, CISHJ-42, Thar Kranti, Jamwant, Gokak-1) were maintained in field repository at CHES for testing of farmer's variety. Onsite DUS testing of denomination jamun variety Round the year jamun of Tumkur district farmer was conducted in the month of October, 2023 and submitted the report to funding agency.

Project: Production of quality planting material of Khejri (2022-23 to 2024-25)

Funding agency: NABARD Regional Centre, Jaipur

Achievements: Under this project the budded plants of Khejri variety Thar Shobha were produced. During the year, raised 40,000 seedlingsfor budding and establishment of demonstration block. Distributed more than 600 saplings of Thar Shobha among the beneficiaries. Seedlings of moringa (500) were also propagated and supplied to the stakeholders.

Project: Establishment of Post Entry Quarantine (PEQ) facility for date palm

Funding agency: MIDH, New Delhi

Achievements: During the year a project on Establishment of Post Entry Quarantine (PEQ) facility for date palm has been prepared and sanctioned with the budget of Rs. 621.425 lakh. Several works such as fencing of 1.5 ha area, land development, internal road (path-paver blocks (150 m), 04 units of Hi-tech green house for primary hardening (108m^2 each unit), 04 units of green house for secondary hardening (162m^2 each unit) and working shed were executed. Procured several instruments such as PCR, Gel electrophoresis, -20°C Deep freezer, refrigerator, vortex mixture, magnetic stirrer, biosafety cabinet and balance for establishment of Virus indexing facility. Procured 3 autoclave, 2 units of water purification system. 2 pH meter and one electronic weighing balance. Several plant propagation/ hardening accessories such as portrays and consumables (chemicals, glassware/ plasticware fertilizers, compost, growing media, polybags, pots, root trainers,biofertilizers) andcomputer system (02) were also purchased. Created a facility of water storage of 25 lakh litre water capacity for irrigation and cooling of greenhouse.

Project: Development of high-tech horticultural nursery with water harvesting structure

Funding agency: RKVY, Gandhinagar, Gujarat

Achievements: Infrastructure related to high tech nursery development were carried out through PWD/ CPWD. Nursery equipments were also purchased.

4 (a). TRANSFER OF TECHNOLOGY

EVENTS ORGANIZED

- Organized a Skill Development programme on Arid Horticultural Technology among the farmers for "Atma Nirbhar Bharat" under Azadi ka Amrit Mahotsav during II week of June, 2023. On this occasion organized a farmers training programme on "Improved arid vegetable production technologies for *kharif* season". The farmers of Phuldeshar village of Lunkaransar block of Bikaner district were participated. The knowledge and skill development work on improved arid vegetable production technologies for *kharif* season were carried out. Celebrated the World Environment Day on 5th June, 2023 and the participating farmers were also benefited.
- Organized arid region vegetable seed sale day on 10.02.2023 at ICAR-CIAH, Bikaner in which seeds of various vegetables (Palak, Bottle gourd, Kachri, Sponge gourd, Snapmelon, Cluster bean, Brinjal, Ridge gourd, Longmelon) was sold among the farmers.
- Organized one day workshop on millets with the theme: "Contribution and potential of millets for rural health and economy" on 2nd June, 2023 to create awareness among researchers/ students/ farmers/ stakeholders about millets. More than 50 participants from different parts of India joined the workshop virtually as well as physically.
- Organized Kisan Mela on "Advance approaches for fruits and vegetables cultivation" under TSP Scheme on 7th June, 2023 at Naya Kheda Gram Panchayat and on 8th June, 2023 at Jawar Gram Panchayat of Udaipur district (Rajasthan).
- Organized a Field Day "Citrus Day-Prospectus and way forward" on 20th October, 2023 at ICAR-CIAH, Bikaner for promotion of citrus in arid region.
- Organized a Field Day "Role of rootstocks in mandarin" on 7th December, 2023 at ICAR-CIAH, Bikaner for promotion of citrus in arid region.
- Organized "Kisan Diwas" on 23rd December, 2023 at ICAR-CIAH, Bikaner.
- Organized National Webinar "Workshop cum Farmer Interaction Meeting for Research Activities, Issues and Challenges in Custard Apple" on 04.05.2023.
- A Webinar on "Natural and organic farming in arid horticultural crops" was organized under Azadi ka Amrit Mahotsav on 26.05.2023.
- Organized a Field Day on "Intercropping in ber based cropping system: Farmer scientific interaction" at ICAR-CIAH, Bikaner on 21st December, 2023.
- Organized "Rashtriya Mahila Kisan Diwas" at ICAR-CIAH, Bikaner on 15th October, 2023.
- Transfer the Institute Technology "Thar Jaivik 41 EC" among the farmers through supplying the product to them and also supplied for research purpose to AU, Jodhpur.



Large number of farmers in the queue for purchase of vegetable seeds during vegetable seed sale day



Inauguration of Trainees House of CIAH by Hon'ble Vice-President of India, Sh. Jagdeep Dhankhar at DGR-RRS, Bikaner on 27-09-2024

DEMONSTRATIONS

Field demonstration of vegetable nursery technology: Surface covering protective vegetable nursery scheme/technology for hot arid climate was demonstrated at KVK, Sardarshahar, Churu on 29th November, 2023. The benefits along with SOPs of this modern cost-efficient vegetable nursery raising technology were disseminated among the local farmers' group of Churu district. Brinjal variety 'Thar Rachit' was sown on the raised beds for the demonstration purpose. The nursery bed was covered with the structural framework and polythene sheet.



Field demonstration on modern vegetable nursery raising technology

Demonstration cum hands-on training on Sangri-ker processing and value addition for self-employment: Two days hands-on training cum demonstration on 'Sangri-ker processing and value addition for self-employment' was organised for a group of 20 rural women from village Motavata, Kolayat, Bikaner in collaboration with Plan India and Udyam Vahini Business Services Private limited during May 02-03, 2023. The training was organised on the basis of learning by doing principle and all the processes involve in sangri dehydration; starting from harvesting, post-harvest handling, grading, blanching, drying, packaging and labelling were carried out by women themselves following all the SOPs for maintaining hygiene. Low cost-structures designed for drying of arid fruits and vegetables were demonstrated to the trainees. Methods of ker debittering and sangri-ker pickle preparation were also revealed to the women. Trainees were apprised with all equipments and machines required for drying of arid fruits and vegetables. The procedure of FSSAI registration was also demonstrated to the rural women to start food-based business.



Hands-on training on Sangri-ker processing and value addition for self-employment

Demonstration of drone under Agri-Drone project

- Field demonstration to spray with drone at farmer's field was done as per guidelines. The farmers were educated about use of drone in modern agriculture to save the manpower as well as time.
- Organized farmers training programme on "Agri-Drone and improved arid horticultural production technologies" on 06.06.2023 at 04 KHM, Khinchiya Village of Bikaner district.
- Drone demonstration was carried out at farmer's field of Khinchiya village on 17.03.2023.
- Demonstrated Agri-Drone to the different visitors in the institute.







Demonstration of Agri-Drone at farmer's field

Other field demonstrations

- Conducted Field Demonstration on “Flower regulation technology in pomegranate” at farmer's field of Sh. Narayan Lal, village-Palana, district-Bikaner during 2023.
- Conducted Field Demonstration on “Flower regulation technology in pomegranate” at farmer's field of Sh. Harendera, village-Palana,

district-Bikaner during 2023.

- Conducted Field Demonstration on "Flower regulation technology in pomegranate" at farmer's field of Sh. Vinod Jain, village-Kanasar, district-Bikaner during 2023.
- Conducted Field Demonstration on "Flower regulation technology in pomegranate" at farmer's field of Sh. Jai Bhagwan, village-Kanasar, district-Bikaner during 2023. Farmers are adopting Mrig and early Mrig Bahar to harvest quality fruits.
- Conducted Field Demonstration on "Canopy management technology in pomegranate" at farmer's field of Sh. Narayan Lal, village-Palana, district-Bikaner during 2023.
- Conducted Field Demonstration on "Canopy management technology in pomegranate" at farmer's field of Sh. Vinod Jain, district-Bikaner during 2023.
- Conducted Field Demonstration on "Canopy management technology in pomegranate" at farmer's field of Sh. Harendera, village-Palana, district-Bikaner during 2023.
- Conducted Field Demonstration on "Canopy management technology in pomegranate" at farmer's field of Sh. Jai Bhagwan, village-Kanasar, district-Bikaner during 2023. Farmers are adopting multi-stem training system (four stem) branching at 1 foot + 10 % pruning during bahar treatment to get quality fruits.
- Demonstrated the improved varieties of semi-arid fruits and vegetable crops in Undva, Zinzari, Navanagar and Vyasada villages of Panchmahal district.
- Demonstration of nursery raising methods in underutilized fruits and vegetable crops at CHES, Vejalpur to improve the skill of tribal farmers.
- Demonstration of high-density planting system models of semi-arid horticultural crops at CHES, Vejalpur to create the awareness among the tribal farmers for better utilization of small holdings.
- Demonstrated newly developed varieties of fruits and vegetables at CHES, Godhra and farmer's field.
- Advisory was given in the five adopted villages (Bedhiya, Nesda, Kharsaliya, Dudvaand Bodidra) of KVK, Panchmahal.

Front Line Demonstrations (FLDs)

- Conducted FLDs on improved varieties of Kachri (AHK-119), snapmelon (AHS-82), ridge gourd (Thar Karni) at KVK, Lunkaransar, Bikaner on 28.02.2023.
- Conducted FLDs on improved varieties of snapmelon (AHS-82), sponge gourd (Thar Tapish) and cluster bean (Thar Bhadvi) at the field of Sh. Ram Chandra S/o Sh. Hari Ram Meghwal, Village- Salasar, Kolayat, Bikaner on 04.03.2023.
- Conducted FLDs on improved varieties of snapmelon (AHS-82), sponge gourd (Thar Tapish) and cluster bean (Thar Bhadvi) at the field of Sh. Mohan Ram S/o Sh. Harji Ram Meghwal, Village- Naiyo ki Basti, Kolayat, Bikaner on 05.03.2023.
- Conducted FLDs on improved varieties of snapmelon (AHS-82) and sponge gourd (Thar Tapish) at the field of Sh. Amar Chand Mali S/o Kanaram Mali, Village- Khinchiya (4KHM), Bikaner on 07.03.2023.
- Conducted FLDs on improved varieties of snapmelon (AHS-82) and Kachri (AHK-119) at the field of Sh. Govind Lal Pareek S/o Kisori Lal Pareek, Village- Khinchiya (4KHM), Bikaner on 14.03.2023.
- Conducted FLDs on improved varieties of ridge gourd (Thar Karni) and cluster bean (Thar Bhadvi) at the field of Sh. Om Prakash Mali S/o Kanaram Mali, Village-Khinchiya (4KHM), Bikaner on 14.07.2023.
- Conducted FLD on improved varieties of Khejri (Thar Shobha) at the field of Sh. Om Prakash Mali S/o Kanaram Mali, Village- Khinchiya (4KHM), Bikaner on 14.07.2023.







Demonstration on improved technologies

AICRP-AZF activities

The Institute has organized Annual Group Meet of research workers of All India Coordinated Research Project on Arid Zone Fruits from 21st to 23rd June, 2023 at ICAR-CIAH, Bikaner through virtual mode. In this workshop, 18 different centres of SAUs and ICAR institutes were participated and presented their annual progress report. The institute has also conducted "Annual Review Meeting" of ICAR-All India Coordinated Research Project on Arid Zone Fruits at ICAR-CIAH, Bikaner on 23rd February, 2023 through virtual mode.

Swachchh Bharat Abhiyan

As per directions from Government of India and ICAR, New Delhi organized the *Swachchhata Abhiyan* from time to time. The awareness and knowledge about *Swachchhata* was created among the students, farmers and masses during the year 2023.

Training programmes organized

- Conducted 21 days Winter School on "Commercialization of arid fruit and vegetable crops through modern approaches" during February 01-21, 2023.

- Organized on campus 7 days training programme on "Technological advances in horticultural crops" to the M.Sc. Horticulture Students of RLBCAU, Jhansi during December 11-17, 2023 at CHES, Vejalpur, Gujarat.
- Organized one week training programme on "Production technology and nursery management of horticultural crops" at ICAR-CIAH, Bikaner for students of CCSHAU, Hisar, Haryana from 25th September to 01st October, 2023.
- Organized 11 days on campus training programme on "Recent advances on dryland horticultural crops for sustainable horticultural production" from 17.07.2023 to 27.07.2023 for RAWE Students of B.Sc. Ag. (Hons.) from COA, Parul University, Vadodara, Gujarat.
- Organized two days training programme on "Interstate officers training" at ICAR-CIAH, Bikaner for Haryana Agricultural Officers during January 13-14, 2023.
- Coordinated a programme "Survey of Pomegranate Orchards of Bikaner district" organized by ICAR-CIAH, Bikaner in collaboration with ICAR-NRC on Pomegranate on 19th July, 2023.
- Organized One Day Training Cum Interaction Meet on "Pomegranate cultivation under hot arid climate" on 20th July, 2023.





Training programme on "Pomegranate cultivation in hot arid region"

Training-cum-awareness programme on PPV&FR Act, 2001

A training-cum-awareness programme on Protection of Plant Varieties and Farmer's Rights Act, 2001 was organized in collaboration with PPV&FRA, New Delhi on 26th June, 2023 at ICAR-CIAH, Bikaner. The programme was chaired by Dr. T. Mohapatra, Chairperson, PPV&FRA, New Delhi. In his inaugural address, Dr. Mohapatra, highlighted that the arid zone is rich in biodiversity of typical economically important arid flora, which needs to be protected under this act. He also emphasized on landraces, their conservation and registration of farmers' varieties with the PPV&FRA. He also urged to the farmers to come forward for registration of their traditional varieties. The programme was also graced by the Director, CIAH, Bikaner, Dr. Jagadish Rane and stressed to organize such awareness programmes regularly in collaboration to KVKs, ATARI, farmers and other stakeholders. The programme was attended by more than 160 farmers, institute staff and representatives from KVKs, ATARI, NRCSS and State Agriculture Department.







Glimpses of training-cum-awareness programme on PPV&FR Act, 2001

Farmer's exposure visits/ educational tours

- Exposure visit of farmers from KVK, Athiasan (Nagaur-I) visited in the experimental blocks of the Institute on 06.01.2023.
- Exposure visit of farmers visited in the experimental blocks of the Institute on 12.01.2023.

- Exposure visit cum educational tour of students visited in the experimental blocks of the Institute on 16.01.2023.
- Exposure visit of farmers under Deputy Director of Horticulture, Sabarkantha, Gujarat visited in the experimental blocks of the Institute on 20.02.2023.
- Exposure visit of 21 days Winter School trainees at experimental blocks of the Institute was made on 02.02.2023.
- Exposure visit of farmers through Agril. Deptt. ATMA, Nagaur on 23.02.2023.
- Farmer's exposure visit from KVK, Sardarshahar (Churu) under NICRA was made in the Institute on 09.03.2023.
- Exposure visit of farmers from Chhota Udepur, Gujarat visited in the experimental blocks of the Institute on 13.03.2023.
- Exposure visit of students from Gujarat in the experimental block of the Institute on 14.03.2023.
- Exposure visit of farmers under Agril. Deptt. ATMA, Nagaur visited in the experimental blocks of the Institute on 16.03.2023.
- Exposure visit of educational tour of students from COA, Kota visited in the experimental blocks of the Institute on 30.03.2023.
- Exposure visit of progressive farmers visited in the Institute on 20.07.2023 from Malwa region (Dewas, Ujjain).
- Exposure visit of SMS of KVKs (14 Nos.) under SKRAU, Bikaner during orientation programme were visited in the Institute on 25.07.2023.
- Educational Tour of IABM students from SKRAU, Bikaner visited in the Institute experimental blocks on 03.08.2023.
- Exposure visit of progressive farmers under Jamnalal Bajaj Trust, Sikar visited in the Institute on 24.08.2023.
- Exposure tout/ meeting with official of NLC India Ltd, Barsinghsar, Bikaner on 12.09.2023.
- Exposure visit of farmers from Agri-Delhi Gujarat visited in the Institute on 29.09.2023.
- Educational Tour of Kendriya Vidhyalaya students from Churu visited in the Institute experimental blocks on 21.11.2023.





Exposure visits at ICAR-CIAH, Bikaner



Exposure visit of farmers at CHES, Vejalpur, Godhra

Exhibitions displayed

- Participated and displayed the technological exhibition of the Institute on 14.01.2023 at NRCC, Bikaner during the International Camel Festival.
- Participated and displayed the technological exhibition of the Institute in Shri Mallinath Pasu Mela at Tilwara, Barmer organized by ICAR-CAZRI, Jodhpur during March 27-29, 2023.
- Participated and displayed the technological exhibition of the Institute in State Level Kisan Mela on *Paushak Anaaj-Samridh Kisan* organized by SKRAU and ATMA, Bikaner during March 27- 29, 2023.
- Participated and displayed the technological exhibition of the Institute on the occasion of "Celebration of 50th Foundation Day of CSWRI-Arid Region Campus, Bikaner" on 04.04.2023.
- Participated and displayed the technological exhibition of the Institute at State Level Farmer's Fair at JECC, Sitapura Industrial Area Jaipur during June 15- 18, 2023.
- Displayed the technological exhibition of the Institute during the National Seminar organized by College of Community Science, SKRAU, Bikaner during August 25- 26, 2023.

- Participation and displaying the CIAH technological exhibition at DGR-RRS, Bikaner on the occasion of Inauguration of New building of DGR-RRS, Bikaner and Trainees House of ICAR-CIAH, Bikaner on 27.09.2023.








