Annual Report
2021

An ISO 9001:2008 Certified Institute

ICAR-Central Institute for Arid Horticulture

Beechwal, Bikaner- 334006 (Rajasthan)

(An ISO 9001:2008 Certified Institute)

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Preface

It gives me immense pleasure in bringing out the Annual Report 2021 of the ICAR-Central Institute for Arid Horticulture, Bikaner. Owing to their strength such as vast area, ample solar radiation, low incidence of diseases and pests; arid and semi-arid regions are bestowed with potential to become the horticultural bowl of India provided adequate technologies are developed. Ever since its establishment on 1st April 1993, ICAR-Central Institute for Arid Horticulture at Bikaner is dedicated to serve the farmers and stake holders of arid and semi-arid region by developing technologies, crop specific genotypes, package and practices of under adverse climatic conditions with limited resources, handling and value addition of produce, production of quality seed and planting materials for the the horticultural crop plants.

The present report highlights glimpses of research programmes and externally funded projects including research accomplishment, significant advisory services provided, dissemination of knowledge acquired, human resource development, linkages cultivated/nurtured with various ICAR institutes, SAUs, line departments and organizations of India. For the same, my appreciation to all the members of the Institute Research Committee (IRC) who have discussed all the activities at length and come out with well laid out plan of action within a definite time frame. I also thank technical personnel, administrative, finance and skill staff of the Institute who have put their lot of efforts to take policies and programmes of the Institute forward.

I take this opportunity to place on record my sincere thanks and deep sense of gratitude to Dr. T. Mohapatra, Secretary, DARE and Director General, ICAR for his constant support in executing the mandate of the Institute. I also express my gratitude to Dr. A. K. Singh, Deputy Director General (Horticultural Science) and ADG (Hort.-I) for their ciritcal remarks and valuable suggestions.

This Annual Report is the culmination of dedicated and sustained efforts by our scientists and staff of the institute. I wish to express my sincere appreciation to Dr. D. K. Sarolia, Dr. Ramesh Kumar, Sh. J. S. Gora, Dr. A. K. Verma and Sh. P. P. Pareek for their sincere and whole-hearted support in bringing out the Annual Report 2021. The technical support in terms of computerization/Hindi Translation by Sh. Bhoj Raj Khatri, Sh. P. P. Pareek and Sh. Sanjay Patil is also appreciated.

30 May 2021
Bikaner

(B. D. Sharma)

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1. EXECUTIVE SUMMARY

Genetic Resources and Crop Improvement

The diverse germplasm of various arid fruit and vegetable crops were collected and conserved for further evaluation, characterization and utilization in improvement programme. The existing germplasm were evaluated for various morphological, physiological and agronomical attributes. In arid fruits and vegetable crops, four new varieties were identified at institute level *i.e.* two in bael, one each in bottle gourd and ivy gourd while two varieties were recommended by State Seed Sub-Committee, Gandhinagar, Gujarat.

Newly indentified bael variety Thar Prakriti have average yield 115.75 kg/plant in 12th year, fruit weight 1.40 kg, shell thickness 0.14 cm, total number of seed 60.23, total seed weight 17.40g, fibre weight 28.42 g, shell weight 190.60g, locules in cross section 14-17 and TSS pulp 38.00^{0}B. The fruits are having good flavour and aroma and rich in antioxidants. It is highly suitable for sharbat, *murabba* and powder making and various ayurvedic medicines. Thar Shivangi have average yield is 109.15 kg/plant in 11th year, fruit weight 1.35 kg, shell thickness 1.9 mm, total seed weight 32.00g, shell weight 190.21g, locules in cross section 15.50, pulp 70.50%, TSS pulp 37.10^{0}B, TSS mucilage 50.50^{0}B, acidity (0.35%) and vitamin C 20.40 mg/ 100 g pulp were recorded. Being small in stature, it is highly suitable for high density planting (5mx5m).

Two varieties recommended by State Seed Sub-Committee, Gandhinagar Gujarat *i.e.* Drumstick-Thar Harsha and Pumpkin-Thar Kavi. Thar Harsha is an annual type having densely foliaged with dark green broad leaves (54.5 cm long and 35.2 cm width), possessing drought tolerance. It produces about 314 fruits/plant, and yield 53-54.7 t/ha annually. It is superior in fruit size and yield (185.6%) over PKM-1. This variety found suitable for table/export purpose due to uniformly parrot green and very long pod having more flesh content. Thar Kavi is developed through hybridization followed by selection from the segregating population of CM16xCM19. It is a sturdy, drought tolerant type due to thicker leaves. Fruits are of small, flat round, dark green and ready for harvest in 80-85 days after sowing at green marketing stage. This variety suits for culinary/export purpose as an icebox type, which possess high TSS (8.5°Brix), with orange flesh colour having rich carotene content (2.36 mg/100g).

In vegetable crops, two varieties were identified at institute level *i.e.* Thar Avani of bottle gourd and Thar Sadabahar of ivy gourd. Thar Avani is developed hybridization followed by selection from the segregating population of LS-4xLS3-2. The fruits are round in shape, with 22.8 cm in length and weight of each fruit layed between 750-860g. The fruits are characterized with high flesh thickness, high TSS (8.1-8.7°Brix), with attractive creamy white flesh colour. Each plant produced 12.91 kg with yield of 43.0 t/ha under rainfed semi-arid conditions. Thar Sadabahar having high yield potential with the maximum fruit weight (29.3 g) as compared to other genotypes with identical appearance in form of attractive dark green shining colour with discontinuous strips, round oblong fruit shape without neck under the dryland semi arid conditions. The fruit weight is 29.30 g with yield of 26.86 t/ha. This genotype is superior for yield (67.01%) as compared to the check variety Indira Kundru-35.

Eight genotypes of ber were collected from different villages in Jobner, Jaipur and Bikaner districts of Rajasthan. Two accessions of ber (Rasisar-1 and Rasisar-2) from Nokha were marked for rootstock and other propose. Plants were in heavy bearing; good blend of sweet and sour taste and no infestation of fruit fly/stone weevil were observed. An elite ker genotype was collected from Khajuwala area having heavy fruiting load (>100 kg fruits/bush). One accession of *Cardia gharaf* was collected from Surjasur area. One red fleshed local guava genotype was collected from Dhar, Madhya Pradesh. Two genotypes of acid lime (PDKV lime & Kagzi lime) were collected from Jalgaon, Maharashtra and maintained at CIAH-RS-CHES, Vejalpur. Obtained IC numbers (IC 638784 and IC 638785) of ber culinary accessions (Z. *mauritiana)* and thorn less bordi (*Z. rotundifolia)* type collected during 2018-19 from Bhilwara and local Bikaner area of Rajasthan, respectively.

In vegetable crops, one germplasm of water melon was collected from Diggi, Tonk (Rajasthan). Seven germplasm of *M. balsamina* were collected from different places of Rajasthan for assessing medicinal properties. Two new collection of chilli were collected from Rajasthan. During 2021, regular monitoring of arid vegetable genetic

resources (500 lines) which mainly consisted of desert melons (125), non-dessert melons (161), gourds (60), chillies (45), tomato (14), brinjal (30), cluster bean and beans (35) was done for their safe conservation in gene-bank facilities at ICAR-CIAH, Bikaner. In addition, germplasm of khejri, sehjan, guarpatha, kundru, kakoda and other perennial crop-plants of vegetable significance were maintained. Under seed enhancement, phog, tumba, velvet bean and chilli were taken. A total 45 chilli breeding material supplied to the institute crop-curator and enhanced seeds stored for conservation.

Pomegranate germplasm were evaluated for growth, fruit quality and aril attributes under hot arid condition. Maximum number of fruits per plant was obtained in Saharanpur (44.00) followed by Jalore Seedless (42.50), Mridula (40.33), Bhagwa (38.50) and Jodhpur Red (38.25). Number of cracked fruits per plant was varied significantly among different germplasm and recorded maximum (23.25) in Saharanpur followed by Mridula (15.50) and very less number of cracked fruits per pant was observed in some of the sour type deciduous germplasm like Gul-e-Shah (1.00), Sur Sukker (1.00), Gul-e-Shah Rose Pink (1.33), Gul-e-Shah Red (1.50) and Saih Sirin (1.50), *etc*. Maximum fruit weight was recorded in Jalore Seedless (265.67 g) followed by G-137 (258.20 g) and Jodhpur collection (254.19 g) while minimum fruit weight was recorded in Yercaud Local (84.50 g) and MR 599 (96.10 g).