Exhibitions organized

- Displayed the technological exhibition on the occasion of Celebration of 31st Foundation Day of the Institute on 30.9.2023.
- Exhibited the CIAH technologies at Gudamalani during inauguration of Pearlmillet Centre, Gudamalani on 27.9.2023.
- Displayed the technological exhibition during ICAR Zonal meeting held at ICAR-CSWRI Avikanagar on 03.11.2023.

Lead/ oral presentation in seminar/ conference

Dr. A.K. Singh

- Delivered a lead talk as invited guest speaker during National Workshop on “Quality planting material production in horticultural crops” on the topic quality planting material production in semi-arid fruit crops organized by NDUAT, Ayodhya on 28-12-2023.
- Delivered a talk as lead speaker on “Genetic resources and varietal wealth of semi-arid fruit crops”in the International Seminar on Exotic and Underutilized Horticultural Crops held at ICAR-IIHR, Bengaluru held during 17-19th October, 2023.
- Delivered an invited lecture on “Fruit tree based medicinal products” in 21 days Winter School on "Diversified Farming with Medicinal and Aromatic Crops as an Important Component in Doubling Farmer's Income” held during 18th December, 2023 to 07th January, 2024 at ICAR-DMAPR, Boriavi, Anand.

Dr. S.R. Meena

- Oral presentation on "Diversification of agriculture through arid horticulture technologies" in National Seminar held at SKRAU, Bikaner during 11-12th September, 2023.

Dr. D.K. Sarolia

- Oral presentation on “Ber technology for higher fruit quality and sustainable production” in 7th International Conference on Sustainable utilization of resources in agricultural growth-It's challenges and opportunities at S.K. Chaudhary Education Trust's-KVK, Madhubani, Bihar during 11-13th February, 2023.

Dr. D.S. Mishra

- Presented an oral paper on “Phenotypic diversity for fruit quality traits and bioactive compounds in red-fleshed guava” in Progressive Horticulture Conclave (PHC 2023) held at GBPUAT, Pantnagar during 3-5th

February, 2023.

- Delivered an invited lecture on "Underutilized and potential fruit crops of tribal areas of north-western parts of India" in 21 days Winter School on "Commercialization of Arid Fruit and Vegetable Crops through Modern Approaches" organized at ICAR-CIAH, Bikaner during February 01-21, 2023.
- Delivered an invited lecture on "Technological advancements in nutraceuticals rich fruits of central India" in 21 days Winter School on "Diversified Farming with Medicinal and Aromatic Crops as an Important Component in Doubling Farmer's Income" held during 18th Dec., 2023 to 07th Jan., 2024 at ICAR-DMAPR, Boriavi.

Dr. Gangadhara K.

- Oral presentation on "Genetic diversity studies in garden type Indian bean (*Lablab purpureus* var. *typicus* L.) genotypes under rainfed semi-arid conditions of western India" in 2nd International Conference on Prospects and challenges of environment and biological sciences in food production system for livelihood security of farmers (ICFPLS-2023) during 18-20th September, 2023 held at ICAR-CIARI, Port Blair.

Dr. Lalu Prasad Yadav

- Oral presentation on "Genetic diversity, morphological and quality traits, antioxidants potentiality and utilization of germplasm resources of *Coccinia grandis*- An underutilized perennial vegetable crop" in 2nd International Conference on Prospects and challenges of environment and biological sciences in food production system for livelihood security of farmers (ICFPLS-2023) held at ICAR-CIARI, Port Blair during 18-20th September, 2023.

Dr. Ajay Kumar Verma

- Delivered an invited talk on "Arid horticulture: Technological advancements for nutritional and livelihood security in resource-poor, hot arid environments" in International Conference on Technology-Driven Agriculture to Face the Imminent Future Challenges (ICAT-2023) held at Galgotias University, Greater Noida during 19-21st December, 2023.
- Delivered an oral presentation on "Native perennial horticultural crops of hot arid region for food and nutritional security" in International Conference on Technology-Driven Agriculture to Face the Imminent Future Challenges (ICAT-2023) held at Galgotias University, Greater Noida during 19-21st December, 2023.

Dr. Anita Meena

- Oral presentation on "Combined use of organic and inorganic fertilizer on growth and yield of ridge gourd (*Luffa acutangula* L. Roxb.) under saline water irrigation at field condition in arid region" in International Conference (Hybrid Mode) on Global Research Initiatives for Sustainable Agriculture & Allied Sciences (GRISAAS-2023) held at Raichur on 18-20th December 2023.
- Oral paper presentation on "Yield of snapmelon as influenced by organic fertilizer under saline water in arid region" during the National Conference on Agro-Ecology Based Agri-Food Transformation Systems organized by FSRDA and ICAR-IIFSR in collaboration with CIMMYT and ICRISAT held at ICAR-IIFSR, Modipuram during 27-28th January, 2023.

Dr. Ramesh Kumar

- Delivered an invited presentation on "Flower regulation in pomegranate under hot arid climate" in the in Seminar on Technology transfer in special horticultural crops-Pomegranate held on 18th March, 2023 at Agricultural University, Jodhpur.
- Delivered a lead lecture on "Pomegranate cultivation management, quality fruit production and flower regulation in pomegranate under hot arid climate" in workshop on Promotion of export quality pomegranate production organized by Shiv Kisan Producer Company, Budhiwara, Barmer on 19th March, 2023.
- Delivered a lead lecture on "Package & practices of pomegranate fruit" in webinar on Advanced production technology of date palm & pomegranate on 26th July, 2023 organized by Hort. Deptt., Govt. of Haryana.
- Delivered a lead lecture on "Package and practices of pomegranate fruits" in webinar on Advances production technology of pomegranate and citrus on 22nd November, 2023 organized by Hort. Deptt., Govt. of Haryana.

Dr. Vikas Yadav

- Oral presentation on "Thar Prabha: a new high yielding wood apple variety for dryland" in 2nd International Conference on "Prospects and challenges of environment and biological

sciences in food production system for livelihood security of farmers (ICFPLS-2023)" held at ICAR-CIARI, Port Blair during September 18-20, 2023.

TV and Radio Talk

Dr. A.K. Singh

- Delivered a radio talk on "Care of bael" at All India Radio, Godhara on 24th July, 2023.

Dr. D.K. Sarolia

- Delivered a TV talk on "Opportunities of employment in horticulture" in Hello Kisan programme DD Kisan Doordarshan on 8th November, 2023.

Dr. Kamlesh Kumar

- Delivered a byte to DD Kisan TV channel on "Biotechnology laboratory facilities and tissue culture date palm research at ICAR-CIAH, Bikaner" during 26-27th October, 2023 and telecasted on 12th November, 2023.

Dr. D.S. Mishra

- Delivered a TV talk in Hello Kisan on "Orchard management of jamun and tamarind" at DD Kisan on 14th April, 2023.
- Delivered a radio talk on "Cultivation of guava" at All India Radio Godhra, on 16th August, 2023.

Dr. L.P. Yadav

- Recorded a radio talk on "Scientific cultivation of rainy season vegetables" on 10th August, 2023 at All India Radio, Godhra and broadcasted on 15.08.2023.

Dr. Ramesh Kumar

- Delivered a TV talk on DD Kisan for the programme *"Shresht Sansthan*-CIAH, Bikaner" telecasted on 12th November, 2023.

Dr. Ramkesh Meena

- Delivered a talk on "Nursery Management" in a special DD Kisan program at Bikaner on 26-27th October, 2023.
- Delivered a talk on "Date palm production technology" in a special DD Kisan program at Bikaner on 26-27th October, 2023.

LECTURES DELIVERED

S.No.	Scientist	No. of lectures delivered	Audience/Stakeholders
1.	Dr. D.K. Samadia	02	Scientists, Intellectuals, Students and Farmers
2.	Dr. Dhurendra Singh	06	Scientists, Intellectuals, Students and Farmers
3.	Dr. A.K. Singh	08	Scientists, Farmers, Students
4.	Dr. D.S. Mishra	07	Scientists, Farmers, Students
5.	Dr. S.K. Maheshwari	03	Scientists, Farmers, Students
6.	Dr. S.R. Meena	01	Scientists, Farmers, Students and Visitors
7.	Dr. D.K. Sarolia	03	Scientists, Farmers, Students
8.	Dr. B.R. Choudhary	06	Scientists, Farmers, Students
9.	Dr. M.K. Jatav	02	Scientists, Farmers, Students
10.	Sh. R.C. Balai	62	Scientists, Farmers, Students, Officials
11.	Dr. Ramkesh Meena	08	Scientists, Farmers, Students
12.	Dr. M.K. Berwal	06	Scientists, Farmers, Students
13.	Dr. Ramesh Kumar	07	Scientists, Farmers, Students
14.	Dr. Anita Meena	03	Farmers, Students
15.	Dr. L.P. Yadav	17	Scientists, Farmers, Students
16.	Dr. Gangadhara K.	12	Scientists, Farmers, Students
17.	Dr. J.S. Gora	02	Scientists, Farmers, Students
18.	Dr. Pawan Gurjar	02	Scientists, Farmers, Students
19.	Dr. A.K. Verma	01	Scientists, Farmers, Students
20.	Dr. Kamlesh Kumar	05	Scientists, Farmers, Students
21.	Dr. Hanuman Ram	04	Scientists, Farmers, Students
22.	Dr. Pawan Kumar	04	Scientists, Farmers, Students
23.	Sh. M.K. Choudhary	05	Farmers, Students
	Total	**176**	

4 (b). KVK, PANCHMAHAL

On Farm Trials (OFT)

OFT on HYVs of sesamum during summer

Evaluation of HYVs of sesamum was conducted during summer season at twelve farmer's field with five varieties. The maximum plant height (146.8 cm), number of branches (5.55), number of capsules/ plant (239.60), yield (6.80 q/ha.), net return (Rs. 34120) and BC ratio (3.40) was recorded in RT-351.

OFT on impact of RDF, NAA and mulching on yield attributes of mango

This trial was conducted during *kharif* season on 10 year old mango cv. Kesar orchard at five farmer's field with four treatments *viz.*, T_1=Farmer's practices-Application of imbalance manure, fertilizers and irrigation, T_2=Recommended technology (manure 80 kg/plant) and fertilizers N-1000g (Urea-1.6 kg/plant), P-750g (DAP-1.6 kg/plant) and K-750 g (MOP-1.25 kg/plant)+ mulching with grasses /straw (15 kg dry grass / sqm), T_3=T_2 (RT) +two spray of NAA@ 20 ppm at III week of March (pea stage) and IV of April (marble stage) and T_4 = 5% T_2 (RT)+two spray of NAA @ 20 ppm at III week of March (pea stage) and IV of April (marble stage). All the treatments had significant effect on all parameters. The maximum fruit weight, length and girth (224 g, 9.32 cm and 6.13 cm) were recorded in T_3 followed by T_4 (219g, 9.30 cm and 6.11 cm), T_2 (213g, 9.27 cm and 6.03 cm) and minimum in T_1 (195.0 g, 9.22 cm and 5.94 cm). The maximum yield, net return and B: C ratio (65.72 q/ha, ₹ 148434, 4.04) was recorded in T_3 followed by T_4 (74.46 q/ha, ₹ 171592 and 4.31), T_2 (57.40 q/ha, ₹ 127724 and 3.87) and T_1 (29.84 q/ha, ₹ 36196 and 2.54).

OFT on HYVs of okra during summer

OFT on HYVs of okra was conducted during summer season at ten farmer's field with five varieties. All the varieties significantly differed for first picking, pod weight, length, diameter, yield/ ha, gross return, net return and B: C ratio. The earliest (45 days) harvesting was recorded in Kashi Lalima and maximum (48 days) in Kashi Chaman. The range of fruit weight 8.22-9.88 g was recorded, being maximum in Gujarat Anand Okra-5 and minimum in Pusa Okra-5. The maximum pod length (11.52 cm) was recorded in Kashi Chaman and minimum (10.27 cm) in Kashi Lalima. The maximum pod diameter (5.38 cm) was recorded in Gujarat Anand Okra-5 and minimum (4.62cm) in Pusa Okra-5. The maximum pod yield (128.50 q/ha) was recorded in Pusa Okra-5 followed by Kashi Lalima (122.60 q/ha), Kashi Chaman (118.70 q/ha) and minimum (106.75 q/ha) in Gujarat Anand Okra-5. The maximum gross returns (₹ 154200/- ha), net returns (₹ 111700/- ha) and highest B: C ratio (3.63) were recorded in Pusa Okra-5 followed by Kashi Lalima (₹ 147120, ₹ 101520 and 3.23), Kashi Chaman (₹ 142440, ₹ 97940 and 3.20) and the it was minimum in Gujarat Anand Okra-5 (₹ 128100, ₹ 87300 and 3.14), respectively.

OFT on management of fall armyworm infesting maize

OFT was conducted during *kharif* season for management of fall armyworm infesting maize. There were 3 treatments viz., T_1 (Farmers' practice), T_2-Spray of emamectin benzoate @ 5 SG, 0.0025% (5 g/10 L water) and T_3-Spray *Bacillus thurengiensis* 0.5 WP (108cfu/g) @ 20 g/10 L of water. Comparison of per cent infestation of maize pest indicated lowest infestation of fall armyworm in T_2 (4.0 %) followed by T_3 (6.5 %) and T_1 (22.0 %). In present study, the mean yield in T_2 was 33.50 q/ha, in T_3 it was 31.0 q/ha as against 24.0 q/ha in T_1. The benefit cost ratio in T_2 was 2.28 and 2.01 in T_3 and 1.84 in T_1.

OFT on termite management in wheat crop

OFT was conducted during *rabi* season for management of termite infesting wheat crop. There were 3 treatments *viz.*, T_1 (Farmers' practice), T_2-Application of neem cake @ 1 ton/ha before wheat sowing and treatment of seed with Fipronil 5 SC 500 ml/100 kg seed and T_3-application of castor cake @ 1 ton/ha before wheat sowing and treatment of seed with Fipronil 5 SC 500 ml/100 kg seed. Result showed that T_3 recorded minimum plant damage (3.50%) as compared to T_2 (5.50 %) and T_1 (12.25 %). In present study, the mean yield in T_3 was 39.50 q/ha, in T_2 it was 36.00 q/ha as against 28.50 q/ha in T_1. The benefit cost ratio in T_3 was 2.58 and 2.39 in T_2 and 2.06 in T_1.

Front Line Demonstrations (FLDs)

During 2023, conducted twelve front line demonstrations at 285 farmer's field covering a total area of 108 ha.

Front line demonstrations conducted by KVK, Panchmahal

S.No.	FLD	Season	Crop	Variety	Critical Input	Area (ha)	No. of farmers	Yield (q/ha)		Increase in yield (%)	B:C ratio
								Demo.	Local		
1.	Use of HYV with INM	*Kharif*	Pigeon pea	GT-105	Seed	20	50	15.4	10.2	50.9	3.4
2.	Use of HYV with INM	*Kharif*	Castor	GCH-7	Seed	20	50	28.4	21.2	33.9	4.1
3.	Use of HYV with INM	*Rabi*	Gram	GG-3	seed	10	25	17.9	14.1	26.9	3.8
4.	Use of HYV with INM	Summer	Groundnut	GJG-32	seed	10	25	18.9	16.1	17.4	3.1
5.	Use of HYV with INM	Summer	Green gram	GAM-5	Seed	20	50	11.3	7.9	43.0	2.7
6.	Use of HYV with INM	Summer	Sesamum	GT-4	Seed	10	25	5.9	4.6	28.3	2.4
7.	Use of HYV with improved practices	*Kharif*	Brinjal	Anand Doli	Seed	04	10	435.5	327.5	32.97	3.55
8.	Use of HYV with improved practices	*Kharif*	Tomato	GT-5	Seed	04	10	352.5	261.5	34.79	3.68
9.	Management of pest complex in green gram	Summer	Green gram	-	Imidacloprid 48 FS, Flubendiamide 48 SC	2.5	10	11.20	8.30	34.94	2.51
10.	Management of stem borer in paddy through pheromone traps	*Kharif*	Paddy	-	Pheromone traps	2.5	10	38.50	31.0	24.19	2.11
11.	Management of banded leaf and sheath blight disease of maize	*Kharif*	Maize	-	*Trichoderma viride*	2.5	10	32.40	25.0	29.60	2.26
12.	Management of fruit and shoot borer in brinjal	*Kharif/ Rabi*	Brinjal	-	Emamectin benzoate 5 SG	2.5	10	247.5	196.5	25.95	3.26

Extension activities organized during 2023

Name of activity	No. of programmes	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
Farmer's 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

Training programs organized

During the period of report, 69 training programmes (On/Off Campus) on agriculture and allied sectors were organized including 1529 farmers, rural youth and farm women.

Advisory service

During reporting period, a total of 208 advisory services on various important aspects of agriculture and related field were provided to the framers.





Kisan Samman Nidhi programme organized at KVK, Panchmahal

















Outreach activities organized at KVK, Panchmahal

4 (c). SCSP AND TSP ACTIVITIES

During 2023, the Institute has organized more than 35 training programmes and two Kisan Mela for empowerment of scheduled caste and scheduled tribe farmers. About 3381 farmers were benefitted through the training programmes under SCSP and TSP Schemes. The inputs like fertilizers, sewing machines, milk collection canes, sprayers, seeds of improved varieties of vegetable, spices, vegetable seed packet for kitchen garden and technical folders were distributed to farmers. Celebrated the International women day and National women day involving scheduled caste farmers under SCSP Scheme.

SC farmers training programme under SCSP

S.No.	Date	Title of the training	Place/ village
1.	05.01.2023	Low tunnel technology for cucurbitaceous vegetable production during off season.	20 KYD Khajuwala, Bikaner
2.	10.01.2023	Management practices to save the fruit and vegetable crops during adverse climatic conditions.	Sadokan, Nagaur
3.	11.01.2023	Orchard development through *in-situ* budding technique.	Dangawas (Merta city), Nagaur
4.	11.01.2023	Production technologies of rabi vegetables and kitchen gardening.	Salasar and Naaeeyon ki Basti (Bikaner)
5.	17.01.2023	Organized training and distribution of sewing machines to SC women.	Salasar, Bikaner
6.	18.03.2023	Improved production technologies of arid fruit crops.	Kolayat, Kotri, Jhajhu (Bikaner)
7.	20-23.03.2023	Rainfed horticultural technologies for enhancing livelihood and nutritional security.	Panchmahal, Gujarat
8.	28.03.2023	Production technologies of summer vegetables and kitchen gardening.	Jhajhu, Kolayat (Bikaner)
9.	02-03.05.2023	Management practices to save the fruit and vegetable crops during adverse climatic conditions.	Motavtan, Kolayat Block (Bikaner)
10.	04.05.2023	*Kharif* vegetable production technology.	Kishmideshar, Jassolai, Rampura (Bikaner)
11.	05.06.2023	Propagation technologies of arid fruit crops.	Phuldesar (Lunkaransar), Bikaner
12.	08.06.2023	*Kharif* vegetable production technology.	Kalyansar (Napasar), Bikaner
13.	13.06.2023	Nursery management of fruit crops.	17 KYD (Khajuwala), Bikaner
14.	26.06.2023	Production technologies of *kharif* vegetables and kitchen gardening.	Bigga (Sri Dungargarh), Bikaner
15.	22.08.2023	Improved production technologies of arid fruit crops.	Pimpera/ Phooldeshar (Lunkaransar), Bikaner
16.	23.08.2023	Production technologies of *rabi* vegetables and kitchen gardening.	Nokhra and Guda (Kolayat), Bikaner
17.	05.12.2023	Management practices to save the fruit and vegetable crops during adverse climatic conditions.	Kolayat, Bikaner
18.	23.12.2023	Low tunnel technology for cucurbitaceous vegetable production during off season.	Phooldesar, Pimpera (Bikaner)













Training programme and input distribution under SCSP Scheme

ST (Tribal) farmers programme under TSP

- Organized a Kisan Mela on 7th June, 2023 at Naya Kheda Gram Panchayat of Udaipur (Rajasthan).
- Organized a Kisan Mela on 8th June, 2023 at Jawar Gram Panchayat of Udaipur (Rajasthan).
- Training on improved horticultural cultivation and input distribution on 9th June, 2023 at Phatadara in Udaipur (Rajasthan).
- Training on improved horticultural cultivation and input distribution on 9th June, 2023 at Manpur in Banswara (Rajasthan).
- Training on *Paushan vatika* and improved horticultural cultivation practices on 10th June, 2023 at Amarthun in Dungarpur (Rajasthan).
- Training on *Paushan vatika* and improved horticultural cultivation practices on 10th June, 2023 at Kadwaamri in Banswara (Rajasthan).
- Training on promotion of kitchen gardening, Paushan vatika and input distribution on 11st June, 2023 in Tulsiyo ka Namla in Salumbar Block, Udaipur (Rajasthan).
- Organized 5 days on campus training programme "Promotion of dryland horticulture in tribal areas of Panchmahal districts of Gujarat" from 13 to 17th March, 2023.










Kisan Mela, Training programme and input distribution under TSP Scheme

5. TRAINING AND CAPACITY BUILDING

Training and Capacity Building of ICAR Employees

The following personnel of ICAR-CIAH underwent in different training programmes:

Name	Topic	Organization	Duration
Dr. Jagadish Rane Director	Executive Development Programme on Leadership Development (Batch-I).	ICAR-NAARM, Hyderabad	22-27th May, 2023
Scientist			
Dr. D. K. Sarolia	Training on Agricultural statistics in practice (online).	ag MOOCs	11th July to 31st August, 2023
Dr. M. K. Jatav	Participated in workshop on IPR and copyright issues in horticultural sciences.	ICAR-CIAH Bikaner	21st February, 2023
Mr. R.C. Balai	Competency Enhancement programme of HRD nodal officers.	ICAR-NAARM Hyderabad	27th February to 01st March, 2023
Dr. Anita Meena	Attended 5 Days training programme on Management Development Programme on Business Plan Development and Accelerating FPOs/FPCs (Online mode).	ICAR-NAARM, Hyderabad	08-12th May, 2023
Dr. Gangadhara K.	Winter School training programme on Climate change and Abiotic stresses management solutions for enhancing water productivity, production quality and doubling farmer's income in scarcity zones.	ICAR-NIASM, Baramati, Pune	05-25th January, 2023
Dr. L. P. Yadav	Attended 21 days virtual training program on Management and Utilization of Plant Genetic Resources.	ICAR-NBPGR, New Delhi & HRM Unit, ICAR, New Delhi	01-21st February, 2023
Dr. Hanuman Ram	Participated in 21 days online training programme on Management and Utilization of Plant Genetic Resources (virtual mode).	ICAR-NBPGR, New Delhi	01-21st February, 2023
Dr. Manpreet Kaur	Participated and completed 3 months Foundation course for Agricultural Research Services.	ICAR-NAARM, Hyderabad	11th April, 2023 to 10th July, 2023
	Successfully completed one month Orientation Training Programme.	ICAR-CIAH, Bikaner	21st July to 20th August, 2023
	Participated and completed three months Professional Attachment Training.	International Food Policy Research Institute, South Asia Office, New Delhi	4th September to 01st December, 2023
Technical			
Sh. Rakesh Meel (STA)	Tech staff associated with farm management/ Farm Manager of ICAR.	ICAR-IIFSR, Modipuram	22-28th February, 2023
Sh. Bhoj Raj Khatri (STO)	E-Governance Application in ICAR (ERP system, E Office, EHRM, TMIS Sparrow.	HRM Unit ICAR-IASRI New Delhi	22-28th February, 2023
Sh. Sanjay Patil (ACTO)			

Seminar/ symposium attended

Dr. Jagadish Rane

- Attended a District Level Farmer Seminar organized by RKVY on 01st March, 2023.
- Attended Global Conference on Precision Horticulture at Jalgaon, M.H. on 29th May, 2023.
- Attended International Millets (Shree Anna) Conference "Enhancing productivity and value addition in millets" at New Delhi on 18th March, 2023.
- Attended National Conference on "Perspective of millets in Global scenario" at College of Community Science, SKRAU, Bikaner on 25th August, 2023.
- Attended meeting on the "National Dialogue for shaping the Indian Horticulture: A way forward" organized by Confederation of Horticulture Associations of India (CHAI) in collaboration with the National Academy of Agricultural Sciences (NAAS) at New Delhi on 26th August, 2023.
- Attended National symposium at ATARI, Jodhpur on 1st September, 2023.
- Attended 4th International Conference on "Sustainable optimization of agriculture production "VAKSANA-2023" organized at Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore (MP) during 15-16th September, 2023.
- Attended National Conference on "Spices, aromatic and medicinal plants for economic prosperity and ecological sustainablity-2023" during 5-6th October, 2023 organized by ASA in Collaboration with Directorate of Arecanut and Spices Development, Kerala and ICAR- CIARI, Port Blair.
- Participated in Brainstorming workshop programme 'Trends in the application of artificial intelligence for sustainable agriculture' organized by ICAR-SBI, NABS & NAAS Chapter (Coimbatore) on 29th November, 2023.
- Participated in National Conference of Plant Physiology-2023 on "Physiological and molecular approaches for climate smart agriculture" held at New Delhi during December 9-11, 2023.
- Participated National Seminar on "Agricultural education and resource empowerment for climate production system to enhance bio-economy" held at University of Agriculture, Dharwad from 13-15th December, 2023 (online mode).

Dr. A.K. Singh

- Attended International Seminar on "Exotic and underutilized horticultural crops" held at ICAR-IIHR, Bengaluru, Karnataka during 17-19th October, 2023.
- Attended National Webinar on Natural and Organic Farming in Horticultural Crops under Azadi ka Amrit Mahaotsav held at ICAR-CIAH, Bikaner on 26th May, 2023

Dr. S.K. Maheshwari

- Attended National webinar "Workshop cum farmer interaction meeting for research activities in custard apple" held at ICAR-CIAH, Bikaner on 04th May, 2023.
- Attended Webinar on "Natural and organic farming in arid horticultural crops" held at ICAR-CIAH on 26th May, 2023.

Dr. S.R. Meena

- Participated in Webinar on PGDAEM programme organized by MANAGE Hyderabad on 09.01.2023.
- Participated in the workshop on "International Year of Millets" organized at the Institute on 18th March, 2023.
- Participated in monthly technical workshop organized at ARS, SKRAU Bikaner.
- Attended the Webinar "World Environment Day" organized at the Institute on 5th June, 2023.
- Participated in 27th AICRP-AZF Research Workers Group Meeting held at CIAH, Bikaner on 23rd June, 2023.
- Participated in National Seminar on "Diversification in Agriculture for enhancing farmer income" organized at COA, SKRAU, Bikaner during 11-12th September, 2023.
- Participated in Brainstorming of AICRP-AZF in the Institute on 01st January, 2023.

Dr. B.R. Choudhary

- Attended a Webinar on 'DUS & PVP Data Management' from Indo-German Cooperation on 17th November, 2023 organized by PPV&FRA and Indo-German Cooperation.

Dr. D.S. Mishra

- Attended International Webinar on "DUS Databases and DUS data use for decision making" held on 17th November, 2023 organized by PPV&FRA and Indo-German Cooperation.
- Attended "Progressive Horticulture Conclave (PHC 2023) on "Transforming horticulture

science into technology" organized at GBPUAT, Pantnagar during 3-5th February 2023.

Dr. Lalu Prasad Yadav

- Attended 2nd Indian Horticulture Summit-2022: Horticulture for prosperity and health security held at NAU, Navsari (Gujarat) during 27-29th April 2022.
- Attended National Symposium on "Self-Reliant Coastal Agriculture" organised by Association for Coastal Agricultural Research (ACAR) held at ICAR-CCARI, Goa during 11-13th May 2022
- Attended "AGRF Summit" virtually on 03rd March, 2022.

Dr. M.K. Berwal

- Attended National Conference on "Emerging innovations in plant molecules for achieving food and nutritional security" held at NAU, Navsari during September 22-23, 2023.
- Attended a Seminar on Mental Health at ICAR-CIAH, Bikaner.

Dr. Ramkesh Meena

- Attended 7th International Conference on "Sustainable utilization of resources in Agricultural growth its challenges and opportunities" at SK Chaudhary Educational Trust's-KVK, Madhubani, Bihar held from 11-13th February, 2023.

Sh. R.C. Balai

- Attended a Webinar on "Intellectual Property Issues and their management in agriculture" on 8th August, 2023.
- Participated in National Training Conclave 2023 at Pragati Maidan, New Delhi on 11th June, 2023.

Dr. Ramesh Kumar

- Participated in Seminar "Technology transfer in special horticultural crops-Pomegranate" on 18th March, 2023 at AU, Jodhpur.
- Attended Workshop on "Promotion of export quality pomegranate production" at Budhiwara on 19th March, 2023 organized by Shiv Kisan Producer Company, Budhiwara.
- Attended Webinar on "Advanced production technology of date palm & pomegranate" on 26th July, 2023 organized by Hort. Deptt., Govt. of Haryana.
- Attended webinar on "Advance production technology of pomegranate and citrus" on 22nd November, 2023 organized by Hort. Deptt., Govt. of Haryana.

Dr. Ajay Kumar Verma

- Attended Webinar on "Natural and organic farming of arid horticultural crops" under Azadi ka Amrit Mahotsav on 26th May, 2023 at ICAR-CIAH, Bikaner.
- Attended International Conference on "Technology-driven agriculture to face the imminent future challenges (ICAT-2023) held at Galgotias University, Greater Noida during December 19-21, 2023.

Dr. Anita Meena

- Attended the National Conference on "Agro-ecology based agri-food transformation systems" organized by FSRDA and ICAR-IIFSR in collaboration with CIMMYT and ICRISAT at ICAR-IIFSR, Modipuram during 27-28th January, 2023.
- Attended International Conference in Hybrid Mode on "Global research initiatives for sustainable agriculture & allied sciences (GRISAAS-2023) during 18-20th December, 2023 at Raichur.
- Attended Workshop on "IPR and copyright issues in horticultural sciences" held on 21st February, 2023 at ICAR-CIAH, Bikaner.
- Attended Conference on "Promoting the use of these organic fertilizers by using new techniques along with the traditional methods of making manure from cow dung and pesticides from cow urine" during 12th April, 2023.
- Attended meeting of "Mati Pariyojana" at Collectorate Bhawan, Bikaner on 18th April, 2023.

Dr. Chet Ram

- Attended "International Conference on "Biochemical and biotechnological approaches for crop improvement" held at NASC Complex, New Delhi during 30th October to 01st November, 2023.

Dr. Gangadhara K.

- Attended 2nd International Conference on "Prospects and challenges of environment and biological sciences in food production system for livelihood security of farmers (ICFPLS-2023)" held during 18-20th September, 2023 at ICAR-CIARI, Port Blair.
- Attended Foundation Day of ICAR–CIAH, Bikaner and Brainstorming session during 30-09-2023 to 01-10-2023.

Dr. Kamlesh Kumar

- Attended "Workshop on IPR and copyright

issues in horticultural sciences" held at ICAR-CIAH, Bikaner on 21st February, 2023.
- Attended Webinar on "Natural and organic farming in arid horticultural crops" under Azadi ka Amrit Mahotsav" held at ICAR-CIAH, Bikaner on 26th May, 2023.
- Attended Workshop on "Contribution and potential of millets for rural health and economy" held at ICAR-CIAH, Bikaner on 2nd June, 2023.
- Attended the cleanliness and Hindi Workshop on "Importance of Cleanliness in the life" held at ICAR-CIAH, Bikaner on 22nd December, 2023.
- Attended Global Conference in virtual mode on "International Year of Millets 2023" on 18th March, 2023

Dr. Vikas Yadav
- Attended 2nd International Conference on "Prospects and challenges of environment and biological sciences in food production system for livelihood security of farmers (ICFPLS-2023)" at ICAR-CIARI, Port Blair during 18-20th September, 2023.

Dr. J. S. Gora
- Attended International e-Conference on PlantsAgroEcon2023e2 during 4-5th December, 2023.

Dr. Pawan Kumar
- Attended Webinar on "Sustainable application in mission approach through research & technology based holistic interventions (SAMARTH)" on 24th February, 2023.
- Attended Workshop on "IPR and copyright issues in horticultural sciences" organised by IP&TM Unit of ICAR, New Delhi on 21st February, 2023 (virtual mode).
- Attended Workshop cum Farmer interaction meeting for research activities, issues and challenges in Custard Apple organised by ICAR-CIAH, Bikaner on 4th May, 2023.
- Attended Webinar on "Natural and Organic farming in arid horticultural crops" under Azadi ka Amrit Mahotsava on 26th May, 2023.
- Attended Workshop on "Contribution and potential of millets for rural health and economy" held on June 2, 2023 at ICAR-CIAH, Bikaner.
- Attended Webinar on "World Intellectual Property Day-2023" on 26th April, 2023 at ICAR-CIAH, Bikaner.
- Attended 'World Environment Day' event in the library hall on 5th June, 2023.
- Attended IPR Awareness lecture (online mode) at ICAR-CIAH, Bikaner on 8th August, 2023.
- Attended Training cum Interaction meet on "Pomegranate cultivation in hot arid region" on 20th July, 2023 at ICAR-CIAH, Bikaner.

Sh. M. K. Choudhary
- Attended Workshop on "IPR and copyright issues in horticultural sciences" organised by IP&TM Unit of ICAR, New Delhi on 21st February, 2023 (virtual mode).
- Attended Webinar on "World Intellectual Property Day-2023" on 26th April, 2023 at ICAR-CIAH, Bikaner.
- Attended Webinar on "Natural and Organic farming in arid horticultural crops" under Azadi ka Amrit Mahotsava on 26th May, 2023.
- Attended Workshop on "Contribution and potential of millets for rural health and economy" under Azadi ka Amrit Mahotsava on 2nd June, 2023 at ICAR-CIAH, Bikaner.
- Attended 'World Environment Day' on 5th June, 2023.
- Attended IPR Awareness lecture (online mode) at ICAR-CIAH, Bikaner on 8th August, 2023.

Dr. Manpreet Kaur
- Attended the National Seminar on "Regulations & governance issues in Indian Seed Sector" during 26-27th September, 2023.
- Participated in "Training and Experience Sharing Workshop on Modelling STATA for Agricultural Economics and Policy Research" conducted by IFPRI and ICAR-NIAP on 7-8th November, 2023.

Meeting attended

Dr. Jagadish Rane
- Attended inaugural function of X Group discussion of ICAR-AICRP on Fruits through virtual mode on 28th February, 2023.
- Attended a meeting to review sustainability and revenue model of PEQ Facilities under the Chairmanship DDG (HS) held on 2nd March, 2023.
- Attended 47th Institute Management Committee Meeting of ICAR-CSSRI, Karnal held on 3rd March, 2023.
- Meeting on Genome Editing under the Chairmanship of DDG, ICAR, New Delhi on 27th March, 2023.
- Chaired SAC Meeting of KVK, Panchmahal on 29th March, 2023.