Fourteen aonla varieties were evaluated under semi-arid condition. Fruit weight recorded maximum in Banarasi (36.90 g) followed by NA-7 (32.80 g) and it was minimum in BSR-1 (12.05 g) and Kanchan (26.30 g). The juice content was recorded highest in NA-7 (57.25 %) followed by Goma Aishwarya (50.70%), however Chakaiya had the lowest juice content (42.22%) followed by Banarasi (38.39%) and Anand-2 (37.50%). The maximum acidity was recorded in BSR-1 (2.21%) followed by Krishna (2.11 %), whereas it was recorded lowest (1.98%) in Kanchan followed by Anand-1 (2.15%).

Bael germplasm were evaluated under semi-arid condition and wide genetic diversity was noticed in their morphological, quantitative and qualitative fruit characters. Genotypes exhibited wide range of variability in terms of yield/plant (64.21-133.70 kg) and fruit weight (0.62-2.71 kg) and pulp weight (0.38-2.20 kg). Genotypes showed wide variation in ripening period (February to June). Based on the observation on various aspects particularly fruiting pattern and quality attributes, genotypes *viz.*, CHESB-27, CHESB-29, CHESB-31, CHESB-42 and CHESB-48 were found superior.

Twenty nine red fleshed and twenty four white fleshed guava genotypes were evaluated for tree growth, yield and fruit quality characteristics under semi-arid condition. Among evaluated white fleshed genotypes, fruit weight was ranged between 120.20 g in MPUAT-1 and 256.90 g in CHESG-38. The maximum number of fruits/tree was observed in MPUAT-1 (146.70) followed by CHESG-38 (139) while it was found minimum in Dhawal (55). Similarly, maximum fruit yield/tree was recorded in CHESG-38 (34.50 kg) followed by L-49 (27.20 kg) while Dhawal recorded the minimum fruit yield (7.35 kg).

Hybrid seedlings of guava were evaluated under semi-arid condition. The yield and number of fruits/tree varied widely among and within progenies. The 3 progenies namely SP x CHESG-28, Thai x CHESG-30 and CHESG-31 x TP recorded higher mean yield (> 6kg/tree) and number of fruits/tree (>25/tree) than the progenies of other crosses. Maximum colour variation was observed in SP x CHESG-28 while all the progenies of CHESG-31 x TP and CHESG-31 x Purple showed pink flesh with variable colour intensities. The TSS:acidity ranged in between 21.50 in BL x SP to 32.66 in CHESG-31 x TP.

In acid lime, twenty genotypes and eight national released varieties were evaluated under hot arid condition. Two promising germplasm CIAH AL-03 and CIAH AL-11 were identified. CIAH AL-03 has semi vigorous plant. The fruits are oblong shape, medium size, pleasant flavour, greenish colour and fruit weight 56.18 g. Fruits have 7.58 °Brix TSS and 6.22% acidity. The juice content is 56.21% by weight and 24.85 kg yield/plant; it is also very less affected by citrus canker. CIAH AL-11 has highly vigorous plant, fruits oblong shape, medium size; pleasant flavors, light greenish colour and fruit weight 42.55g. Fruits have 7.41°Brix TSS and 5.62% acidity. The juice content is 51.81% by weight and fruit yield 17.48 kg yield/plant. Acid lime germplasm were evaluated under semi-arid condition. Significantly highest average fruit weight was recorded in CHESL-22

(46.12 g) followed by CHESL-27 (42.57 g) and CHESL-12 (41.80 g). The highest juice content was recorded in CHESL-22 (52.90 %) followed by CHESL-29 (52.34 %). The highest acidity was observed in CHESL-12 (8.53 %) followed by Vikram (8.33 %) while Ganganagar-1 recorded the minimum acidity (5.78 %).

Ten sweet orange cultivars were evaluated for growth, yield and fruit quality attributes under hot arid region of Rajasthan. The plant height (315.45 cm), canopy spread N-S (325.58 cm) and E-W (322.80 cm), scion diameter (113.45 mm) and rootstocks diameter (118.19 mm) were found maximum in Sathgudi followed by Hamlin and Jaffa. During forth year, maximum average number of fruits per plant was recorded (130.40) in Sathgudi followed by Hamlin (118.60). Fruit weight was ranged from maximum 230.98 g in Pineapple to minimum 138.46 g in Jaffa. Acidity was found minimum in 0.45 % in Sathgudi and maximum 0.60% in Valencia Olinda. In conclusion, Sathgudi was found significantly superior as compared to other sweet orange varieties under arid region climatic conditions.

Twenty promising genotypes of jamun were evaluated for growth, flowering, fruiting and fruit quality attributes under semi-arid conditions. Fruit yield was noted highest in CHESJ-30. Peak period of ripening was recorded in the month of May-June in all the genotypes. The fruit yield varied from 19.70 to 36.00 kg/plant under rainfed semi-arid conditions. Qualitative characters in terms fruit weight ranged between 9.00-19.20 g, pulp weight 7.10-16.30 g, pulp per cent 79.00-86.12, TSS 12.50-16.60°Brix, acidity 0.35-0.42%, total sugar 8.12-12.20 % and vitamin C 39.90-45.74 mg/100g in different genotypes of jamun.

Sixteen promising genotypes of wood apple were evaluated under semi-arid conditions. The maximum fruit weight was recorded in Thar Gaurav (452.53 g) followed by CHESW-6 (388.10 g). Genotypes CHESW-6 was recorded maximum fruit pulp percentage (58.42%) followed by CHESW- 10 (53.53%) and CHESW-15 (52.62%). The highest yield per plant was noted in CHESW-6 (162.0 kg), followed by CHESW-4 (129.27 kg) CHESW-10 (123.96 kg) and CHESW-15 (115.43 kg). The highest TSS was recorded in genotype CHESW-6 (19.80°Brix) in fruit pulp.

Under semi-arid conditions, forty seven custard apple germplasm were evaluated and significant variation was found such as fruit weight (118.12-340.36 g), pulp percentage (40.23-64.51%), fruit pulp color (creamy white to dull white), pulp texture (soft to gritty), total sugars (13.28-18.37%), no. of flakes (40.87-90.20), no. of flakes with seed (35.25-80.12), TSS (23.27-30.15°Brix), acidity (0.24-0.54%), shelf life (3-5 days) and yield (10.37-26.58 kg/tree). Among the evaluated existing germplasm, CHESCA-4, 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.

Chilli germplasm were evaluated under hot arid climate. The genotypes took 7 to 16 days for germination and out of them, 35 genotypes were germinated. A significant variation was observed for plant height (29.5-86.67 cm), plant canopy width (24.17-70.67 cm), number of fruits per plant (12.5-76.5), fruit length (4.4-13.05 cm), fruit diameter (0.69-1.43 cm) and average fruit weight (1.14-8.19 g). Selections were also made for yield and marketable quality traits under abiotic stressed conditions. Different varieties of onion were evaluated during *rabi* season under hot arid conditions. The highest bulb yield was recorded by the variety Bhima Red (44.85 t/ha) closely followed by Bhima Kiran (41.47 t/ha) and Bhima Shakti (41.00 t/ha) which were statistically at par with each others. The variety Bhima Shubhra registered the lowest bulb yield (19.14 t/ha) which was statistically at par with Bhima Light Red (19.27 t/ha) and RO-252 (20.10 t/ha).

A total of 123 genotypes of dolichos bean, 181 genotypes of vegetable cowpea and 62 genotypes of cluster bean were conserved and multiplied at ICAR-CHES (CIAH), Vejalpur, Gujarat. Obtained sixteen IC (Indigenous collection) number from ICAR- NBPGR for dolichos bean (13 genotypes) and bush vegetable cowpea (03 genotypes).