- Attended Inaugural Programme of 112th FOCARS at NAARM, Hyderabad on 11th April, 2023.
- Attended a meeting with ICAR-CRIDA, Hyderabad on 17th April, 2023.
- Attended XII Institute Management Committee Meeting of ICAR-NIASM, Baramati held on 30th May, 2023 through virtual mode.
- Attended Annual Zonal Review Workshop of KVKs of Rajasthan, Haryana and Delhi held during 19-21st June, 2023 (Online mode).
- Attended 95th Foundation Day/ Technology Day of ICAR during 16-18th July, 2023 at New Delhi.
- Attended VI Institute Management Committee Meeting of ATARI Zone-8 through virtual mode held on 7th August, 2023.
- Attended SAC Meeting of KVK, Lunkaransar on 8th August, 2023.
- Attended Meeting of Institute Management Committee of ICAR-CSSRI, Karnal held on 20th September, 2023.
- Attended Meeting with VC, RAJUVAS, Bikaner on 29th September, 2023.
- Attended Meeting with Director, CEERI, Pilani on 6th October, 2023.
- Participated in XXVII Meeting of ICAR, Regional Committee (VI) held at ICAR-CSWRI, Avikanagar, Tonk on 3rd November, 2023.
- Participated in IRC Meeting of Plant Physiology as an External expert at IARI, New Delhi on 16th November, 2023.
- Attended Meeting of ICAR Regional Committee No. III of ICAR-RC-NEH, Umiam (Barapani), Meghalaya on 01st December, 2023 (online mode).

Dr. A.K. Singh

- Participated in 37th IMC Meeting on 20th March, 2023 at ICAR-CIAH, Bikaner.
- Attended on line meeting on IPR awareness organized by ZTMU, ICAR-IIVR on 8th August, 2023.
- Attended 32nd Foundation Day celebration of ICAR-DMAPR, Boriabi, Anand on 24th November, 2023.
- Attended RAC Meeting at ICAR-CIAH, Bikaner during 26-27th December, 2023.
- Attended on line QRT Meeting conducted at ICAR-IIHR, Bengaluru from 31st May to 2nd June, 2023.
- Attended on line QRT Meeting conducted at ICAR-CIAH, Bikaner from 24-26th April, 2023.
- Attended on line 27th AICRP on AZF meeting conducted by ICAR-CIAH, Bikaner during 21-23rd June, 2023.
- Attended as Member SLPSC meeting for screening of projects under RKVY on 20th April, 2023 at Gandhinagar, Gujarat.
- Participated on line World Intellectual Property Day held at ICAR-CIAH, Bikaner on 24th April, 2023.
- Attended on line Meeting conducted by IT Unit of IASRI, New Delhi on ARMS-APAR-SPARROW on 6th June, 2023.
- Attended ITMC Meeting of ICAR-CIAH, Bikaner, Rajasthan on 26th July, 2023.
- Attended SLSC Meeting to discuss about the progress of RKVY projects at Gandhinagar on 01st January, 2023.
- Attended 66th State Level Executive Committee of State Horticulture Mission under MIDH and 24 State Level Executive Committee of State Plan of Directorate of Horticulture on 04.10.2023 and 7.10.2023.
- Attended as member in 35th SAC meeting of KVK, Dahod (AAU, Anand) on 28th December, 2023.
- Attended Webinar on 17th November, 2023 on "DUS & PVP Data Management" from Indo-German cooperation conducted by PPV&FRA, New Delhi.
- Participated in Citrus Day held at ICAR-CIAH, Bikaner on 20.10.2023 in virtual mode.

Dr. S.R. Meena

- Attended the Meeting of "MATI Project" organized by Dy. Director (Extension) at Bikaner on 4th January, 2023.
- Attended SAC Meeting of KVK, Lunkaransar on 8th August, 2023.
- Participated in the meeting held at CAD office, Bikaner on 12th May, 2023 under the Chairmanship of Divisional Commissioner, Bikane.
- Participated in Annual Zonal Workshop of KVKs under ATARI, Jodhpur organized at AU, Jodhpur during 19-21st June, 2023.
- Attended the Meeting at ATMA office Bikaner to discuss about the Development Vision-2030.

Dr. S.K. Maheshwari

- Attended RAC Meeting held at ICAR-CIAH, Bikaner on 27th February, 2023.
- Attended QRT Meeting held at ICAR-CIAH, Bikaner on 24th April, 2023.

- Attended 04th SOC meeting held at ICAR-CIAH, Bikaner on 10th May, 2023.
- Attended a lecture on ARMS delivered by Dr. S.B. Lal, IASRI, New Delhi online on 15th June 2023.
- Attended PPV&FRA training-cum-farmers awareness programme held at ICAR-CIAH, Bikaner on 26th June, 2023.
- Attended IRC Meeting held at ICAR-CIAH, Bikaner during 4-6th July, 2023.
- Attended training cum interaction meet on pomegranate cultivation in hot arid region held at ICAR-CIAH, Bikaner on 20th July, 2023.
- Attended Hindi Pakhwada function held at ICAR-CIAH, Bikaner on 14th September, 2023.
- Attended Inaugural function of Foundation stone of Amrit Sarovar held at ICAR-CIAH, Bikaner on 27th September, 2023.
- Attended Foundation Day function and industry meet held at ICAR-CIAH, Bikaner on 30th September, 2023.
- Attended brainstorming programme on "Arid and semi-arid horticulture: developing a roadmap for Amrit Kaal (2047)" held at ICAR-CIAH, Bikaner on 01st October, 2023.
- Attended Citrus day held at ICAR-CIAH, Bikaner on 20th October, 2023.
- Attended RAC Meeting held at ICAR-CIAH, Bikaner during 26-27th December, 2023.

Dr. D.K. Sarolia

- Participated in State bio-diversity board (awareness & sensitization) at ICAR-NRC on Camel, Bikaner on 14th December, 2023.
- Attended online meeting of horticulture course committee as External member conducted by AU Jodhpur on 28th June 2023.
- Attended meeting of Regional Advisory Group on subject agri-value chain finance at regional office NABARD, Jaipur on 22nd November, 2023.

Dr. D. S. Mishra

- Attended the Scientific Advisory Committee meeting of KVK, Panchmahal as a member on 29th March, 2023.
- Attended QRT Meeting held at ICAR-CIAH, Bikaner during 24-26th April, 2023; at IIHR, Bengaluru on 31st May, 2023 and at CHES, Vejalpur during 17-18th August, 2023.
- Attended Industry Meet and Foundation Celebration and a brainstorming session on "Arid horticulture: a road map for Amrit Kaal (2047)" at ICAR-CIAH, Bikaner during 30.09.2023 to 01.10.2023.

Dr. B.R. Choudhary

- Attended the Institute Technology Management Committee meetings at ICAR-CIAH, Bikaner on 10th March, 2023 and 12th June, 2023.
- Attended QRT Meeting of the Institute on 23-24th April, 2023.
- Attended ZREAC Meeting (*Kharif* 2023) held at ARS, SKRAU, Bikaner during 5-6th April, 2023.
- Attended *Kharif* 2023 Standing Committee Meeting and reviewing of the activities of the Command Area Development (CAD) Agriculture research wing for *Kharif* 2022 held on 12th May, 2023 under the Chairmanship of Commissioner CAD, Bikaner.
- Attended the Institute Variety Identification Committee meeting held on 6th June, 2023.
- Attended 'Review Meeting of Coordinating Centres of AICRP on Vegetable Crops' held on 11th December, 2023 virtually.
- Attended 30th meeting of Central Sub-Committee on Crop Standards, Notification and Release of Varieties for Horticultural Crops held virtually on 21st February, 2023.

Dr. Ramkesh Meena

- Attended meeting of Nodal Officers of AICRP-AZF held on 11th April 2023 at ICAR-CIAH, Bikaner.
- Attended industry meet and foundation day on 30th September, 2023 at ICAR-CIAH, Bikaner.

Dr. Ramesh Kumar

- Attended Annual Review Meeting of AICRP-AZF Annual Group Meeting organized virtually at ICAR-CIAH, Bikaner on 23rd February, 2023.
- Attended meeting of Nodal Officers of AICRP-AZF organized on 11th April, 2023 at ICAR-CIAH, Bikaner.
- Attended pre QRT Meeting of AICRP on AZF organized on 19th April, 2023 at ICAR-CIAH, Bikaner in virtual mode.
- Attended and assisted in organization of QRT meeting of AICRP-AZF at ICAR-CIAH, Bikaner on 25th April, 2023.
- Attended "Nodal Officers virtual meetings of AICRP-AZF" held during May 2-18, 2023 at ICAR-CIAH, Bikaner.
- Attended and assisted in organization of QRT meeting of AICRP-AZF at ICAR-IIHR, Bengaluru on 31st May, 2023 virtually.
- Attended Annual Group Meeting of AICRP-AZF

organized held during June 21-23, 2023 at ICAR-CIAH, Bikaner virtually.

Dr. M.K. Berwal

- Attended Industry Institute interaction meeting of Crop and Horticultural Sciences Divisions held under the Chairmanship of Dr. T.R. Sharma, DDG, ICAR on 16th July, 2023 at New Delhi.
- Convener for Review Meeting of AICRP-AZF held in virtual mode at ICAR-CIAH, Bikaner.
- Hosted the ITMU meeting on virtual platform on 10th March, 2023.
- Hosted Scientific Advisory Committee Meeting of KVK, Vejalpur, on Zoom held on 29th March, 2023.
- Hosted the AICRP-AZF Nodal Officers presentation meeting held during May 2-15, 2023.
- Attended a Workshop on "Contribution and potential of millets for rural health and economy" organized by ICAR-CIAH, Bikaner on 02nd June, 2023.
- Convened and attended a ITMU Meeting for discussion on opportunity of TFL seed production of Ridge gourd on 12th June, 2023.
- Convened Annual Group Meeting of AICRP AZF held in virtual mode at ICAR-CIAH, Bikaner during June 21-23, 2023.
- Chairman of Selection Committee for recruitment of YP-1 & 2 at AKMU Cell on 10th July, 2023.
- Participated in West Zone ICAR Sports Meet held at ICAR-IGFRI, Jhansi during 16-19th December, 2023.
- Convened and attended the RAC Meeting organized in hybrid mode at ICAR-CIAH, Bikaner during 26-27th December, 2023.

Dr. Gangadhara K.

- Attended Institute variety identification committee meeting held on 6th June, 2023 at ICAR-CIAH, Bikaner through virtual mode.
- Attended Institute Hindi Rajbasha committee meeting held on 24th March, 2023 at ICAR-CIAH, Bikaner through virtual mode.

Dr. Lalu Prasada Yadav

- Attended Institute variety identification committee meeting held on 6th June, 2023 at ICAR-CIAH, Bikaner through hybrid mode.
- Attended a Meeting at APIC cell, Agriculture Secretariat, Gandhinagar, Gujarat.
- Attended the "Natural farming awareness programme" at KVK, Panhhmahal on 13th January, 2023.
- Attended Scientific Advisory Committee meeting as member of KVK, Panchmahal on 29th March, 2023
- Attended lecture of Dr. (Mrs.) N. Kalaiselvi, Secretary, DSIR and DG, CSIR on 12th January, 2023.

Dr. Vikas Yadav

- Participated in QRT meeting of ICAR-CIAH, Bikaner held during 17-18th August, 2023 at CHES, Vejalpur (Godhra).

Sh. R.C. Balai

- Attended QRT Meeting of the Institute during April 23-24, 2023.
- Attend a Meeting of World intellectual property day-2023 on 26th April, 2023 at CIAH Bikaner.
- Acted as a Member of assessment committee meeting held on 9th October, 2023.
- Attend a Meeting with regard to CAD (Command Area Development) on 12th May, 2023 at Superintendent Office, Bikaner.

Dr. Anita Meena

- Attended the AICRP-AZF workshop during June 21-23, 2023.
- Attended the Institute foundation day and Institute technology day at CIAH, Bikaner during 30-09-2023 to 01-10-2023.
- Attended the briefing of centre superintendents, observers and flying squad of JET 2023 at SKRAU, Bikaner on 12th May, 2023
- Attended the the Pre-ZREAC meeting of *Kharif*-2023 on 10-11 March, 2023 and ZREAC *Kharif* 2023 meeting held during March 20-21, 2023 at ARS, Bikaner.

Dr. Ajay Kumar Verma

- Attended ZREAC meeting for *Rabi* 2023 of Zone Ic held at ARS, SKRAU, Bikaner during 19-20th September, 2023.
- Attended Review Meeting of Coordinating Centres of AICRP on Vegetable Crops" held virtually on 11th December, 2023.
- Attended 30th meeting of Central Sub-Committee on Crop Standards, Notification and Release of Varieties for Horticultural Crops held virtually on 21st February, 2023.

Dr. Hanuman Ram

- Attended DUS monitoring team for watermelon and muskmelon as member at ICAR-CIAH, Bikaner on 24th April, 2023.

- Attended ZREAC meeting for *Rabi* 2023 of Zone Ic held at ARS, SKRAU, Bikaner during 19-20th September, 2023.
- Attended Review Meeting of Coordinating Centres of AICRP on Vegetable Crops" held virtually on 11th December, 2023.
- Attended 30th meeting of Central Sub-Committee on Crop Standards, Notification and Release of Varieties for Horticultural Crops held virtually on 21st February, 2023.

Dr. Kamlesh Kumar

- Attended AICRP on AZF Review Meeting held at ICAR-CIAH, Bikaner on 23rd February, 2023.
- Attended World environment day celebration programme organized at ICAR-CIAH, Bikaner on 5th June, 2023.
- Participated in IRC Meeting held at ICAR-CIAH, Bikaner during 4-6th July, 2023.
- Participated and interacted with team of experts visited for institute nursery accreditation on 09th August, 2023.
- Attended a meeting with ADG, Horticultural Science and ADG, Crop Science at ICAR-CIAH, Bikaner on 27th September, 2023.
- Attended "National women farmer's day" programme organized at ICAR-CIAH, Bikaner on 15th October, 2023.
- Attended "Institute foundation day and Industry meet" organized at ICAR-CIAH, Bikaner on 30th September, 2023.
- Attended the Inaugural function of DGR-RRS, Bikaner and Trainees House of CIAH, Bikaner on 27th September, 2023.

Dr. Pawan Kumar

- Attended QRT Meeting of AICRP-AZF during 24-25th April, 2023 organised by ICAR-CIAH, Bikaner in hybrid mode.
- Attended Scientific Advisory Committee (SAC) meeting at KVK Bikaner-II, Lunkaransar, on 8th August, 2023.
- Attended DUS monitoring team for watermelon and muskmelon as member at ICAR-CIAH, Bikaner on 24th April, 2023.
- Attended 27th Research Workers Group Meeting-2023 of AICRP- AZF during June 21-23, 2023.
- Attended and nominated for smooth conduct of Kisan Mela and inauguration function for office building of DGR-RRS, Bikaner and Trainees House of ICAR-CIAH, Bikaner on 27th September, 2023.
- Attended Training cum Interaction meet on "Pomegranate cultivation in hot arid region" on 20th July, 2023 at ICAR-CIAH, Bikaner.
- Attended Field Day "Field Exhibition cum Farmer-Scientist Interaction" on Anola at ICAR-CIAH, Bikaner on 14th December, 2023.
- Attended Field Day "Intercropping in Ber Based Cropping System" at ICAR-CIAH, Bikaner on 21 December, 2023.
- Participated in ICAR-Sports event at ICAR-IGFRI, Jhansi (UP) during 16-19th December, 2023.

Sh. M.K. Choudhary

- Attended IRC Meeting of the Institute during 4-6 July, 2023.
- Attended 27th Research Workers Group Meeting-2023 of AICRP- AZF during June 21-23, 2023.
- Attended Field Day "Field Exhibition cum Farmer-Scientist Interaction" on Anola at ICAR-CIAH, Bikaner on 14th December, 2023.
- Attended Field Day "Intercropping in Ber Based Cropping System" at ICAR-CIAH, Bikaner on 21st December, 2023.
- Participated in ICAR-Sports event at ICAR-IGFRI, Jhansi (UP) during 16-19th December, 2023.

6 (a). WOMEN EMPOWERMENT

Training programmes on women empowerment

It is commendable to focus on the empowerment of women in arid regions, recognizing their pivotal role in rural economy. The training programs outlined align with the goal of enhancing the quality of life for women through increased knowledge and skills. The vocational trainings and entrepreneurial skills have been provided to women farmers to enable them to establish and manage their own enterprises. An overview of training programs organized for the empowerment of women is presented below:

- Trainings on specialized techniques like propagation and cultivation of horticultural crops.
- Emphasis on sustainable development and water-efficient practices for crop production.
- Establishment of nutri-garden to promote the cultivation of diverse and nutrient-rich crops for household consumption.
- Economic and nutritional benefits of nutri-garden.
- Educating women farmers on balanced nutrient management practices.
- Training on planning, designing and maintaining nutri-gardens.
- Training on organic methods of pest control, composting and soil health management.
- Capacity building to establish and maintain nurseries.
- Awareness programs on their rights and opportunities.

Several training programs under TSP and SCSP Schemes have been organized to address the specific needs of rural women. During the training programmes, vegetable seed kits (rabi and kharif) for kitchen gardening and literature have been distributed.









पोषण वाटिका पर हुआ प्रशिक्षण

Rajasthan Patrika...
पत्रिका
सब्जियों की उन्नत बागवानी की दी जानकारी

6 (b). PERSON WITH DISABILITY *(DIVYANGJAN)*

Accessibility to the person with disability *(Divyangjan)*

The Institute is having ramp and washrooms in all office buildings/ guesthouse for person with disabilities *(Divyangjan)*. The scientists also interacted with them and conducted their visit to museum, experimental fields, *etc.*

7. AWARDS AND RECOGNITIONS

Institute Awards

- Participated and displayed the technological exhibition of the Institute on 14th January, 2023 at NRCC, Bikaner during the International Camel Festival where our Institute's exhibition awarded with **Best Exhibition Award.**
- Participated and displayed the technological exhibition of the Institute in Shri Mallinath Pashu Mela Tilwara, Barmer organized by CAZRI, Jodhpur during 27-29th March, 2023 and our Institute honoured with **Best Exhibition Award**.
- Participated and displayed the technological exhibition of the Institute in "State Level Kisan Mela on *"PAUSHAK ANAAJ - SAMRUDH KISAN"* organized by SKRAU and ATMA, Bikaner from 27-29th March, 2023 and our Institute honoured with **Best Exhibition Award**.
- Participated and displayed the technological exhibition of the Institute on the occasion of "Celebration of 50th Foundation Day of Arid Region Campus, CSWRI, Bikaner" on 4th January, 2023 and our Institute got **Best Exhibition Award**.
- Participated and displayed the technological exhibition of the Institute on 7th April, 2023 at CSWRI-ARC, Bikaner where our Institute's exhibition was awarded with **Best Exhibition Award**.









Individual Awards

Dr. D.S. Mishra

- Received Best oral presentation Award for paper presented on "Phenotypic diversity for fruit quality traits and bioactive compounds in red-fleshed guava" In: Progressive Horticulture Conclave (PHC 2023) held at GBPUAT, Pantnagar during 3-5th February, 2023.
- Received Fellow of ISHRD Award conferred by Indian Society of Horticultural Research & Development (ISHRD), Uttrakhand during Progressive Horticulture Conclave (PHC 2023) held at GBPUAT, Pantnagar from 3-5th February, 2023.

Dr. Ramesh Kumar

- Received "Young Scientist Award-2023" for contribution in the field of horticulture from AIASA, Rajasthan during National Conference on Milllets: Magical crops for nutritional sustainability held from 28-29th April, 2023.

Dr. Ramkesh Meena

- Received best oral presentation award in 7th International Conference on Sustainable utilization of resources in agricultural growth- It's challenges and opportunities held at SK Chaudhary Educational Trust's- KVK, Madhubani, Bihar during 11-13th February, 2023.
- Received second position award in *"Nibandh Lekhan"* competition on Hindi Chetna Pakhawada at ICAR-CIAH, Bikaner during 2023.
- Received honors of External examiner for conducting practical Examination of Hort-221 (Production technology for fruit and plantation crops) on 30th August, 2023 at College of Agriculture, Bikaner.
- Received honors as an expert in brainstorming session on "Assessment of Post-harvest losses of Major fruit crops in Rajasthan: An Agribusiness prospective on 2nd June, 2023 at Institute of Agri-Business Management, SKRAU, Bikaner.

- Received a Silver Medal as a member of the Kabbadi team in ICAR Western Zone Tournament held at ICAR-IGFRI, Jhansi during 16-19th December, 2023.

Dr. Mukesh Kumar Berwal

- Received Nation Builder Award from Rotary Club Under "Rotary India Literacy Mission" on 5th September, 2023.

Dr. R.C. Balai

- Received III prize in Hindi Nibandh Lekhan Pratiyogita during Hindi Pakhwara - 2023 organized in the institute.

Dr. Lalu Prasad Yadav

- Received the Best oral presentation award on Genetic diversity, morphological and quality traits, antioxidants potentiality and utilization of germplasm resources of *Coccinia grandis*-An underutilized perennial vegetable crop in 2nd International Conference on Prospects and challenges of environment and biological sciences in food production system for livelihood security of farmers (ICFPLS-2023) during 18-20th September, 2023 held at ICAR-CIARI, Port Blair.

Dr. Vikas Yadav

- Best oral presentation award on Thar Gaurav: a new high yielding wood apple variety for dryland in 2nd International Conference on Prospects and challenges of environment and biological sciences in food production system for livelihood security of farmers (ICFPLS-2023) held at ICAR-CIARI, Port Blair during 18-20th September, 2023.

Dr. Anita Meena

- Awarded with First prize for Oral paper presentation on Yield of snapmelon as influenced by organic fertilizer under saline water in arid region during the National Conference on Agro-Ecology Based Agri-Food Transformation Systems organized by FSRDA and ICAR-IIFSR in collaboration with CIMMYT and ICRISAT at ICAR-IIFSR, Modipuram, Meerut during 27-28th January, 2023.

Dr. Gangadhar K.

- Received the Best oral presentation award in 2nd International Conference on Prospects and challenges of environment and biological sciences in food production system for livelihood security of farmers (ICFPLS-2023) during 18-20th September, 2023 held at ICAR-CIARI, Port Blair.

Dr. Jagan Singh Gora

- Received best Young Scientist Award in National Conference on Millets: Magical crops for Nutritional sustainability (MMCNS-2023) held at Jagannath University during 28-29th April, 2023.

Recognitions

Dr. Jagadish Rane

- Honoured as Chief Guest in inaugural session of ICAR-NAHEP sponsored training program at ICAR-NIASM, Baramati.
- Delivered a Guest lecture 'Phenotyping for drought tolerance' in Workshop organized by ICAR-NRC for Banana, Trichy (online mode) on 10th March, 2023.
- Attended thesis viva-voce examination of Ms. Sonone Madhavi Prakash, Ph.D. (Ag.) student of Dr. B.S. Konkan Krishi Vidyapeeth, Dapoli held on 11th August, 2023 (online mode).
- Attended a programme as a Chief Guest in Investiture Ceremony at RNB Global University, Bikaner on 28th August, 2023.
- Attended the meeting of Selection Board for finalizing promotion proposals under Career Advancement Scheme (CAS) organized by Maharashtra Council of Agricultural Education and Research, Pune from 29th December, 2023 to 1st January, 2024 (online mode).

Dr. A.K. Singh

- Acted as Member of Jury for evaluation of posters presented during the International Seminar on Exotic and Underutilized Horticultural Crops held at ICAR-IIHR, Bengaluru during 17-19th October, 2023.
- Acted as Coordinator during Industrial meet and Foundation Day Celebration at ICAR-CIAH, Bikaner on 30th September, 2023.
- Acted as Member of ICAR-DMAPR, Boriabi, Anand Logo finalization Committee on 19th November, 2023.
- Acted as Nodal Officer for SCSP and TSP scheme at the station for socio-economic uplift of Schedule caste and schedule tribes through various inputs.
- Organized QRT meeting at CIAH-CHES, Vejalpur during 17-18th August, 2023.
- Acted as Organizing Secretary for conducting National Webinar "Workshop cum Farmer Interaction Meeting for Research Activities, Issues and Challenges in Custard Apple" on 4th May, 2023.

- Rescived patent for design ''Smart device for monitoring the health of horticultural plants'', Govt. of India, dated 08-08-2023, No. 392207-001
- Rescived patent of design ''Automated finacial risk management sysytem for agricultural investment using big data analytics and machine learning'', Federal Republic of Germany, dated 08-06-2023, No. 202023102126.
- Acted as panelist during the session -V, VI & VII: Plant Propagation, Plant Densities, Training and Pruning, and Post Harvest Management during 27th AICRP on AZF in virtual mode during June 21-23, 2023.
- Acted as Course Director for 7 days training programme "Technological advances in horticultural crops" to the M.Sc. Horticulture Students of RLBCAU, Jhansi from 11-17th December, 2023 at CHES, Vejalpur.
- Worked as Mentor to ARS Probationer Scientist orientation training programme from 10th October to 29th November, 2023.
- Acted as Member of State Level Eexecutive Committee-2023, Gujarat Horticulture Mission under National Horticulture Mission, GoI.
- Acted as Programme Coordinator for orientation training for ARS Probationer Scientist Dr. Manpreet Kaur from 7-9th August, 2023.
- Acted as Programme Coordinator during on campus training programme "Recent advances on dryland Horticultural Crops for sustainable horticultural production" from 17-27th July, 2023 for RAWE Students of B.Sc. Ag. (Hons.) from COA, Parul University, Vadodara, Gujarat.
- Acted as Convenor for five days on campus Training programme under TSP "Promotion of dryland Horticulture in tribal areas of Panchmahal district of Gujarat" from 13-17th March, 2023.

Dr. V.V. Apparao

- As a Co-Convenor in five days On Campus training programme "Promotion of dryland horticulture in tribal areas of Panchmahal district" under TSP Scheme during 13-17th March, 2023.

Dr. S. K. Maheshwari

- Nominated as Chairman for selection committee of YP-I and also as Member for YP-II on 10th July, 2023.
- Nominated as Member in Editorial Board of Current Horticulture.
- Nominated as Editor in Annals of Plant and Soil Research.

Dr. S. R. Meena

- Attended the presentation of DG, CSIR, New Delhi about the collaborative research programme with ICAR on 12th January, 2023.
- Worked as Chairman in finalising the rates of food of scientist home of the Institute and farm produces and seed rates of the Institute on 16th January, 2023.
- Attended the Standing Committee Meeting Rabi-2023-24 at CAD officer Chaired by Divisional Commissioner, Bikaner and gave presentation/ lecture on "Arid vegetables and fruits".
- Acted as Mentor of Dr. Manpreet Kaur, Scientist for one month Orientation Training Programme.
- Attended and contributed in DPC of different technical (Sh. G. U. Trivedi, CHES, Vejalpur, ACTO to CTO) of the Institute.
- Attended a meeting of District Horticulture Development Committee at Collectorate Office Bikaner related to analyse the different programmes/ activities related to horticulture development.

Dr. B.R. Choudhary

- Nominated for joint inspection of the project proposals on 'Hi-tech cultivation of cucumber under shade net house and poly house' at two locations (village-Amarpura, Tehsil-Pugal of Bikaner district) under NHB schemes.
- Deputed Rapporteur of Brainstorming session on 'Arid and semi-arid horticulture: A road map for Amrit Kaal (2047)' on 01st October, 2023.
- Acted as Chairman of Vegetable Seed Sale Committee and celebrated Vegetable Seed Sale Day on 10th February, 2023.
- Acted as Chairman of the committee to celebrate International Year of Millets-2023.
- Acted as Coordinator of Industry Meet and Foundation Day Celebration organized on 30th September, 2023.
- Acted as Chairman of Farm Visit Committee on the occasion of Foundation Day of ICAR-CIAH, Bikaner (30-09-2023 & 01-10-2023).
- Acted as Chairman of Publication Release Committee on Foundation Day of the institute celebrated on 30th September, 2023.
- Acted as Chairman of a committee to count successful budded plants of ber and khejri in

Nursery Unit on 5th October, 2023 for stock entry.

- Acted as Editor in-Chief of ISAH Indian Journal of Arid Horticulture, Bikaner.

Dr. D.K. Sarolia

- Worked as Course Director in Winter School programme entitled Commercialization of arid fruit and vegetable crops through modern approaches at ICAR-CIAH, Bikaner (1-21 February, 2023).
- Served as Rapporteur for session-II (PGRM) in 27th research workers group meeting (online) on 21st June, 2023.
- Convenor of session-II "Farmers awareness cum training programme" on 26th June, 2023.
- Served as External member of purchase committee of ICAR-IIPR Regional Centre, Bikaner.

Dr. D.S. Mishra

- Acted as Editor (PHT) for ISAH Indian Journal of Arid Horticulture, Bikaner.
- Attended the Scientific Advisory Committee meeting of KVK, Panchmahal as member on 29th March, 2023.
- Acted as Rapporteur in the first session of Crop improvement in Progressive Horticulture Conclave (PHC 2023) held at GBPUAT, Pantnagar during February 3-5, 2023.
- Acted as Rapporteur in Farmer Scientist Interaction in AICRP-AZF Research Workers Group Meeting-2023 held at ICAR-CIAH, Bikaner on virtual platform on 23rd June, 2023.
- Acted as Member of constituted committee for clearance of probation of Scientist at ICAR-CIAH, Bikaner on 24th April, 2023.
- Evaluated Ph.D. (Horticulture) thesis "Effect of drip irrigation regimes, mulching and micronutrients on growth and yield attributes in litchi cv. Rose Scented" of GBPUAT, Pantnagar.
- Worked as Reviewer of Indian Journal of Horticulture, Indian Journal of Agriculture Sciences and Indian Horticulture during the year 2023.

Dr. Ramesh Kumar

- Acted as Rapporteur in the Brainstorming Session "Arid and semi-arid Horticulture: A road map for Amrit Kaal-2047" organized by ICAR-CIAH, Bikaner and ISAH, Bikaner on 01st October, 2023.
- Acted as Rapporteur in "Interaction with farmers and developmental agencies and plenary sessions" of AICRP-AZF Annual Group Meeting 2023, held from 21st to 23rd June, 2023 at ICAR-CIAH, Bikaner.
- Acted as Associate Editor of ISAH Indian Journal of Arid Horticulture, Bikaner.
- Acted as Editor of Journal of Agriculture and Ecology published by SAAER, Bikaner.
- Organized and acted as Course Coordinator in the Winter School "Commercialization of arid fruits and vegetable crops through modern approaches" during 01-21st February, 2023.
- Organized two days training programme on "Interstate officers training" at ICAR-CIAH, Bikaner for Haryana Agricultural Officer from 13-14th January, 2023.
- Organized One Training Cum Interaction Meet "Pomegranate cultivation under hot arid climate" on 20th July, 2023 and acted as Coordinator.
- Organized Field day entitled "Citrus Day-Prospectus and way forward" on 20th October, 2023 and acted as Convener.
- Organized Field day entitled "Role of rootstocks in mandarin" on 7th December, 2023 and acted as Co-coordinator.
- Acted as Coordinator of one week training programme "Production technology and nursery management of horticultural crops" at ICAR-CIAH, Bikaner organized for the students of CCSHAU, Hisar, Haryana from 25th September to 01st October, 2023.
- Worked as Coordinator of "Kisan Diwas" organized on 23rd December, 2023 at ICAR-CIAH, Bikaner.
- Coordinated a programme entitled "Survey of Pomegranate Orchards of Bikaner district" in collaboration with ICAR-NRC on Pomegranate on 19th July, 2023.
- Coordinated in organization of "Annual Review Meeting" of AICRP-AZF Annual Group Meeting at ICAR-CIAH, Bikaner on 23rd February, 2023 and during 21st to 23rd June, 2023 (virtual mode).

Dr. Ramkesh Meena

- Acted as Co-editor of ISAH Indian Journal of Arid Horticulture, Bikaner.
- Acted as Editor of Annals of Plant and Soil Research, Agra.

Dr. M.K. Berwal

- Organized One Day Farmers Training cum Interaction meet on "Pomegranate cultivation in hot arid region" in hybrid mode at ICAR-

CIAH, Bikaner on 20th July, 2023.

- Orientation class on AKMU, KRISHI Portal, e-Office and research highlights of Biochemistry Lab for newly joined Scientist Mrs. (Dr.) Manpreet Kaur (Agril. Economics).
- Acted as Member of organizing committee for Inauguration of office building cum Farmer's Fair at ICAR-DGR, RSS Bikaner held on 27th September, 2023.
- Orientation class on AKMU, KRISHI Portal, e-Office and research highlights of Biochemistry Lab for newly join Scientist Dr. Anil (Agri. Entomology).
- Acted as Coordinator of Citrus Field Day organized on 20th October, 2023 at ICAR-CIAH, Bikaner.
- Attended the ICAR Foundation cum Technology Day at NAAS Complex, New Delhi and exhibited the Institute technologies during 16-18th July, 2023.

Dr. Lalu Prasad Yadav

- Acted as Associate Editor of Current Horticulture.
- Editorial board Member of Hort Flora Research Spectrum (Vegetable Science).
- Editorial board Member of International Journal of Environment, Agriculture and Biotechnology.
- Awarded Research in Excellence Award-2022 by Society for Science Development in Agriculture and Technology-virtually (SSDAT) in absentia.
- Acted as Co-organizing Secretary in five days On Campus training "Promotion of dryland horticulture in tribal areas of Panchmahal district" under TSP Scheme during 13-17th March, 2023.
- Acted as Co-convener in three days On Campus training on "Rain-fed horticultural technologies for enhancing livelihood and nutritional security of resource poor farmers of Panchmahal district" under SCSP Scheme at ICAR-CHES, Vejalpur during March 20-22, 2023.
- Programme developed and organized 11 days training programme for RAWE students of B.Sc. Ag. (Hons.) as Program Convenor on "Recent advances in dryland horticultural crops for sustainable horticulture production" at ICAR-CHES, Vejalpur during July 17-27, 2023.
- Acted as Programme Coordinator of orientation training programme for Dr. Manpreet Kaur (ARS probationer), Scientist, Agril. Economics at CHES, Vejalpur from 7-9th August, 2023.
- Acted as Course Co-Director in 15 days training programme for RAWE students of B.Sc. Ag. (Hons.) on "Climate resilient horticultural crops for hot semi-arid region of western India" at ICAR-CHES, Vejalpur from 07.08.2023 to 21.07.2023.
- Organized one day training programme "Kitchen Gardening for nutritional security" in collaboration of Horticulture Department, Vejalpur in urban horticulture development scheme on 30.10.2023 at CHES, Vejalpur.
- Conducted a Field school for the students of Jawahar Navodaya Vidyalaya, Panchmahal at CHES, Vejalpur on 10th August, 2023.
- Organized student field school on kitchen gardening of Jawahar Navoday Vidyalay, Panchmahal students at CHES, Vejalpur in October, 2023.
- Training to the farmers on nursery raising and its management practices in adopted villages during 2023.
- Acted as Co-Organizing Secretary in one week training programme "Technological advancement in semi-arid Horticultural crops" for 7 M.Sc. (Hort.) students of RLBCAU, Jhansi, UP under ICAR-NAHEP, IG Grant organized at CHES, Vejalpur during December 11-17, 2023.
- Coordinated the training programmes on women empowerment through skill development activities on 'Advance production technology of arid and semi-arid horticultural crops' in adopted villages during 2023.