In cluster bean, 62 genotypes were evaluated under rainfed semi-arid conditions. Among them, the genotypes like CHESCB-60, CHESCB-59, CHESCB-25 and CHESCB-24 are superior with respect to fresh number pods and pod yield. CHESCB-25 produced 280-320 pods/plant with an average yield of 1.2 kg/plant of fresh pods. CHESCB-24 showed single stem growth behavior

with green colour pods, produced 300-320 pods/plant with an average yield of 1 kg/plant of fresh pods. A total of 50 genotypes of drumstick, 28 genotypes of ivy gourd, 25 genotypes of spine gourd, 7 genotypes of bottle gourd, 3 genotypes of tomato and 4 genotype of pumpkin were conserved and evaluated under semi-arid condition. The evaluation of promising lines exhibited wide range of variability with respect to growth, yield and quality attributes under dryland semi-arid condition.

During rainy season, cowpea line AHCP-1-4-1 and AHCP-2-3 studied with AICRP (VC) IET entries (07). Seventeen cluster bean genotypes evaluated for over the years performance, and line AHG-23 is found promising. During summer and rainy season, twenty seven roundmelon genotypes including two advanced material and AICRP (VC) IET entries (06) studied for comparative performance. Evaluated and characterized of watermelon promising genotypes. AHW/BR-22 have ice box type fruits and found promising with respect to days to 50% pistillate flowers (35-40 DAS), days to first fruit harvesting (75-80 DAS) and TSS (11.5-12%). The fruit weight, length and diameter varied from 2.0-2.5 kg, 25-28 cm and 14-18 cm, respectively with red flesh and small seeds. The fruit rind colour was attractive and dark green devoid of stripes. In AHW/BR-43 fruit weight, fruit diameter and rid thickness varied from 2.5-3.0 kg, 11.5-14.0 cm and 1.3-1.8 cm, respectively. Fruits were sweet and TSS ranged from 12-13%.

Evaluated and characterized of muskmelon promising genotypes. AHMM/BR-35 is an advance line characterized by round fruit shape, netted rind, devoid of sutures, salmon orange flesh and small seed cavity (4-5 cm width). The fruit weight, TSS and flesh thickness ranged from 500-700 g, 11-12% and 2.4-3.0 cm, respectively. AHMM/BR-47 is promising muskmelon genotype characterized by having salmon orange flesh colour, netted rind with clear sutures. It produced 4-5 fruits per plant weighing 750-980 g with 11.0-12.4 % TSS. Flesh thickness varied from 2.3-3.4 cm.

In *Momordica balsamina* L. evaluated seven germplasm during rainy season. The evaluated germplasm showed variability with respect to fruit and yield traits. Among the evaluated genotypes, CIAHMB-1 performed best under hot arid conditions. CIAHMB-1 registered maximum fruit length (3.49 cm), fruit diameter (2.63 cm), number of marketable fruits per plant (212.4) and fruit yield per plant (1.05 kg). Fruits are spindle shaped and attractive green green in colour at tender stage.

In round melon, study was carried out for high temperature tolerant and fruit quality. During the summer and rainy season, twenty seven round melon genotypes which consisted of institute breeding lines, AICRP varieties and checks were evaluated for vine growth, flowering, fruit-set and yield component characters. Two advanced breeding material of round melon (AHRM-1/2017/17-a/whitish-green-Bikaneri type series) were also studied and both the lines exhibited variations with seasons in their plant growth and fruiting attributes. However, in rainy season, good plant growth, fruit-set and yield was recorded.

In khejri, fourteen elite genotypes were identified by CIAH from 2000-2005 and collected germplasm was conservation and maintained with good management practices. Khejri variety Thar Shobha and Selection-2 studied in reference to growth, pod yield and bio-mass production over the years under rainfed conditions. Khejri Selection-2 was also studied for picking intervals and sangri yield in response to training-pruning.

On the basis of intensive native germplasm utilization, a promising brinjal genotype CIAH-22 (AHB-03) was identified. The plants are moderate in growth and have prickles (thorns) on their stem, leaf and fruit calyx. Tender fruits at marketable stages are oblong, bluish-purple in colour and 145.2-154.5 g in weight. It has the marketable yield potential of 2.32-3.68 kg per plant and 394.2-510.7 q/ha per season. The genotype has the ability to tolerate high temperature up to 46^{o}C.

Crop Management and Agro-techniques

In production system management in *ber* under hot arid ecosystem, four training systems were imposed on four ber varieties. Among the varieties, canopy volume was found maximum in Gola (4.51 m^3), fruiting density in Goma Kirti (787.8 fruits per m^3), and yield (20.46 kg/plant & 11.35 t/ha) in Thai. Corresponding all parameters were minimum in variety Thar Sevika. In training systems, canopy volume (3.4 m^3) and yield (plant^{-1} 21.21 kg/plant & 11.77 t/ha) both under Y-shape and fruiting density (681.9 fruits per m^3) was high in espalier system of training.

In bael, for management of fruit drops and

sun scald, plant growth regulator and chemicals were applied. Among the various treatments combination, minimum fruit drop (93.87%) and sun scald (19.00%) and the highest fruit retention (6.15%) were recorded with grass mulch + NAA (15 ppm) + course cotton cloth followed by grass mulch + NAA (15 ppm) + ascorbic acid (96.10, 25.30 and 4.00%) and grass mulch + $ZnSO_4$ (1000 ppm) + coarse cotton cloths (97.50, 27.00 and 3.38), whereas fruit drop and sunscald affected fruits were recorded maximum in control (98.61% and 48.21%) while fruit retention was also recorded minimum (1.98%) in control.

In canopy management in bael var. Goma Yashi**,** maximum number of shoots (3.65) was recorded with treatment 3 m plant height + 25 per cent AGE (annual growth extension). Average yield per plant was recorded highest with 3 m plant height + 25% AGE (78.50 kg) followed by 2.5 m plant height +25% AGE (72.55 kg), whereas the lowest yield per plant was observed with 2.5 m height +75 % AGE (57.00 kg) among the different combination of plant height and pruning intensity. Fruit weight (1.37 kg) and fruit size and TSS (38.00°Brix) was recorded maximum in the plants in which height was maintained at 3 m and pruned at 25 per cent AGE.

The compatibility and adaptability studies of sweet orange, lime and lemon scions on different rootstock were conducted. Various combinations (forty two) of scions and rootstocks were made and planted in the field. In sweet orange cv. Mosambi, highest scion rootstock (SR) ratio was recorded on Karna Khatta (0.96) rootstock followed by Volkamericana (0.93) as compared to minimum recorded on sour orange (0.81) rootstock. In sweet orange cv. Sathgudi, highest scion rootstock (SR) ratio was recorded on Rough lemon (0.97) rootstock followed by Macrophylla (0.94) as compared to minimum recorded on Cleopatra (0.82) rootstock. In lemon cv. Pant lemon, highest scion rootstock (SR) ratio was recorded on Rangpur lime (0.93) rootstock followed by Rough lemon (0.91) as compared to minimum recorded on Karna Khatta (0.81) rootstock.

The performance of interspecific Mandarin hybrid cv. 'Fremont' was evaluated on four rootstocks under typical conditions of arid region for maximizing the production and quality fruits. Karna Khatta rootstock found to produce the greatest no. of fruits, fruit weight, fruit diameter and fruit yield followed by Rough lemon and Pectinifera. While the lowest fruit yield parameters were observed in Troyer Citrange. Furthermore, Fremont scion on Karna Khatta rootstock appeared to be more productive in terms of number of fruits/tree (12.82%), fruit weight (20.48%) and fruit yield (19.55%) as compared to the commercially adopted rootstock (Rough lemon).

The performance of interspecific hybrid of Mandarin cv. Daisy was evaluated on five rootstocks under typical conditions of arid region for obtaining the higher production and quality fruits. The no. of fruit and fruit yield were obtained maximum in Rough lemon (98.18 & 22.11) followed by Pectinifera (91.51 & 21.10) and Sour orange (68.47 & 16.12), respectively while it was minimum in Troyer citrange and Rangpur lime; whereas, Karna Khatta produced heaviest fruits (238.47g) and fruit diameter (8.20 cm). All fruit quality parameters were observed superior in Pectinifera as juice percentage (58.60), TSS (13.95 ^{0}B), acidity (0.80 mg/100 ml), ascorbic acid (63.57 mg/100 ml), rind thickness (2.12 mm) and ripening index (17.44) as compared to other rootstocks.