Dr. Hanuman Ram

- Acted as Co-convenor of one day workshop on "Contribution and potential of millets for rural health and economy" organized by ICAR-CIAH, Bikaner on 02nd June, 2023 and prepared the proceedings of the workshop.
- Served as Member in Editorial Board of Journal of Agriculture and Ecology.
- Acted as Member of a committee for counting of successfully budded plants of ber and khejri in Nursery Unit, ICAR-CIAH, Bikaner on 5th October, 2023 for stock entry.
- Acted as Member of the committee to celebrate International Year of Millets-2023 at ICAR-CIAH, Bikaner.

Dr. Vikas Yadav

- Awarded with Fellow Award by Society for Scientific Development in Agriculture and Technology in 5th International Conference on 'Innovative and current advances in agriculture and allied sciences' held during 10-16th July, 2023 at Dubai, UAE in hybrid mode.
- Received Certificate of Excellence in Reviewing (2023) from International Journal of Environment and Climate Change published from London, UK.
- Convener in National webinar on 'Workshop cum farmer interaction meeting for research activities, issues and challenges in custard apple' held at ICAR-CIAH, Bikaner in virtual mode on 4th May, 2023.

Dr. Anita Meena

- Worked as Coordinator of Kisan Mela at Naya Kheda, Udaipur (Rajasthan) on 7th June, 2023 and at Jawar, Udaipur (Rajasthan) on 8th June, 2023 under TSP Scheme.
- Acted as Coordinator of training on "Technological intervention on horticulture crops, nutri-garden and village seed bank" under TSP Scheme on 11th June, 2023 at Tulsiyo ka Namla village of Salumber district (Rajasthan).
- Coordinated a training on "Propagation techniques in different fruits and vegetables for entrepreneurship" under TSP Scheme on 10th June, 2023 at Amrthun village of Banswara district (Rajasthan).
- Worked as Coordinator of a training "Entrepreneurship and nursery management techniques for getting higher income through Paushan Vatika and kitchen gardening" under TSP Scheme on 10th June, 2023 at Kadwaamri village of Banswara district (Rajasthan).
- Acted as Coordinator of training programme "Off season vegetable cultivation to get higher market fetch" under TSP Scheme on 9th June, 2023 at Manpur village of Dungarpur district (Rajasthan).
- Coordinated a training programme "Improved horticultural cultivation and input distribution" under TSP Scheme on 9th June, 2023 at Phatadara village of Udaipur district (Rajasthan).
- Acted as Convener of training programme on "Skill development for self-employment to empower rural women" under aegis of Azadi Ka Amrit Mahotsav 2023.
- Worked as Convener to organize a webinar "Women and IP: Accelerating Innovation and Creativity" under the theme of World Intellectual Property on 26th April, 2023.
- Acted Convener to organize a webinar "National Women Farmer's Day" with the theme of Gender equity and empowerment through horticulture technology on 15th October, 2023.
- Worked as Convener to organize the "World Soil Health Day" at Jhajaoo, Kolayat, Bikaner district with the theme of "Soil and Water: A source of life" on 5th December, 2023.
- Worked as Organizing Secretary to conduct Anola Field Day cum Farmer Interaction Meet on 14th December, 2023.
- Acted as Coordinator of Field day on Intercropping in ber-based cropping systems cum farmer-scientific interaction meet organized on 21st December 2023.

Dr. Gangadhara K.

- Acted as Organizing Secretary in five days on campus training "Promotion of dryland horticulture in tribal areas of Panchmahal district" under TSP Scheme during 13-17th March, 2023 at CHES, Vejalpur.
- Worked as Co-convener in three days on campus training on "Rain-fed horticultural technologies for enhancing livelihood and nutritional security of resource poor farmers of Panchmahal district" under SCSP Scheme during March 20-22, 2023.
- Worked as Course Co-Director in 15 days training programme for RAWE students of B.Sc. Ag. (Hons.) on "Climate resilient horticultural crops for hot semi-arid region of western India" during August 7-21, 2023.
- As Co-coordinator organized 11 days training programme for RAWE students of B.Sc. Ag. (Hons.) on "Recent advances in dryland horticultural crops for sustainable horticulture production" during July 17-27, 2023.
- Acted as Co-Coordinator of one week training programme entitle "Technological advancement in semi-arid horticultural crops" for 7 M.Sc. (Hort.) students of RLBCAU, Jhansi, UP under ICAR-NAHEP, IG Grant organized during 11-17th December, 2023.

Dr. Kamlesh Kumar

- Recognized as External examiner for online

Thesis Evaluation (M.Sc.) of subject 'Effects of tree age and heading-back on mango (Mangifera indica L.) cv. Amrapali' from ICAR-IARI, New Delhi during September, 2023.

- Recognized as "Paper Setter" twice for Final Theory Examination (M.Sc. and B.Sc.) of subject 'Tropical and Temperate Fruit Production (FSC 502) and Production Technology for Fruit and Plantation Crops (HFS 224)' for Banda University of Agriculture and Technology, Banda during March and April 2023, respectively.

Dr. Jagan Singh Gora

- Acted as Coordinator of the "Citrus Day - Prospects and Way Forward" organized at ICAR-CIAH, Bikaner on 20th October, 2023.
- Acted as Coordinator of "Role of Rootstock in Mandarin: A Technology Demonstration" organized at ICAR-CIAH, Bikaner on 7th December, 2023.

Dr. Pawan Kumar

- Participated in State Level Farmer's Fair organized by State Agriculture Department during 16-18th June, 2023 at JECC, Sitapura, Jaipur
- Exhibited the institute technologies in Kisan Mela at DGR, Regional Centre, Bikaner on 27th September, 2023.
- Worked as Coordinator of one day Workshop on "Contribution and potential of millets for rural health and economy" organized by ICAR-CIAH, Bikaner on 02nd June, 2023
- Acted as Rapporteur for session-III 'Improvements of Arid Zone Fruits' during 27th Research Workers Group Meeting-2023 held at ICAR-CIAH, Bikaner on 21st June, 2023.

Sh. R.C. Balai

- Participated in State Level Farmer's Fair organized from 16-18th June, 2023 at JECC Sitapura, Jaipur.
- Displayed the Institute technological exhibition at SKRAU Bikaner on 25th August, 2023.
- Displayed the institute exhibition during inauguration of Pearlmillet Centre, Gudamalani on 27th September, 2023.
- Displayed Institute technological exhibition during the Foundation Day of Institute celebrated on 30th September, 2023.
- Displayed the technological stall during ICAR Zonal meeting held at ICAR-CSWRI, Avikanagar on 3rd November, 2023.
- Participated in several Scientist-Farmer Meet organized by the Institute and interacted.
- Displayed the technological exhibition of the Institute during the National Seminar organized by College of Community Science, SKRAU, Bikaner held from 25-26th August, 2023.
- Participated and displayed the Institute technological exhibition at DGR-RSS, Bikaner on 27th September, 2023.

Mr. M. K. Choudhary

- Nominated as a Member in management committee for smoothly conduct of Kisan Mela and inauguration function of office building of DGR-RRS, Bikaner and Trainees House of ICAR-CIAH, Bikaner on 27th September, 2023.

8. PUBLICATIONS

Research paper

- Bagdi, D.L., Bagri, G.K., Jakhar, M.L., Kakralya, B.L., Bairwa, L.N. and Rane, J. 2023. Role of anti-transpirants on transpiration rate and physio-biochemical aspects in ber. *The Pharma Innovation Journal*, **12**(2): 3461-3465.
- Basavaraj, P.S., Boraiah, K.M., Gupta, P., Raskar, N. Rane, J. 2023. Genetic analysis and characterization of diverse pigeonpea genotypes for yield-enhancing traits. *Vegetos*, 1-10.
- Basavaraj, P.S. Raje J. Boraiah, K.M., Gangashetty, P. and Harisha, C.B. 2023. Genetic analysis of tolerance to transient waterlogging stress in pigeonpea (*Cajanus cajan* L. Millspaugh). *Indian Journal of Genetics and Plant Breeding*, **83**(3): 316-325.
- Boraiah, K.M., Basavaraj, P.S., Harisha, C.B., Kakade, V.D., Halli, H., Kate, P., Rane, J. and Pathak, H. 2023. Supplementary manual pollination: a potential technology to enhance the yield and quality in white fleshed dragon fruit variety. *National Academy Science Letters*, 1-4.
- Chand, L., Sharma, N., Sharma, R.M., Pandey, R., Sathee, L. and Dubey, A.K. 2023. Physio-biochemical and growth response of contrasting reciprocal grafting in citrus under water deficit and rehydration. *Journal of Plant Growth Regulation*, pp. 1-17.
- chesvejalpur@gmail.com, 2023. New varieties from CHES (ICAR-CIAH), Godhra, Gujarat, *Current Horticulture*, **11** (1): 71-72.
- Choudhary, B.R., Maheshwari, S.K., Haldhar, S.M. and Rane, J. 2023. New vegetable varieties. *Current Horticulture*, **11**(3): 80.
- Gangadhara K., Abraham, M.,Yadav, V., Singh, A.K., Verma, A.K., Selvakumar, R., Kumar, R. and Ashvatham, V.H. 2023. Diverse inbred lines with better fruit traits improves earliness and yield traits in eggplant (*Solanum melongena*. L.) in malabar coast of India. *Agril. Mecha. in Asia, Africa, L. America,* **54**(08):15133-15148.
- Gangadhara K.,Yadav, L. P., Apparao, V. V., Singh, A. K., Verma, A. K., Selvakumar, R. and Jat, G. S. 2023. Genetic diversity and principal component analysis in Indian bean (*Lablab purpureus* var. *typicus* L.) genotypes under rainfed conditions of Western India. *Genet. Resour. Crop. Evol.* https://doi.org/10.1007/s10722-023-01702-9.
- Gangadhara K., Yadav, L.P., Apparao, V.V., Singh, A.K. and Verma, A.K. 2023. Character association and path coefficient analysis for growth and yield parameters in cluster bean (*Cyamopsis tetragonoloba* L). *Int. J. Environment and Climate Change,* **13**(10):2211-2217.
- Gangadhara K., Abraham, M., Verma, A.K., Ashvathama, V.H. and Yadav, V. 2023. Correlation and path analysis for growth, yield, quality and incidence of shoot and fruit borer in brinjal (*Solanum melongena* L). *Int. J. Environment and Climate Change,* **13**(10):2204-2210.
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9. RESEARCH PROJECTS

Institutional 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)	Ber (*Ziziphus* spp.)	Dr. D.K. Sarolia Sh. M.K. Choudhary
(b)	Pomegranate (*Punica granatum* L.)	Dr. Ramesh Kumar Dr. D.S. Mishra Dr. Chet Ram Dr. Pawan Kumar Dr. M.K. Berwal
(c)	Date palm (*Phoenix dactylifera* L.)	Dr. Ramkesh Meena Dr. P.S. Gurjar Sh. M.K. Choudhary
(d)	Aonla (*Emblica officinalis* Gaertn)	Dr. A.K. Singh Dr. D.S. Mishra Sh. M.K. Choudhary
(e)	Bael (*Aegle marmelos* Correa.)	Dr. A.K. Singh Dr. Ramkesh Meena Dr. K.L. Kumawat
(f)	Wood apple (*Feronia limonia*) and custard apple (*Annona squomosa),* Tamarind, chironji, karonda, Palmyra palm and Tendu.	Dr. Vikas Yadav Dr. A.K. Singh
(g)	Jamun, mahua, rayan, phalsa, manila tamarind and Indian dates.	Dr. D.S. Mishra Dr. V. V. Apparao Dr. P.S. Gurjar
(i)	Guava and acid lime.	Dr. D.S. Mishra Dr. V. V. Apparao Dr. Vikas Yadav Dr. Jagan Singh Gora
(j)	Underexploited fruits (lasoda, ker, karonda & mulberry).	Dr. K.L. Kumawat Dr. Kamlesh Kumar Dr. Chet Ram Dr. D.K. Samadia Dr. P.S. Gurjar
(k)	Maintenance and use of arid vegetable genetic resources for crop improvement.	Dr. D. K. Samadia Dr. A.K. Verma Dr. Hanuman Ram
(l)	Cucurbitaceous crops (Muskmelon, watermelon, sponge gourd and longmelon).	Dr. B.R. Choudhary Dr. S.K. Maheshwari Dr. Hanuman Ram
(m)	Dolichos bean, cluster bean, cowpea, okra and chilli.	Dr. Gangadhara K. Dr. V. V. Apparao Dr. L. P. Yadav Dr. A.K. Verma
(n)	Drumstick, spine gourd, ivy gourd, tomato, pumpkin and bottle gourd.	Dr. L.P. Yadav Dr. V. V. Apparao Dr. Gangadhara K.
(o)	Collection, conservation and utilization of un-tapped minor fruits of hot arid region.	Dr. K.L. Kumawat Dr. P.S. Gurjar

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)	Biochemical mechanism of abiotic stress tolerance in arid horticultural crops.	Dr. M.K. Berwal Dr. Chet Ram
(c)	Development, exploitation and validation of genomic resources for enhanced utilization of arid horticultural crops.	Dr. Chet Ram Dr. M.K. Berwal Dr. A.K. Verma Dr. Kamlesh Kumar Dr. Ramesh Kumar
(d)	Genetic improvement of arid vegetable legumes for quality yield under heat stressed environment.	Dr. A.K. Verma Dr. Hanuman Ram Dr. R.P. Meena Dr. Gangadhara K.
(e)	Breeding behaviour and population studies in diverse horticultural crops under hyper arid condition.	Dr. Pawan Kumar Sh. M.K. Choudhary Dr. K.L. Kumawat
(f)	Population studies for genetic improvement in targeted perennial crop-plants under hyper arid condition.	Sh. M.K. Choudhary Dr. Pawan Kumar
CIAH:3	**Standardization of arid and semi-arid fruits and vegetables production technology**	
(a)	Intensification of research on tissue cultured date palm in hot arid region.	Dr. Ramkesh Meena Dr. Anita Meena
(b)	Standardization of production technology of bael under rainfed semi-arid conditions of western India.	Dr. A. K. Singh Dr. V. V. Apparao
(c)	Performance evaluation of citrus germplasm and rootstocks study under hot arid environment of Rajasthan.	Dr. Jagan Singh Gora Dr. Ramesh Kumar Dr. P.S. Gurjar Dr. Pawan Kumar
(d)	Nutrient management in chironji, custard apple, jamun and tamarind.	Dr. V. V. Apparao Dr. A. K. Singh Dr. D.S. Mishra
(e)	Production system management in *ber* under hot arid ecosystem.	Dr. D.K. Sarolia Dr. S.K. Maheshwari
(f)	Standardization of production technology of jamun and custard apple under semi-arid conditions of western India.	Dr. D.S. Mishra Dr. V. V. Apparao
(g)	Response of date palm cultivar to pollen sources, pollen quality, quantity and suitability under hot arid ecosystem.	Dr. Ramkesh Meena Dr. Chet Ram Sh. M. K. Choudhary
(h)	Management practices for saline soil and water for crop production in arid region.	Dr. Anita Meena Sh. R.C. Balai
(i)	Development of native crop-plant production system using saline water under hot arid environment.	Sh. R.C. Balai Dr. Anita Meena Dr. S.R. Meena
(j)	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
(k)	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

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
CIAH:5	**Post harvest management studies**	
(a)	Development of functional foods and nutraceutical value added products from arid horticultural crops.	Dr. M.K. Berwal Dr. Ramesh Kumar Dr. P.S. Gurjar
(b)	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
CIAH:6	**Agriculture extension studies**	
(a)	Impact assessment ofadoption ofpomegranate and date palm in hot arid and semi-arid regions of Rajasthan.	Dr. S. R. Meena Sh. R.C. Balai Dr. Ramkesh Meena Dr. Ramesh Kumar

Externally Funded / Collaborative Projects

S.No.	Project Name	Name of PI & Co-PI
1.	DUS Nodal centre for watermelon and muskmelon.	Dr. B. R. Choudhary Dr. Hanuman Ram
2.	DUS Nodal centre for ber.	Dr. D. K. Sarolia
3.	DUS Nodal centre for date palm.	Dr. Ramkesh Meena
4.	DUS Nodal centre for bael.	Dr. A. K. Singh
5.	DUS Co-nodal centre for aonla.	Dr. A. K. Singh
6.	DUS Co-nodal centre for jamun.	Dr. D.S. Mishra
7.	DUS Nodal centre for chironji and tamarind.	Dr. A.K. Singh
8.	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
9.	Development of Hi - tech horticultural nursery with water harvesting structure (RKVY).	Dr. A.K. Singh Dr. L.P. Yadav Dr. V. V. Apparao
10.	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

10. IMC, IRC, RAC AND QRT

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Bhubaneswar, Odisha
Dr. Govind Singh
Former Director of Research, SKRAU, Bikaner
Dr. V.B. Patel
ADG (HS-II), ICAR, KAB-II, New Delhi
Dr. Jagadish Rane
Director, ICAR-CIAH, Bikaner
Sh. Sharan Pal Singh
Progressive Farmer, Suratgarh, Sri Ganganagar,
Rajasthan

Member Secretary

Dr. S. K. Maheshwari
PS, ICAR-CIAH, Bikaner

Two meetings were conducted on 27th February, 2023 and 26-27th December, 2023.





Quinquennial Review Team (QRT)

Chairman

Dr. A.K. Karnatak

Hon'ble Vice Chancellor, University of Horticultural and Forestry, Bharsar, Uttrakhand

Members

Dr. Ravi Gopal Singh

BISA Scientific Lead & Cropping System, Jabalpur

Dr. M.R. Dinesh

Former Director, ICAR-IIHR, Bengaluru

Dr. S.K. Singh

ADR, CAU, Pusa, Samastipur, Bihar

Dr. C.K. Narayan

PS, ICAR-IIHR, Bengaluru

Dr. Jagadish Rane

Director, ICAR-CIAH, Bikaner

Member Secretary

Dr. Dhurendra Singh,

PS, ICAR-CIAH, Bikaner

The meeting was held on 24-25th April, 2023 at ICAR-CIAH, Bikaner and 17-18th August, 2023 at CHES, Vejalpur.

Institute Research Committee (IRC)

Chairman

Dr. Jagadish Rane

Director, ICAR-CIAH, Bikaner

Members

All Scientists of ICAR-CIAH

Member Secretary

Dr. R. P. Meena

Sr. Scientist, ICAR-CIAH, Bikaner

IRC meeting was held at ICAR-CIAH, Bikaner during 4-6th July, 2023.





11. LINKAGES AND COLLABORATIONS





12. राजभाषा RAJBHASHA

राजभाषा कार्यान्वयन समिति की बैठक एवं त्रैमासिक हिन्दी कार्यशाला

कलैण्डर वर्ष 2023 के दौरान राजभाषा कार्यन्वयन समिति की तिमाही बैठकों का आयोजन क्रमशः दिनांक 24 मार्च. 2023, 25 जुलाई, 2023, 08 सितम्बर, 2023 एवं 28 दिसम्बर, 2023 को किया गया था। इन सभी बैठकों में संस्थान की राजभाषा गतिविधियों की समीक्षा की गयी एवं हिन्दी की प्रगति को संस्थान के दैनिक कार्यों में सुनिश्चित किया गया। इन बैठकों का कार्यवत्त तैयार कर उसी अनुसार कार्रवाई की गयी।





हिंदी कार्यशाला के दौरान व्याख्यान देते अतिथिगण एवं संस्थान के निदेशक डॉ. जगदीश राणे

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 2023 की पहली कार्यशाला का आयोजन दिनांक 30–31 मार्च, 2023 को किया गया जिसमें ''ई–ऑफिस में यूनीकोड की सहायता से हिन्दी में कार्य करने को सुगम बनाने का प्रशिक्षण संस्थान के वैज्ञानिकों, तकनीकी, प्रशासनिक एवं सहायक कर्मचारियों को दिया गया। वर्ष 2023 की दूसरी कार्यशाला दिनांक 21 जून, 2023 को आयोजित की गयी जिसमें ''स्वस्थ शरीर के लिए योग'' विषय पर व्याख्यान आयोजित करवाया गया था। तीसरी कार्यशाला का आयोजन 14 सितम्बर, 2023 को किया हिन्दी दिवस के आयोजन के साथ ही किया गया था। वर्ष 2023 की अंतिम कार्यशाला का आयोजन दिनांक 22 दिसम्बर, 2023 को किया गया जिसमें ''स्वच्छता का जीवन में महत्व' विषय पर व्याख्यान का आयोजन किया गया था।

हिंदी पखवाड़ा का आयोजन

संस्थान में दिनांक 15 से 29 सितम्बर 2023 तक हिंदी पखवाडा आयोजित किया गया। एक पखवाड़े के इस आयोजन में विभिन्न प्रतियोगिताएं रखी गयी थी, जिनमें संस्थांन के वैज्ञानिकों सहित सभी कार्मिकों ने भाग लिया। इस दौरान 14 सितम्बर 2023 को हिन्दी दिवस का आयोजन किया गया था। इस कार्यक्रम के मुख्य अतिथि डॉ. उमाकांत गुप्त, पूर्व प्राचार्य, महारानी बालिका महाविद्यालय, बीकानेर थे। उन्होंने अपने सम्बोधन में कहा कि भाषा सांस्कृतिक अस्तित्व और चेतना की प्रतीक होती है। गर्व करो कि हिन्दी हमारी राजभाषा है। हिंदी भारत की आत्मा है और आत्मीयता के सम्बंध से इसे अपनाया जा सकता है। हिन्दी किसी अन्य भारतीय भाषा की विरोधी नहीं है। हिन्दीं भाषा की विशेषता है कि यह अन्य भाषाओं के शब्दों को सरलता से अपना लेती है। हिन्दी में कार्य करना, इसे दिन प्रतिदिन के कार्य की भाषा बनाना आपकी कमजोरी नहीं वरन् मजबूती होनी चाहिए।

हिन्दी पखवाड़े का समापन दिनांक 29 सितम्बर, 2023 को किया गया। इस पखवाड़े के दौरान संस्थान में हिन्दी के प्रयोग को बढ़ावा देने के लिए अनेक कार्यक्रमों का आयोजन किया गया। हिन्दी पखवाड़ा आयोजन समिति के अध्यक्ष डॉ. डी. के. समादिया ने इसमें आयोजित हुए कार्यक्रमों की जानकारी दी। राजभाषा अधिकारी श्री प्रेम प्रकाश पारीक ने विजेताओं के नामों की घोषणा की तथा मुख्य अतिथि ने उन्हें पुरस्कार प्रदान किए।



हिन्दी दिवस पर आयोजित समारोह में व्याख्यान देते मुख्य अतिथि डॉ. उमाकांत गुप्त

क्र.स.	प्रतियोगिता का नाम/वर्ग	विजेता		
		प्रथम	द्वितीय	तृतीय/सांत्वना
1	हिन्दी कविता वाचन प्रतियोगिता	डॉ. पवन सिंह गुर्जर	श्री राकेश, वाईपी	श्री महेश कुमार मीणा
2	हिन्दी सम–सामयिक लेख प्रतियोगिता	डॉ. दीपक कुमार सरोलिया	डॉ. रामकेश मीणा	श्री रूप चंद बलाई
3	हिन्दी सामान्य ज्ञान प्रतियोगिता			
	प्रथम वर्ग	श्री स्वरूप चंद राठौड	श्री भूपेन्द्र सिंह पंवार	श्री पृथ्वी राज सिंह
	द्वितीय वर्ग	डॉ. चेत राम	डॉ. राजेन्द्र कुमार	श्री माली राम यादव
	तृतीय वर्ग	डॉ. हनुमान राम	श्री अखेराम जाट	डॉ. अजय कुमार वर्मा
4	हिंदी शब्द ज्ञान प्रतियोगिता			
	वैज्ञानिक वर्ग	डॉ. हनुमान राम	डॉ. अजय कुमार वर्मा	श्री महेन्द्र कुमार चौधरी
	प्रशासनिक, तकनीकी एवं एसएसएस वर्ग	श्री स्वरूप चंद राठौड	श्री कुलदीप पान्डे	श्री पृथ्वी राज सिंह श्री भरत कुमार आचार्य
	एस.आर.एफ. तथा वाईपी वर्ग	श्री मनीष कुमार	श्री लोकेश कुमार	श्री माली राम यादव
6	हिन्दी में सर्वाधिक कार्य करने पर नकद राशि पुरस्कार	श्री प्रभुभाई नायक, सहायक, प्रशासनिक अनुभाग श्री पृथ्वी राज सिंह, तकनीकी अधिकारी, फार्म अनुभाग		

इसके अतिरिक्त संस्थान के अधिकारियों एवं कर्मचारियों के बच्चों के लिए पोस्टर प्रतियोगिता का आयोजन भी किया गया था। सभी बच्चों को पुरस्कार भी दिए गए थे।

13. DISTINGUISHED VISITORS

AT ICAR-CIAH, BIKANER

S.No.	Date	VIP Visited
1.	27.02.2023	Dr. V. B. Patel, ADG (Hort.), ICAR, New Delhi
2.	27.02.2023	Dr. V.S. Thakur, Ex. VC, YSPUHF, Solan
3.	27.02.2023	Dr. D. P. Wasker , VNMKV, Parbhani, MS
4.	27.02.2023	Dr. Govind Singh, Ex. Director, SKRAU, Bikaner
5.	24-25.04.2023	Dr. A. K. Karnatak, VC, MPUAT, Udaipur
6.	24-25.04.2023	Dr. S. K. Singh, ADR, Dr. Rajendra Prasad CAU, Pusa, Samastipur, Bihar
7.	01.05.2023	Dr. Amol N. Nankar, Research Scientist, Bulgaria
8.	05.06.2023	Dr. J. P. Singh, Former PS & Head, CAZRI-RRS, Jaisalmer
9.	26.06.2023	Dr. Trilochan Mohapatra, Chairperson, PPV&FRA, New Delhi
10.	27.09.2023	Dr. Himanshu Pathak, Secretary, DARE and DG, ICAR, New Delhi
11.	30.09.2023	Dr. S. K. Garg, VC, RAJUVAS, Bikaner
12.	10.10.2023	Dr. O. P. Pareek, Founder Director, ICAR -CIAH, Bikaner













AT CHES, VEJALPUR, GODHRA

S.No.	Date	VIP Visited
1.	13.01.2023	Sh. Fatehsinh Chauhan, MLA, Kalol, Panchmahal, Gujarat
2.	18.12.2023	Dr. S. K. Malhotra, Director, ICAR-DKMA, New Delhi
3.	17-18.08.2023	Dr. A. K. Karnatak, Vice Chancellor, MPUAT, Udaipur
4.	17-18.08.2023	Dr. Ravi Gopal Singh, BISA Scientific Lead & Cropping System, Jabalpur
5.	17-18.08.2023	Dr. M. R. Dinesh, Former Director, ICAR-IIHR, Bengaluru
6.	17-18.08.2023	Dr. S. K. Singh, ADR, Dr. Rajendra Prasad CAU, Pusa, Samastipur, Bihar
7.	17-18.08.2023	Dr. C. K. Narayan, PS, IIHR, Bengaluru

14. PERSONNEL

As on 31.12.2023

STAFF POSITION

S.No.	Category	Sanctioned	In-position	Vacant
1.	Scientific	44+1*	31+1*	13
2.	Technical	37	25	12
3.	Administration	26	17	09
4.	SSS	60	36	24
	Total	167+1*	109+1*	58

***Director**

AT ICAR-CIAH, BIKANER

Dr. Jagadish Rane, Director

Scientific staff

S.No.	Name & Designation
1.	Dr. D.K. Samadia, Principal Scientist
2.	Dr. Dhurendra 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. Deepak Kumar Sarolia, Principal Scientist
7.	Dr. B.R. Choudhary, Principal Scientist
8.	Dr. Ramkesh Meena, Senior Scientist
9.	Dr. Mukesh Kumar Berwal, Senior Scientist
10.	Dr. Ram Prassana Meena, Senior Scientist
11.	Dr. Ramesh Kumar, Senior Scientist
12.	Sh. Roop Chand Balai, Scientist
13.	Dr. Chet Ram, Scientist
14.	Dr. Anita Meena, Scientist
15.	Dr. Pawan Singh Gurjar, Scientist
16.	Dr. Jagan Singh Gora, Scientist
17.	Dr. Kishan Lal Kumawat, Scientist
18.	Sh. Lal Chand, Scientist
19.	Dr. Kamlesh Kumar, Scientist
20.	Dr. Ajay Kumar Verma, Scientist
21.	Dr. Hanuman Ram, Scientist
22.	Dr. Pawan Kumar, Scientist
23.	Sh. Mahendra Kumar Choudhary, Scientist
24.	Dr. Manpreet Kaur, Scientist

Administrative staff

S. No.	Name & Designation
1.	Sh. Akhil Thukral, Administrative Officer - Additional Charge
2.	Sh. Bharat Kumar Acharya, Finance & Accounts Officer
3.	Sh. Kuldeep Pandey, Assistant Administrative Officer

Technical staff

S. No.	Name & Designation
1.	Sh. Prem Prakash Pareek, Assistant Chief Technical Officer
2.	Sh. Sanjay Patil, Assistant Chief Technical Officer
3.	Sh. Bhoj Raj Khatri, Senior Technical Officer
4.	Sh. Prithvi Raj Singh, Technical Officer
5.	Sh. Ashok Kumar Mali, Technical Officer

AT CHES, VEJALPUR, GODHRA

Scientific staff

S.No.	Name & Designation
1.	Dr. A.K. Singh, Principal Scientist & I/c CHES
2.	Dr. V.V. Apparao, Principal Scientist
3.	Dr. Daya Shankar Mishra, Principal Scientist
4.	Dr. Lalu Prasad Yadav, Scientist
5.	Dr. Vikas Yadav, Scientist
6.	Dr. Gangadhara K., Scientist
7.	Sh. Anil, Scientist

Administrative staff

S.No.	Name & Designation
1.	Sh. S.N. Patel, Assistant Administrative Officer

Technical staff

S.No.	Name & Designation
1.	Sh. G.U. Trivedi, Assistant Chief Technical Officer
2.	Sh. G.R. Baria, Senior Technical Officer
3.	Sh. R.B. Baria, Senior Technical Officer
4.	Sh. K.K. Vankar, Technical Officer
5.	Sh. R.D. Rathva, Technical Officer
6.	Sh. D.C. Joshi, Technical Officer
7.	Sh. K.V. Parmar, Technical Officer
8.	Sh. C.S. Chamar, Technical Officer
9.	Sh. K.M. Parmar, Technical Officer
10.	Sh. B.F. Patelia, Technical Officer
11.	Sh. B.R. Baria, Technical Officer
12.	Sh. B.V. Rathva, Technical Officer
13.	Sh. R.V. Rathva, Technical Officer
14.	Sh. I.P. Thakor, Technical Officer

AT KVK-PANCHMAHAL, VEJALPUR, GODHRA

S.No.	Name & Designation
1.	Dr. (Smt.) Kanak Lata, Sr. Scientist & Head
Technical staff	
1.	Sh. J.K. Jadav, Assistant Chief Technical Officer
2.	Dr. A.K. Rai, Assistant Chief Technical Officer*
3.	Dr. Raj Kumar, Assistant Chief Technical Officer*
4.	Dr. Shakti Khajuria, Assistant Chief Technical Officer
5.	Sh. Rakesh Meel, Technical Officer

* Relieved on selection to the posts of Sr. Sci. & Head, KVK of the other Institute.Lien is being maintained.

NEW ENTRANTS

1. Sh. Akhil Thukral, AO took additional charge of the Institute as AO on 12.04.2023.
2. Dr. Manpreet Kaur, Scientist (On Probation) (Agril. Eco.) joined on 10.07.2023 (AN).
3. Sh. Anil, Scientist (On Probation) (Agril. Ento.) joined at CHES, Vejalpur on 30.10.2023.