In canopy management trial in pomegranate, among all the treatment, maximum number of fruits and yield per plant (39.50 and 9.44 kg) was recorded in four stem branching at 1 foot + 10 % pruning followed by four stem branching at 1 foot + 20 % pruning (34.50 and 78.70 kg) and minimum number of fruits and yield per plant were found in control (20.67 and 3.83 kg), respectively. Fruit weight was ranged from minimum 185.27 g in control without any training and pruning to maximum 252.15 g in four stem branching at 1 foot + 20 % pruning.

In flower regulation and identification suitable *bahar* in pomegranate under hot arid condition, among all the treatments, maximum fruits yield per plant were observed in *Hasta bahar* (10.34 kg) followed by *Mrig* + *Hasta bahar* (10.27 kg), *Mrig bahar* (10.10 kg) as compared to minimum in control (4.33 kg), respectively. Fruit cracking was varied significantly among different flower regulations treatments. The minimum fruit cracking was observed in *Ambe bahar* (10.15%) followed by Late *ambe bahar* (12.18%) while maximum fruit cracking was observed in control (29.25%) followed by *Ambe* + *Mrig* + *Hasta bahar* (25.87 %). Fruit juice TSS and maturity index were observed maximum (17.10°Brix and 47.50) in *Hasta bahar* followed by *Mrig bahar* (15.73°Brix and 41.50) followed by *Mrig* + *Hasta bahar*

(15.60°Brix and 41.49) as against minimum TSS and maturity index recorded in control (12.19°Brix and 24.48), respectively.

Tomato genotype AHSL-1 was evaluated with varying environments (open drip, open mini-sprinkler and shade net) under protected condition during spring-summer season. The fruit yield was ranged from 2.14 to 3.56 kg/plant. The highest fruit yield per plant was recorded under open mini-sprinkler followed by shade net and the lowest was recorded under open drip environment. Brinjal genotype AHB-03 (CIAH-22) was evaluated under protected condition with varying environments (open drip, open mini-sprinkler and shade net) during spring-summer season. Numbers of fruits per plant were found maximum under open mini-sprinkler followed by shade net and minimum under open drip. The fruit yield was ranged from 2.32 to 3.68 kg/plant. The highest fruit yield per plant was recorded under open mini-sprinkler followed by shade net and the lowest was recorded under open drip environment.

In standardization of sowing date and covering material in watermelon, crop raised under tunnel (20th December with polythene covering) attained the harvestable maturity on 8th March in comparison to open field sowing (second week of February), which came in harvesting during first week of May which was 61 days later than the tunnel. Tunnel facilitated the early harvest of crop which earn higher market price in off-season than the normal season. The sowing on 10th January with polythene covering recorded maximum fruit yield (256.32 q/ha) followed by sowing on the same date with non-woven covering (232.64 q/ha) and minimum was recorded in sowing under open condition (156.78 q/ha).

During 2021, seed production of snapmelon (AHS-82, 11 kg), kachri (AHK-119, 32.5 kg), sponge gourd (Thar Tapish, 27 kg), cluster bean (Thar Bhadavi, 112 kg), palak (Thar Hariparna, 16 kg), Indian bean (Thar Kartiki and Thar Maghi, 0.125 kg), brinjal (Thar Rachit, 2.3 kg) and other arid vegetable crop varieties was done under revolving funds of ICAR seed programme. About 205 kg seed of varieties/genotypes of arid vegetables was produced for distribution to farmers, NGO's, KVK's and national, state and private agencies for spread of the crop-varieties and further seed-chain from CIAH. Seed propagated progeny of phog (CIAH-PHOG1) was studied with training-pruning and management practices as standardized at CIAH for promoting its cultivation and high bio-mass harvest under natural crop production system.

Physiological, bio-chemical and Bio-technological Interventions

The non-targeted metabolites profiling of khejri leaves (Thar Shobha) was done through GC-MS/MS during January, March, June, August, October and November which represents almost all seasonal environmental conditions of the hot arid region. Expression of 1,3-Dioxolane-4-methanol, 2-ethyl-; Benzofuran, 2,3-dihydro-; Cyclohexasiloxane, dodecamethyl- and 3-O-Methyl-d-glucose increased drastically during summer month (June) while 3-O-Methyl-d-glucose increased during winter month (January) and the expression of Hexadecanoic acid, 9,12-Octadecadienoic acid (Z,Z)- and stigmasterol was highest during severe winter as well as severe summer months. These particular metabolites might play a vital role in tolerance against specific abiotic stresses.

Assessed biochemical parameters of fruit of Thai ber budded on jharber (*Z. nummularia*) and deshi ber (*Z. rotundifolia*). Thai ber fruits were recorded higher dry matter, acidity, TSS, sugars, phenolic substances and flavonoids content where jhar ber used as rootstocks, except ascorbic acid. Forty two ber genotypes were evaluated for fruit set under the hot arid ecosystem. The genotypes showed wide variation in fruit sets ranging from 0.34% in Chochal to 13.89% in Illaichi. About 74 % of genotypes under observation exhibited fruit set less than 6 per cent.

A study was conducted to evaluate the effect of extreme environmental conditions on the phenolic, flavonoids, tannin content, and total antioxidant activities of *C. polygonoides* foliage harvested during different months. The highest phenolic compounds and antioxidant activity was observed during severe winter and summer months, when monthly average environmental temperature was lowest and highest of the year, respectively. On the basis of the results, two harvests of *C. polygonoides* foliage during June and December are advised to maximize the phenolic compound production with highest antioxidant activity.

The physico-biochemical characterization

and fatty acid profile of tumba (*Citrullus colocynthis* L.) seed oil grown in hot arid environment was carried out. It contains bioactive compounds like phenolics (5.39 mg GAE/100g) flavonoides (938 mg catechin Eq./100g), carotenoids (79.5 mg/kg), oryzanol (0.066%), lignans (0.012%) along with 70 to 122 mgAAE/100 g total antioxidant activity at different scales. The results demonstrated that tumba seed oil contains about 70% unsaturated fatty acids with more than 51% PUFAs. It mainly contains linoleic acid C18:2n6 (50.30%), followed by oleic acid C18:1n9 (18.02%), stearic acid C18:0 (15.15%) and palmitic acid C16:0 (12.41%).

In shape deformity and stone splitting studies in Thai ber fruits, different treatments of sucrose, boric acid, zinc sulphate and GA_3 were imposed on Thai ber. The result revealed that all the treated plants observed less off shape fruits as compared to control. Among the agrochemicals, boron and GA_3 treatments not only reduced the splitting of fruits, but also enhanced the TSS content (18.9°B) and mean fruit weight (42.52 g) compared to control (18.2°B & 37.25 g), respectively. In bottom-up mechanism of tolerance against concurrent abiotic stresses in khejri, a significant seasonal variation was observed in chlorophyll, MDA, phenolics, flavonoids, TAA, and antioxidant enzymatic activities. The Principle component analysis (PCA) carried out with the assayed parameters like phenol, flavonoids, tannins, pralines, MDA, chlorophyll content and total antioxidant activities along with antioxidant enzymes like SOD, APOX and catalase for wild as well as Thar Shobha variety.

For DNA fingerprinting of watermelon cultivars, sixteen ScoT and 25 CBDP markers were used for profiling on genomic DNA of watermelon cultivars namely Wm-37, Wm-40, YF5-2-7, Durgapura Kesar, Thar Manak and Sugar baby. Leaf samples were collected at seedling stage and DNA was isolated from the pooled sample. Consequently, eleven ScoT and 16 CBDP markers produced varietal specific bands and differentiated cultivar to each other. Among 6 cultivars, the Wm-37 and Wm-40 lines were shown highly polymorphic bands.

For the molecular characterization of ber genotypes, thirty four SSR markers were selected from public literature and validated through PCR amplification on genomic DNA of 37 ber cultivars. Thirty three markers were resulted into 61 polymorphic alleles with range of 2 to 3 alleles per locus. The Polymorphism Information Content (PIC) value was ranged from 0.41 to 0.69 with an average value of 0.55. Similarly, the expected heterozygosity (He) level was observed in a rage of 0.09 to 0.64 with an average of 0.37. The UPGMA phylogenetic tree classified 37 genotypes into two major groups. The assessed genetic diversity and population structure analysis in ber can be employed for crop improvement in Indian ber. In assessment of molecular diversity in Gola strains, out of 34 markers, the best 13 markers are used to determine the clonal fidelity and duplicacy in 16 Gola strains. Amplified markers showed very low level of polymorphism. Though the polymorphism was shown by some primers (Zma168, Zma189 and Zma195) but the level of polymorphism was very low. This discrepancy due to either low level of polymorphism in all Gola clones or they are genetically similar.

In assessment of molecular diversity in cowpea genotypes, for molecular characterization of cowpea genotypes, ten each ScoT and CBDP markers were profiled on genomic DNA of cowpea genotypes. The markers were amplified significant number of polymorphic bands and thus differentiated the genotypes clearly. Twenty used markers produced 165 polymorphic alleles with range of 2 to 6 alleles per locus. The Polymorphism Information Content (PIC) value was ranged from 0.39 to 0.65 with an average value of 0.52. In identification the RBOH genes in watermelon, the BLASTp search was performed against the genomic database of watermelon using *Arabidopsis* RBOH protein as a query sequence. Consequently, nine putative RBOH genes were identified in watermelon. Based on the species belong and their chromosomal position, the RBOH genes were named as ClaRBOH genes and nomenclatured as ClaRBOH01 to ClaRBOH09, respectively.

Integrated Water and Nutrient Management

A systematic soil survey was carried out in arid vegetable growing areas of Bikaner district. Analyzed the soil samples collected from adopted villages of CIAH, Bikaner and 60 soil health card were prepared and distributed among farmers (Gigasar village) during International soil health day. The soils were neutral to alkaline in reaction with an average pH of 7.68. The organic carbon content ranged from 0.05 to 0.13 with an average value of 0.1 %, available nitrogen, phosphorus (P)

and potassium (K) content of these soils ranged from 115.48 to 285.80, 7.70 to 18.71 and 136.76 to 292.68 kg ha^{-1} with an average value of 211.27, 12.48 and 217.18 kg ha^{-1}, respectively. Among major nutrients, about 95.29% of the soil samples were low, whereas, rest of the samples (4.71 %) were found to be medium in available nitrogen, 32.65 and 65.35% soil samples were observed to be low and medium in available P_2O_5, whereas, 95.19 and 4.81% samples were in medium and high in available K, respectively.

The field experiment was conducted to investigate the effect of different level of salinity ($0.5EC_{IW}$ and $4EC_{IW}$ dSm^{-1}) with the combination of amendments for snapmelon, kachri and water melon crop performance. The application of saline water with amendments increased yield of snapmelon as compared to control. The data revealed that with the two salinity level the highest yield was observed under the treatment of IW 4EC + FYM 15 t/ha was (186.78 q/ha) followed by IW 4EC + vermicompost 10 t/ha (171.60 q/ha), IW 4EC + gypsum 4 t/ha (168.86 q/ha) and 137.77 q/ha yield of snapmelon in control treatment (IW 4EC). In kachri, highest kachri yield was observed with the treatment of IW 4EC + gypsum 5 t/ha that was (50.00 q/ha) followed by IW 4 EC+ vermicompost 10 t/ha (45.83 q/ha), IW 4EC+ FYM 15 t/ha (42.66 q/ha) and 36.66 q/ha yield of kachri in control. While with the salinity level of 0.5 EC the highest yield was observed with the treatment of IW 0.5EC + FYM 15 t/ha (69.83 q/ha) followed by IW 0.5 EC+ vermicompost 10 t/ha (64.67q/ha), IW 0.5EC+ gypsum 5 t/ha that was (58.00 q/ha) and in control (IW 0.5EC) was (42.00 q/ha). In watermelon, maximum yield was observed in treatment of IW 0.5 EC (dSm^{-1}) + 50% organic + 50% inorganic (420 q/ha) followed by IW 2 EC (dSm^{-1}) + 50% organic and 50% inorganic (420 q/ha) and IW 4EC (dSm^{-1}) + 50% organic and 50% inorganic (300.00 q/ha). It was observed that the increases the salinity level of irrigation water significantly affect the yield parameter like fruit weight, fruit length and fruit diameter.

In bael, among different combination of mulches, biofertilizer and fertilizer, plant height (3.91 m) was recorded maximum in standard dose of NPK followed by grass mulch + FYM + neem cake + 50% recommended dose of NPK + *Azotobactor* + VAM culture; grass mulch+ FYM + 25% recommended dose of NPK + *Azotobactor* + PSB culture; and it was recorded minimum in FYM (20 kg/plant), whereas plant spread (4.27m), stem girth (31.60) and fruit retention (14.23 fruits/plant) was also recorded the maximum with grass mulch + FYM + neem cake + 50% recommended dose of NPK + *Azotobactor* + VAM culture under rainfed semi-arid conditions.

Post-harvest Management and Value addition

An experiment was conducted for evaluation of shelf life of mulberry fruits in different packaging material at ambient conditions (Temp.40±2°C and RH 50-60%). Results revealed that slow progression in TSS and anthocyanin content were noticed in CFB box covered with cling film and CFB box with 0.3% ventilation throughout the storage period. Moreover, minimum cumulative physiological loss in weight (7.63%) after 2 days (48 hrs) was observed in CFB box covered with cling film followed by CFB box with 0.3% ventilation (12.87%) and maximum in control (23.72%). Thus, CFB box covered with cling film and CFB box with 0.3% ventilation enhanced shelf life for 2 days and found suitable packaging for mulberry fruits.

In standardization of packaging for safe transport and marketing of fresh dates, date palm cv. Halawy fruits were harvested at doka stage, packed in different packaging materials and stored at ambient conditions (temp. 42±2°C and RH 55-60%) for 4 days period. After 2 days of storage, significantly high physiological loss in weight (PLW) was observed in without packaging (16.74%) followed by woven cloth bags (9.92%) and minimum PLW was recorded in plastic box with 0.5% ventilation (6.34%) followed by plastic box with 1.0% ventilation (6.75%). In order to improve color in dry dates, anti-browning agents were applied through dip treatment. Citric acid 1.0% and potassium metabisulphite 1.0% significantly reduced browning as compared to control. No significant difference was observed in non enzymatic browning (NEB) value among ascorbic acid, cystene treated dates and control.

Technological Impact Assessment

Impact assessment of adoption of pomegranate and date palm crops in hot arid regions of Rajasthan was carried out. The study revealed that the total area under date palm in different districts of hot arid region like Bikaner, Jaisalmer, Shri Ganganagar, Hanumangarh, Barmer, Nagaur, Jodhpur, Jalore, Churu, Pali, Jhunjhunu, and Sikar

was 422, 224, 202, 148, 158, 49, 46, 126, 91, 78, 22, 18 ha with 4865, 3176, 3154, 1341, 1437, 498, 427, 1174, 732, 640, 161, 81 metric tonnes production/year, respectively. In case of pomegranate, the total area under pomegranate crop production in different districts of hot arid region like Barmer, Jalore**,** Jodhpur, Jaisalmer, Bikaner, Pali, Nagaur, Sikar, Churu, Shri Ganganagar, Hanumangarh, and Jhunjhunu was 8544, 3928, 404, 380, 1705, 358, 226, 388, 99, 233, 181, 378 ha with 14798, 4499, 565, 564, 2525, 538, 298, 569, 128, 388, 366 and 578 metric tonnes/year, respectively.

An intensive survey was conducted in Bikaner district and collected basic data about the impact of adoption of "Low Tunnel Technologies" for cultivation of vegetables during off season (winter). The study revealed that the local farmers grow various vegetables (specially, cucurbits) under "Low Tunnel Technologies (LTT)" during the winter season for advance production with the aim to fetch the high price and high earning from the vegetable market/Mandies. "Low Tunnel Technologies (LTT)" vegetable production spread over 1200 ha in Bikaner district and farmers get/ earn Rs. 2.0 - 3.0 lacs net profit from one hectare of land per season depending on type of vegetable, seed quality, climatic conditions, marketing demand and natural hazards.