PROMOTION

Administrative staff

S.No.	Previous position	Present position	No. of Staff
1.	Assistant	Assistant Administrative Officer	01
2.	Steno Grade-III	Personal Assistant	01

Technical staff

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

PROBATION CLEARANCE & CONFIRMATION

S.No.	Category	No. of Staff
1.	Scientist	02

RELIEVING ON PROMOTION / APPOINTMENT / TRANSFER / DEPUTATION

S.No.	Category	No. of Staff
1.	Technical	02

SUPERANNUATION / RETIREMENT

S.No.	Category	No. of Staff
1.	Administration	01
2.	Technical	03
3.	Supporting	10

OBITUARY

1. Sh. Damabhai Vankar, Skilled Supporting Staff, CHES expired on 13.11.2023.

15. BUDGET

Government Grant (January-December, 2023)

ICAR-CIAH, Bikaner

(Rs. in Lakhs)

Head	RE
Grant in Aid - Salaries	1615.00
Grant in Aid - General (Pension & retirement benefits)	243.50
Grant in Aid General (excluding pension & retirement benefits)	360.00
Grant in Aid - Capital	30.00
Grant in Aid General (1270)	80.00
Total	**2328.50**
SCSP Scheme	
Grant in Aid General (excluding pension & retirement benefits)	25.00
Grant in Aid - Capital	5.00
Total	**30.00**
TSP Scheme	
Grant in Aid General (excluding pension & retirement benefits)	40.00
Grant in Aid - Capital	0.00
Total	**40.00**

Under AICRP on AZF

(Rs. in Lakhs)

Head	RE
Grant in Aid - Salaries	392.86
Grant in Aid General (excluding pension & retirement benefits)	125.00
Grant in Aid - Capital	2.00
Grant in Aid General (1270)	25.00
Total	**544.86**
SCSP Scheme	
Grant in Aid General (excluding pension & retirement benefits)	10.00
Grant in Aid - Capital	0.00
Total	**10.00**
TSP Scheme	
Grant in Aid General (excluding pension & retirement benefits)	7.00
Grant in Aid - Capital	0.00
Total	**7.00**

Revenue Generation

(Rs. in Lakhs)

S.No.	Head	Amount
1.	Sale of farm produce	36.06
2.	Interest on STD	8.02
3.	License fee	1.12
4.	Interest on loans and advances	1.22
5.	Sale of condemned items	4.00
6.	Miscellaneous (application fee, guest house, *etc.*)	9.22
	Total	**59.64**

16. SEED AND PLANTING MATERIAL (JAN.-DEC.- 2023)

AT ICAR-CIAH, BIKANER

A. Quality planting material produced and sold during 2023

S.No.	Name of plants	Number of plants produced	Number of plants sold
1.	Ber	4007	2817
2.	Khejri	2700	1702
3.	Pomegranate	2068	1362
4.	Aonla	263	251
5.	Phalsa	2934	30
6.	Lemon	1178	479
7.	Lasoda (Rootstock)	1174	52
8.	Karoda	690	177
9.	Bael (Seedling)	4292	118
10.	Jamun (Seedling)	1266	327
11.	Mulberry	302	274
12.	Lasoda (Budded)	206	203
13.	Khejri (Seedling)	3796	26
14.	Fig	51	23
15.	Moringa	753	42
16.	Kinnow	185	151
17.	Mosambi	309	294
18.	Bael Budded	50	7
19.	Ker	474	423
20.	Kundru	200	52
21.	Aonla (Seedling)	3197	199
22.	Jamun (Budded)	20	4
23.	Guava	197	13
24.	Ber (Rootstock)	2184	-
	Total	**32496**	**9026**

B. Quality vegetable seed produced and sold during 2023

S.No.	Crop and variety	Seed produced (kg)	Seed sold including previous stock (kg)
1.	Snapmelon (AHS-82)	43.5	63.2
2.	Kachri (AHK-119)	35.0	64.0
3.	Cluster bean (Thar Bhadvi)	87.0	69.0
4.	Bottle gourd (Thar Samridhi)	7.0	13.2
5.	Palak (Thar Hariparna)	3.2	15.6
6.	Brinjal (Thar Rachit)	7.3	1.2
7.	Sponge gourd (Thar Tapish)	-	6.7
8.	Longmelon (Thar Sheetal)	4.4	4.9
9.	Ridge gourd (Thar Karni)	11.5	6.7
10.	Jhaar Karela	6.9	-
	Total	**205.8**	**244.5**

AT CHES, VEJALPUR, GODHRA

A. Quality planting material produced and sold during 2023

S.No.	Name of plants	Number of plants produced	Number of plants sold
1.	Mango (Grafted)	4885	3847
2.	Pomegranate (Air layered)	40	31
3.	Lime (Seedling)	104	60
4.	Guava (Air layered)	150	72
5.	Guava (Seedling)	380	340
6.	Tamarind (Budded)	03	03
7.	Jamun (Budded)	725	688
8.	Bael (Budded)	209	141
9.	Bael (Seedling)	438	-
10.	Custard apple (Budded)	25	18
11.	Custard apple (Seedling)	150	99
12.	Chironji (Seedling)	1000	411
13.	Aonla (Budded)	690	631
14.	Ber Budded	36	26
15.	Karonda (Seedling)	100	09
16.	Jamun (Seedling)	1600	120
17.	Ivy gourd cuttings	20	18
18.	Moringa (Seedling)	50	45
19.	Tomato (Seedling)	450	450
	Total	**11005**	**7009**

B. Quality planting material produced and sold during 2023 (RFS Nursery)

S.No.	Name of plants	Number of plants produced	Number of plants sold
1.	Mango (Grafted)	6624	5512
2.	Aonla (Budded)	327	307
3.	Pomegranate (Air layered)	57	34
4.	Kagzi lime (Air layered)	260	250
5.	Lime (Seedling)	512	395
6.	Guava (Budded)	710	664
7.	Guava (Seedling)	256	175
8.	Karonda (Seedling)	182	172
9.	Jamun (Budded)	1257	1237
10.	Bael (Budded)	505	456
11.	Bael (Seedling)	8000	203
12.	Custard apple (Budded)	160	151
13.	Custard apple (Seedling)	1308	05
14.	Chironji (Seedling)	18	15
15.	Ber (Budded)	05	02
16.	Lasoda(Seedling)	1010	15
17.	Manila tamarind (Seedling)	250	03
18.	Mahuva(Seedling)	500	05
19.	Phalsa (Seedling)	25	05
	Total	**21966**	9606

C. Quality vegetable seed produced and sold during 2023

	Name of crop	Seed produced (kg)	Seed sold (kg)
1.	Moringa	16.0	13.2
2.	Tomato	0.5	0.3
3.	Pumpkin	0.5	0.1
4.	Bottle gourd	19.0	12.5
	Total	**36.0**	**26.1**

17. VARIETIES IDENTIFIED DURING 2023

A. AT INSTITUTE LEVEL

Fruit crops

Crop	Variety	Traits
Bael	Thar Gauri 	Heavy yielder with 154.35 kg per plant during 14th year of age. Fruit weight ranged between 1.30-1.40 kg, fruit size 14.20 cm x 13.25 cm, fruit girth 40.43-41.0 cm, shell thickness 0.22-0.24 cm and total number of seed 63.1-70.0. The total seed weight 30.50 g, fibre weight 60.90 g, shell weight 190.15 g, locules in cross section 15-17, TSS of pulp 42.50°B, TSS of mucilage 50.0°Brix, acidity (0.39%) and vitamin C content (22.28 mg/100 g) pulp were recorded under semi-arid rainfed conditions. It is mid maturing variety (4th week of April). The distinct characters are dark green colour of leaves and cluster bearing. Shelf life is excellent (13-18 days). It is highly suitable for pickle, candy, powder making and for various *ayurvedic* formulations.
	Thar Bhavya 	It produced yield of 98.25 kg per plant in 10th year. Fruit weight ranged between 600-750 g, fruit size 11.05 cm x 10.20 cm, fruit girth 35.13-38.0 cm, shell thickness 0.16-0.18 cm, total number of seed 56-68, fibre weight 40.0-48.20 g, shell weight 85.37-103.23 g, locules in cross section 14.15-16.0, TSS of pulp 33.0-35.50°Brix, TSS of mucilage 51.80°Brix, acidity (0.34%) and vitamin C (21.0 mg/ 100 g) in pulp. It starts ripening in 4th week of April. It is highly suitable for slice and *sharbat* making. Being small fruited it is suitable for nuclear families.
Acid lime	Thar Vaibhav 	A precocious and prolific bunch bearing variety. Fruits are round with an attractive yellowish smooth peel. Fruit is juicy (49%), acidic (6.84 %) with less number of seeds/ fruit (6-8). It is high yielder with yield of 68.55 per plant kg during 7th year of planting under rainfed semi-arid conditions. Its fruit weight is 42.57 g, fruit size 42.71 mm x 42.82 mm, peel thickness 1.59 mm, TSS 7.34°Brix and ascorbic acid 43.45 mg/ 100 ml. Fruit ripens in 125-135 days in summer while the rainy season and winter season crop may take 145-155 days from fruit set. The keeping quality is excellent at ambient storage.
Tamarind	Thar Rashmi 	It has up right growth habit, thick trunk and drooping branches. It recorded 74.80 kg fruit per tree. Peak period of ripening time was last week of March. It recorded 53.20% pulp and 70.30°Brix TSS during ripening.
Wood apple	Thar Prabha 	It starts flowering in 4th year, regular bearer and ripens in 2nd fortnight of December to late January. It has 452.25 g fruit weight, 58.37% fruit pulp, 3.23% acidity and 19.82°Brix TSS. The average fruit yield per plant was recorded 183.25 kg during 15th year after planting under rainfed semi-arid ecosystem. It can be used as table purpose as well as in value added products, owing to rich in TSS, high pulp percentage with remarkable pectin and protein content.

Vegetable crops

Crop	Variety	Traits
Drumstick	Thar Tejas 	Produced 2.74 m plant height, 245 pods per plant, 218 g pod weight, 45-48 cm fruit length, 9-10 seed per pod and more flesh under rainfed semi-arid conditions. Fruits mature during January-March. It is a comparatively early maturing variety and matures during January-March. Recorded high protein, potassium, iron and zinc in dry pods. The dried leaves contain high dry matter, protein, calcium, magnesium, iron, manganese, and zinc.
Spine gourd	Thar Varsha 	Fruit weight (15.4-20.6 g), less seeded (16-20) and high yielding (1.6-2.8 kg/ plant) with dark-green round fruits having small spines attributing to consumer preference. The fruits are rich in ascorbic acid (423.7 mg/100g). Its fruits are 3.5-5.7 cm long and 9.1-9.6 cm in diameter yielding 5.50 t/ha at spacing of 2 m x 2 m. A single plant produced 104-134 fruits during entire cropping season (112-118 days).
Ivy gourd	Thar Dipti 	Fruits are attractive with shining dark green stripeless fruit appearance, trilobe leaf shape, small-medium size and pointed styler end. The fruit weight and fruit length are 14.2 g and 4.7 cm, respectively. Produced 1497 fruits/ vine with fruit yield of 24.4 kg/ vine. Tolerant to powdery mildew and fruit fly under field conditions. The edible fruits are rich in vitamin C (51.4 mg/100 g).
Dolichos bean	Thar Vinaya 	It is pole type Indian bean variety with cluster bearing habit. It has attractive long and light green coloured pods. The plants have climbing growth habit and grow up to 4.0-4.6 m. Pods are long (14 cm), girth (4.20cm) with pod weight (8.5 g). It takes 90-91 days for first flowering and 102-105 days for first harvest after sowing. Produced 1000-1265 fresh pods/ plant with yield of 6.5-7.5 kg/ plant and 50 t/ ha. Pods contain protein (4.2 g/ 100 g), vitamin C (7.7 g/ 100 g), beta-carotene (7.2 mg/ 100 g), total phenols (138.2 mg GAE/ 100 g) and total antioxidant (158.65 mg AAE/ 100 g). Moderately resistant to dolichos bean yellow mosaic virus disease under field conditions.
	Thar Lakshmi 	A pole type variety having long flat and medium sized green colour pods. Length of pod 14 cm, girth 5.5 cm and weight 10 g. First harvesting of fresh pods was started at 90-95 days after sowing. Took 90-95 days to first harvesting of pods after sowing and produced 800-1240 pods per plant. An average yield of 6.5-6.7 kg/ plant and 45-50 t/ ha of fresh pods can be obtained under rainfed conditions. The pods are rich in protein (4.2 g/ 100 g), vitamin C (8.8 mg/ 100 g), beta-carotene (11.8 mg/ 100 g), flavonoids (36.2 mg CE/ 100 g) and total antioxidants (227.86 mg CE/ 100g). It was found moderately resistant to dolichos bean yellow mosaic virus disease under field conditions.

Crop	Variety	Traits
Yardlong bean	Thar Prateeksha 	It has attractive long light green colour pods. It is an early flowering (38-40 days) and early maturing (45-48 days) variety with 66.0 cm pod length, 3.4 cm pod girth and 32.0 g pod weight. It bears 120-150 pods/ plant with yield of 3.0 kg/ plant. It is rich in protein (6.0 mg/ 100 g), vitamin C (14.5 g/ 100 g), Ca (420.30 mg/ 100 g), Mg (248.6 mg/ 100 g), P (258.84 mg/ 100 g), Na (22.0 mg/ 100 g), K (294.5 mg/ 100 g), Fe (5.3 mg/ 100 g), total phenols (2.8 mg/ g) and total antioxidant activity (8.7 µm TE/ g). Moderately resistant to cowpea mosaic virus disease under field conditions.
	Thar Deeksha 	It is an early flowering and early maturing variety (Pole type) which has attractive long and light green colour pods. It takes 29-30 days for first flowering and 36-38 days for first harvesting. The pods have 52.0-54.0 cm length, 3.30 cm girth and 28.0-30.0 g weight. It bears 150-180 pods/ plant with yield of 3.0 kg/ plant. Nutritional value in terms of protein (5.8 mg/ 100 g), vitamin C (18.5 mg/ 100 g), Ca (268.30 mg/ 100 g), Mg (262.6 mg/ 100 g), P (155.96 mg/ 100 g), Na (8.0 mg/ 100 g), K (316.5 mg/ 100 g), Fe (4.3 mg/ 100 g), antioxidants like total phenols (2.8 mg/ g) and total antioxidant activity (18.7 µm TE/ g).
	Thar Surya 	It is an anthocyanin rich (190-200 mg/ 100 g) variety (Pole type) having attractive long and dark purple red colour pods. It is an early flowering and early maturing variety. It takes 35-36 days for first flowering and 44-46 days for first harvesting. The pods have 52.50 cm length, 2.5 cm girth and 23.0 g pod weight. The total number of pods per plant varies 180-200 pods/ plant with fresh pod yield of 2.5 to 3.0 kg/ plant. It contains protein (5.2 mg/ 100 g), vitamin C (17.2 mg/ 100 g), Ca (258.50 mg/ 100 g), Mg (226.6 mg/ 100 g), P (212.84 mg/ 100 g), Na (12.0 mg/ 100 g), K (394.5 mg/ 100 g), Fe (3.96 mg/ 100 g), antioxidants like anthocyanins (190-200 mg/ 100 g), total phenols (3.17 mg/ g) and total antioxidant activity (19.24 µm TE/g).

B. VARIETY IDENTIFIED BY AICRP

Vegetable crops

Crop	Variety	Traits
Watermelon	AHW/BR-37 (Thar Tripti) 	The fruits are attractive and characterized by green stripes. It produced round fruits weighing 2.4-3.6 kg having diameter of 16-20 cm. Flesh colour is light red with 11.2-12.28% TSS and rind thickness (1.5-1.8 cm). It took 75-80 days for first picking of fruits after sowing. It is tolerant to high temperature conditions. Yield potential is 237.7-693.5 q/ ha in Zone VII. Identified for release in Agro-climatic Zone VII (Semi-arid Lava Plateaux and Central High Lands) during 41st Annual Group Meeting of AICRP (Vegetable Crops) held at SKUAS&T, Srinagar (J&K).

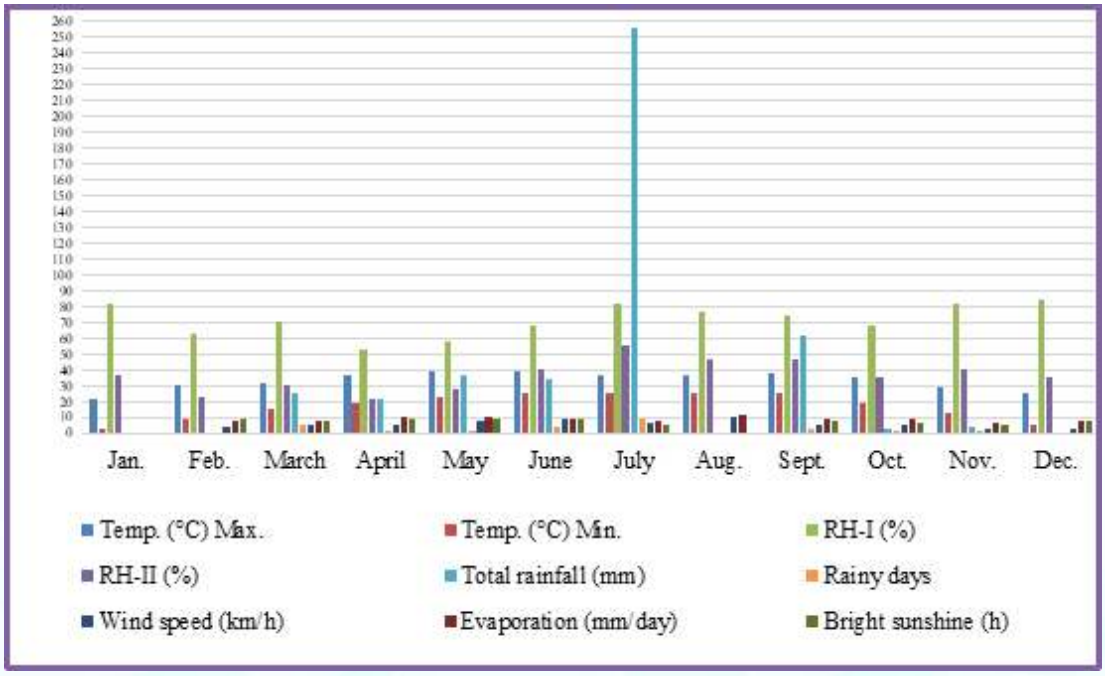
18. METEOROLOGICAL DATA

AT ICAR-CIAH, BIKANER

Monthly weather data from January 2023 to December 2023*

Month	Temperature (°C)		Relative humidity (%)		Total rainfall (mm)	Rainy days	Wind speed (km/h)	Evapo-ration (mm/day)	Bright sunshine (h)
	Max.	Min.	RH-I	RH-II					
January	21.1	2.7	81.2	36.6	0.0	0.0	4.0	4.0	7.3
February	30.1	9.5	63.6	22.5	0.0	0.0	4.1	7.7	8.9
March	32.1	14.8	70.1	30.2	25.6	5.0	5.0	7.7	7.4
April	36.8	19.1	53.2	21.2	21.6	2.0	5.9	9.8	9.3
May	39.7	22.6	57.4	27.6	37.0	2.0	8.1	10.1	9.3
June	39.0	25.6	67.6	40.3	34.6	4.0	8.9	9.6	9.0
July	37.3	25.5	81.3	55.2	256.2	9.0	6.6	8.1	6.0
August	36.1	25.4	76.7	47.3	0.0	0.0	10.2	11.1	0.0
September	37.6	24.9	74.3	46.4	61.8	3.0	5.9	8.8	7.5
October	35.3	18.8	68.5	35.4	3.0	1.0	5.1	8.9	7.0
November	28.8	12.4	81.4	40.8	4.6	1.0	2.9	6.3	5.3
December	25.3	5.9	84.7	35.1	0.0	0.0	3.0	7.5	7.9
Average	33.3	17.3	71.7	36.6	444.4	27.0	6.0	8.3	7.1

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



SHAMRAN









भाकृअनुप
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