Plant Protection

A survey programme of pomegranate orchards was conducted in the second week of September, 2021 at Palana, Ambasar and Sujasar villages of Bikaner district for occurrence of nematode infestation. Root knot nematode infestation was found up to average 6.33% in pomegranate orchards. At initial stages of infestation, no flowering and little leaf symptom was observed on infected plants with stunted growth while on later stage of infestation (after 2-3 year), leaf yellowing and wilting of plants with knots on the roots were observed. Nematode produces galls or knots on the roots. Root system is manifested by retarded growth, leaf yellowing and falling of mature plants. With the increase in nematode population, feeder roots are invaded and destroyed as fast as they are formed. The resulting setback in the uptake of plant nutrients leads to debility of the plants and production of smaller fruits. No root knot nematode infestation was recorded in case of tissue culture plants of variety 'Bhagwa' at Institute and also farmer's orchards. Forty two date palm germplasm were screened for resistance against *Alternaria* leaf spot under natural conditions. Symptoms were observed as small light, dark gray to black circular spots. Later on, these spots increased in size and become irregular and black to straw colored and coalesced. Disease incidence (PDI) was found from 0.0 to 28.62% in different date palm germplasm of the Institute.

2. INTRODUCTION

The SWOT analysis of hot arid eco-system reveals that it has ample strengths such as plenty of sunshine, vast land, human labour, bio-diversity harbouring important genes, low humidity and low incidences of insect-pests and diseases for the production of quality fruits and vegetables. In addition to this, the arid eco-system also has opportunities to improve the horticultural scenario which can lead to overall development of socio-economic and nutritional security of the inhabitants. This can be achieved if adequate technologies are made available for sustainable agricultural production in the arid and semi-arid regions.

In view of this, the National Research Centre for Arid Horticulture came into existence on 1st April 1993. This was later upgraded to Central Institute for Arid Horticulture on 27th September 2000 and CHES, Vejalpur, Godhra (earlier Regional Station of IIHR, Bengaluru) was merged as its Regional Station on 1st October, 2000. The Krishi Vigyan Kendra of Panchmahal was also established on 01 October 2005 by the ICAR under the administrative control of ICAR-Central Institute for Arid Horticulture, Bikaner. This KVK is located at Vejalpur, Godhra Vadodara Highway away about 16 km from the District Headquarter Panchmahal (Godhra).

Mandate

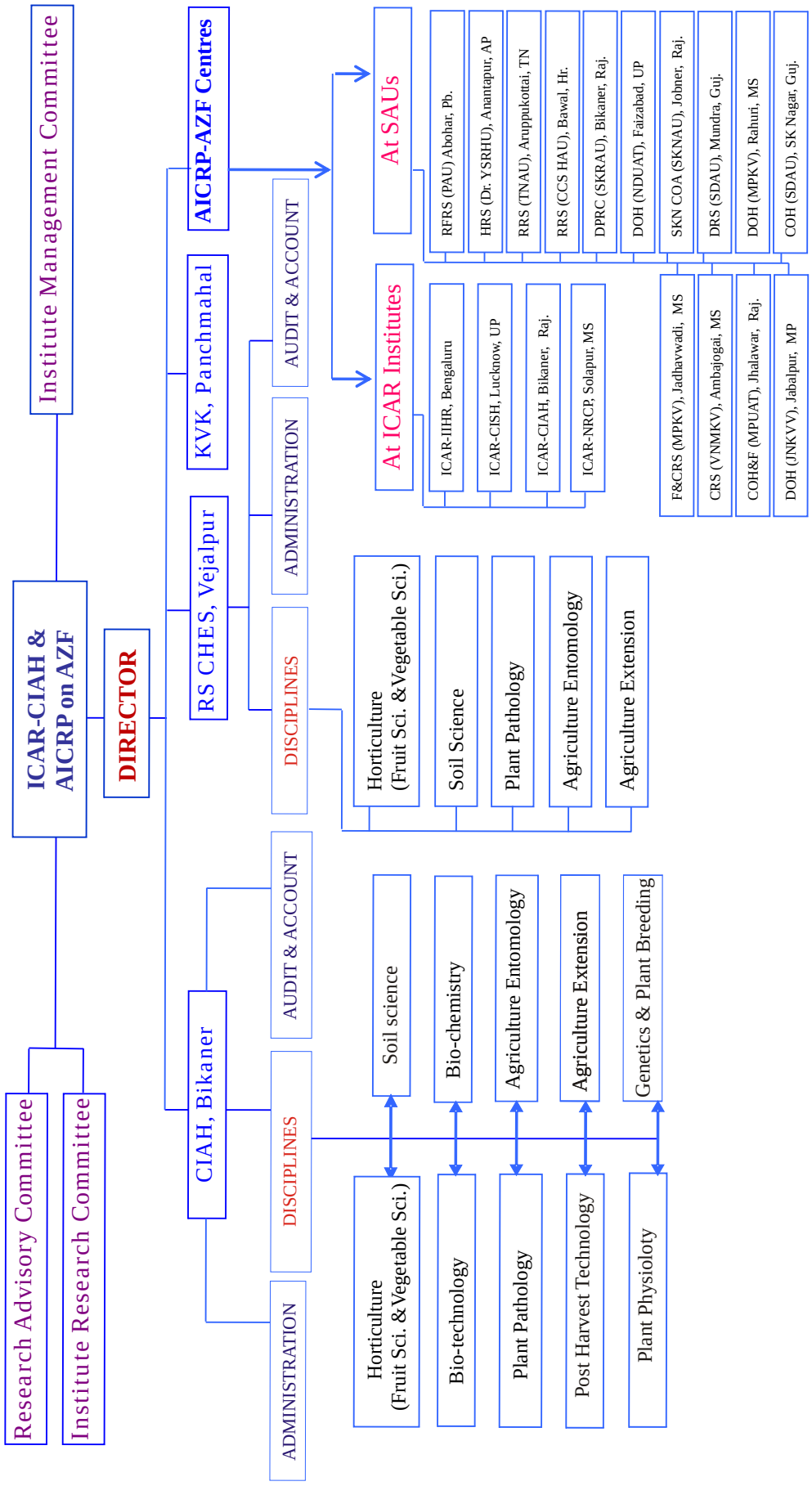
- Basic, strategic and applied research to enhance sustainable productivity, quality and utilization of horticultural crops of arid and semi-arid regions.
- Repository of genetic resources and scientific information on horticultural crops of arid and semi arid region.
- Transfer of technology, capacity building and impact assessment of technologies.
- Coordinate research and validation of technologies on fruit crops of arid and semi-arid regions.

Programmes and 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 vegetable crop-plants 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.

Keeping in view the above mandate and objectives, the research and extension works were carried out during January-December, 2021 and the significant results obtained in different projects are presented hereunder.

ORGANIZATIONAL SETUP



3. RESEARCH ACHIEVEMENTS

Genetic Resources Management and Crop Improvement

Eight genotypes of ber were collected from different locations (SKNAU, Jobner, Jaipur, SK RAU, Bikaner, Farmer's field, Bikaner).

One accession of *Cardia gharaf* was collected from Surjasur area with geographical coordinates of 27°92' N, 73°31' E, and elevation of 235 meters above mean sea level.

One red fleshed local guava genotype was collected from Dhar, Madhya Pradesh. Fifty five guava accessions are being conserved in the field gene bank at CIAH-RS-CHES, Vejalpur Two genotypes of acid lime (PDKV lime & Kagzi lime) were collected from Jalgaon, Maharashtra and maintained at CIAH-RS-CHES, Vejalpur.

One germplasm of Water melon collected from Diggi, Tonk (Rajasthan)

Seven germplasm of *M. balsamina* were collected from different places of Rajasthan for assessing medicinal properties. Two new collection of chilli were collected from Rajasthan.

Introduction, collection, characterization, conservation and evaluation of germplasm of arid and semi arid fruit crops

Ber *(Zizyphus sp.)*

Ber culinary (*Z. mauritiana)* and thorn less bordi (*Z. rotundifolia)* type were collected during 2018-19 from Bhilwara and local Bikaner area of Rajasthan. Plants were planted in the field and received IC number as 638784 and 638785, respectively from NBPGR, New Delhi during the reporting period.

Marked two accessions of ber from Sh. Bhagwana Ram's field, Rasisar village, Nokha with GPS location at 27.74^0 and 73.37^0 at 232 m MSL for rootstock and other proposes. Preliminary passport data were recorded of these two about 15 year old tree. Plants were in heavy bearing and no infestation of fruit fly/ stone weevil and good blend of sweet and sourness in taste. Fruits were collected and coded as Rasisar-1 and Rasisar-2 (Fig. 1.).

Rasisar-1 mean fruit weight 4.7 g, fruit size 2.32 x 1.95 cm , stone weight 0.8 g and TSS 28 ^{0}B and acidity 0.23 %	**Rasisar-2** mean fruit weight 3.80 g, fruit size 2.32 x 1.95 cm , stone weight 0.75g and TSS 26^{0}B and acidity 0.21 %

Fig. 1. Elite germplasm of ber

Thai ber fruit quality evaluation on jhar ber (*Ziziphus nummularia*) and deshi ber (*Ziziphus rotundifolia*) rootstock: Assessed biochemical parameters of fruit of Thai ber budded on jharber and deshi ber. Thai ber fruits were recorded higher dry matter, acidity, TSS, sugars, phenolic substances and flavonoids content where jhar ber used as rootstocks, except ascorbic acid.

Root stocks	Fruit quality parameters							
	Dry matter (%)	Acidity (%)	Ascorbic acid (mg/100g)	TSS (%)	Total sugar (%)	Reducing sugars (%)	Phenolic (mg. GAE/g)	Flavonoids (mg /g)
Z. *nummularia*	17.78	0.39	15.39	15.78	10.5	1.26	3.41	0.20
Z. *rotundifolia*	15.11	0.33	18.35	13.56	9.31	1.00	2.60	0.16

Evaluation of ber varieties for fruit set

The determination of fruit set has been used in ber as a consistent indicator of the real productivity level. Due to prevalence of self and cross incompatibility and pollen sterility, fruit set in the ber largely depends on sources of pollination, its related factors like effective pollination period, pollinators, environmental conditions and the success in fertilization. Ber forty two genotypes were evaluated for fruit set under the hot arid ecosystem. The genotypes showed large variation in fruit sets ranging from 0.34 per cent in Chochal to 13.89 per cent in Illaichi. About 74 per cent of genotypes under observation exhibited fruit set less than 6 per cent.

Range (%)	Genotype
0 – 2	Chochal, Chhuhara, Bawal, Nazuk, Khatti.
2 – 4	Gola, Umran, Banarsi Kadaka, Chhuhara, Sanaur, ZG-3, Jogia, Kissmiss, Safeda Rohtak, Kala Gola, Dharki No. 1, Safeda Selection, Tikadi, Aliganj, Jogia, Nanki, Laddu, Nilgiri.
4 – 6	Seb, Banarsi Pavindi, Mundia, Katha phal, Lakhan, Thar Malti, Kheera, Kali, Dadan, Thornless, Banarsi.
6 – 8	Rashmi, Mehrun, Meharwali, Badami.
8 – 10	Gularvasi, Kaithli.
>10	Illaichi

Comparative evaluation of ber genotypes collected from different locations

Eight genotypes of ber were collected from different locations (SKNAU, Jobner, Jaipur, SR RAU, Bikaner, Farmer's field, Bikaner) and compared with ICAR-CIAH germplasm /reference block fruit samples with fruit physico-chemical parameters. Among the genotypes maximum deviation in fruit volume and weight was recorded in Lakhan and least in Goma Kirti. As far as parameter is concerned shape index, seed weight and acidity content not much deviations were recorded irrespective of location except Supari genotype.

Evaluation of ber varieties at different fruit maturity stages

Fruit samples of ber varieties namely Gola, Thai, Goma Kirti and Thar Sevika were collected at different fruit maturity and evaluated for colour, TSS and acidity content periodically (Fig. 2-5).

Fig. 2. Ber fruits at different maturity stage cv. Gola

Stage of maturity	Chocolate	Golden yellow	Yellowish green	Greenish yellow	Green
TSS (^{0}B)	27.23	23.95	22.0	16.65	15.55
Acidity (%)	0.38	0.36	0.42	0.45	0.47
Colour value (RHS)	N199(A)	1(D)	144 (D)	138 (B)	138 (B)

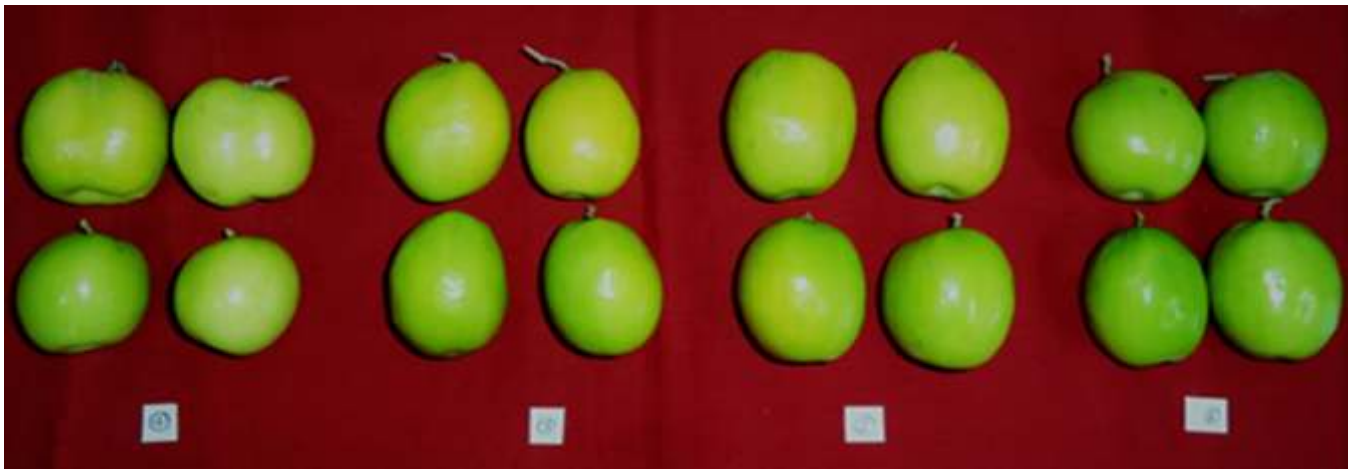


Fig. 3. Ber fruits at different maturity stage cv. Thai

Stage of maturity	Yellowish green	Greenish yellow	Dull green	Deep Green
TSS (^{0}B)	22.7	22.1	21.6	18.2
Acidity (%)	0.28	0.32	0.32	0.34
Colour value (RHS)	N144 (D)	141 (D)	138 (B)	138 (A)

Fig. 4. Ber fruits at different maturity stage cv. Goma Kirti

Stage of maturity	Chocolate	Yellowish	Greenish
TSS (^{0}B)	20.4	21.2	19.6
Acidity (%)	0.22	0.20	0.30
Colour value (RHS)	176 (A)	10A	N144 (C)

Fig. 5. Ber fruits at different maturity stage cv. Thar Sevika

Stage of maturity	Chocolate (Full ripe stage)	Yellowish green (Ripening stage)	Greenish yellow (Mature green)
TSS (^{o}B)	21.2	23.25	22.4
Acidity (%)	0.20	0.23	0.24
Colour value (RHS)	165 (B)	1(C)	144 (B)

Hybridization in ber

Hybridization in ber was carried out to obtain superior progeny in Thai ber. In this direction crossing were made for improvement in TSS (donor parent Reshmi) and fruit shape-colour (donor parent Kathaphal) in Thai ber. During the year 2020 total 764 crosses were made and set fruits nineteen that is 2.48 per cent of total crosses. Last year crossed in same combination and harvested thirty fruits obtained seventy healthy seeds and germinate two (Reshmi x Thai) only (Table 1).

Table 1. Details of crosses made in Thai ber

Cross combination	Crossing time	Status of crosses made in the year 2021			Last year cross status	
		No. of cross made	No. of fruit set	Fruit set (%)	Total fruit harvest	Seed sown
Thai x Reshmi	10 AM to afternoon	247	06	2.42	7	1
Thai x Kathaphal	9.30 AM to afternoon	196	09	4.59	0	0
Reshmi x Thai	3.30 PM to evening	110	02	1.81	8	6
Kathaphal x Thai	3.30 PM to evening	101	00	00	0	0
Selfing of Thai	Full day	110	02	1.81	18	10
Total		764	19	2.48	33	17

Reshmi? x Thai? Thai ? x Kathphal? Thai ? xReshmi? Selfing of Thai

Fig.6. Harvested fruits in cross combinations

Fig. 7. Crossing, hybrid seed and progeny of cross (Reshmi? x Thai?) seedling

Introduction, collection, characterization, conservation and evaluation of aonla under semi-arid and arid region

Aonla varieties namely Chakaiya, Banarsi, Francis, Krishna, Kanchan, NA-6, NA-10, Anand-1, Anand-2, NA-7, Goma Aishwarya, BSR-1, Laxmi-52 and BSR-2 were studied for their morphomatrix, yield and qualitative attributes of fruits during the year 2021. Genotypes (CHESA-1 to CHESA-13) were studied for their growth, flowering and fruiting characters.

Evaluation of aonla varieties

The inflorescence colour was deep pink in Banarasi, BSR-1, BSR-2. and Krishna; yellowish green in Francis; pinkish green in Chakaiya, Goma Aishwarya and Kanchan; green to light pink in NA-7, NA-10 and Anand-1 while light green to pinkish colour of inflorescence was observed in Anand-2.

Triangular fruit shape was observed in

Banarasi and Krishna; flattened round in Francis, NA-7, Goma Aishwarya, Chakaiya, Kanchan and NA-10, and flattened oval in Anand-1, BSR-1 and BSR-2 and Anand-2. Fruit colour of Banarasi and Kanchan was whitish green; light green in Krishna, Francis and Chakaiya; yellowish green in NA-7, NA-10 and Anand-2 and greenish yellow in Anand-2. Fruit stalk was observed short and thick in Banarasi, Krishna, NA-7 and NA-10 and short and thin was observed in Francis, Chakaiya, Kanchan, Aanand-1 and Anand-2. Fruit stem end cavity was noticed shallow and deep, it was observed shallow in Banarasi, Francis, Chakaiya, Kanchan, Anand-1 and Anand-2, whereas it was deep in Krishna, NA-7 and NA-10. Styler end cavity was levelled in Banarasi, Francis, Chakaiya, Kanchan, and NA-10; prominent in Krishna and less prominent in NA-7, Goma Aishwarya, Anand-1 and Anand-2. Number of segments in all the varieties had six but in few varieties like Krishna and Kanchan 6-8 segments may also be seen occasionally. Most of the varieties showed whitish green colour flesh excluding Krishna which had yellowish green colour. The highest fruit set was recorded in the NA-7 (51.70%) followed by Goma Aishwarya (50.63%), Krishna (44.12%), NA-10 (45.37%), NA-10 (40.30%) and Kanchan (38.15%) and the same was the lowest in Banarasi (35.00%) followed by Chakaiya (34.23%).

Fruit weight varied between 27.24-36.22 g, being maximum in Banarasi (36.90 g) followed by NA-7 (32.80 g) and it was measured the minimum in BSR-1 (12.05 g) and Kanchan (26.30 g).The fruit length ranged between 3.15-3.63 cm, whereas it was observed the maximum in Banarasi (3.58 cm) followed by Krishna (3.38 cm) and NA-7 (3.60 cm), fruit breadth ranged between 3.35-4.15 cm and the maximum breadth was observed in Banarasi (4.21 cm) followed by NA-7 and Chakaiya, while it was minimum in BSR (1.87 cm). The percentage of fruit retention (28.31%) was recorded the maximum in NA-7 followed by Krishna (24.10%) and the minimum fruit retention were recorded in Banarasi (16.97%) among the evaluated varieties.

The juice content was recorded the highest in NA-7 (57.25%) followed by Goma Aishwarya (50.70%), however Chakaiya had the lowest juice content (42.22%) followed by Banarasi (38.39%) and Anand-2(37.50%). The acidity ranged between 1.98-2.21% being the maximum in BRS-1 (2.21%) followed by Krishna (2.11%), whereas it was recorded the lowest (1.98%) in Kanchan followed by Anand-1 (2.15%). The vitamin C content ranged between 351.60- 497.00 mg /100 g. It was observed the highest in NA-7 (497.00 mg/100 g) followed by Kanchan (477.75 mg/100 g) and the same was found to be the lowest in Banarasi (397.40 mg/100 g) followed by Francis (370.25 mg/100 g) and Krishna (355.00 mg/100 g). The total soluble solids were recorded the maximum in NA-7 (9.50 ^{0}Brix) followed by Anand-1 (9.00^0 Brix) and Anand-2 (9.20 ^{0}Brix) while Banarasi had the minimum value (8.75 ^{0}Brix) followed by NA-10 (9.00^0 Brix). The value of specific gravity ranged between 1.03-1.41 being the highest in Banarasi (1.41) followed by Anand-1 (1.35), and it was least in Francis (1.02) followed by NA-7 (1.21).

Evaluation of aonla genotypes

Among the 13 genotypes, plant height (4.05 m) was recorded in CHESA-4 followed by CHESA-7 (3.95 m) and it was recorded least in CHESA-1 (3.41 m) followed by CHESA-2 (3.15 m) whereas yield per plant was recorded the maximum in CHESA-4 (45.60 kg) under rainfed semi-arid conditions. Among the genotypes, tree growth which was observed semi-spreading in CHESA-1 and CHESA-2; tall upright in CHESA-7 and CHESA-8; tall spreading in CHES-5 and CHESA-6, semi-drooping in CHESA-4 under rainfed conditions of western India. The foliage density was observed dense and sparse in different genotypes under semi-arid condition.

Introduction, collection, characterization, conservation and evaluation of bael under semi-arid region

Germplasm collection and evaluation

Among 215 established germplasm in field repository, flowering and fruiting was noticed in 147 genotypes during the year 2021. Wide genetic diversity was noticed in their morphological, quantitative and qualitative fruit characters. Variation in growth habit was observed as upright, spreading, semi spreading and drooping type, whereas foliage was observed compact, dense and sparse among all the 147 characterized genotypes. Tree shapes of different genotypes were dome, irregular, semi circular, broad vase and elliptical types. Wide range of variability was recorded in their leaf, flower, fruit yield and quality attributes, and maturity period under rainfed semi-arid conditions. Genotypes exhibited wide range of variability in terms of yield/ plant (64.21-133.70 kg), fruit weight (0.62-2.71 kg), fruit length (7.11-22.35 cm), fruit circumference (25.70- 55.45 cm), shell thickness (1.4-3.13 mm), seed number/ fruit (60.30-257.52), number of seed sacs (10.47-16.70),

seed weight (0.10-0.20 g), shell weight (109.80-445.00 g) and pulp weight (0.38-2.20 kg), and for chemical composition including TSS in pulp (32.23- 41.50 ^{0}Brix), TSS in mucilage (40.20-55.00 ^{0}Brix), acidity (0.31-0.59%), vitamin C (12.10-23.70 mg/100 g), total phenol contents (1785-2730 mg/100 g) and total sugar (14.13-18.11%) exhibited wide variation. Among the germplasm, considerable variability with regards to physical composition of fruit *viz.*, pulp (45.35-75.10%), shell (12.95-26.20%), fibre content (2.40-6.44%), mucilage (11.08-17.45%) and seed content (1.72-4.75%) were recorded, among the studied germplasm. Genotypes showed wide variation in ripening period (February to June).

Based on the observation on various aspects particularly fruiting pattern and quality attributes, genotypes, *viz*., CHESB-27, CHESB-29, 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 to be superior for their morphological, quantitative and qualitative characters among the genotypes evaluated under rainfed semi-arid ecosystem. Details of striking features of promising genotypes, CHESB-21, CHESB-27, CHESB-29 and CHESB-31 are as follows:

CHESB-27 (IC-06293867)

Average yield per plant 133.70 kg in 12th year (heavy yielder), fruit weight ranged between 1.37-1.45 kg, fruit size 14.31 cm x 13.33 cm, fruit girth 41-73 cm, shell thickness 0.23-0.24 cm, total number of seed 59.13-62.00, seed weight 0.18g, total seed weight 29.59g, fibre weight 49.70g, shell weight 195.40g, locules in cross section 15-17, TSS pulp 42.50^{0}B, TSS mucilage 47.50^{0}B, acidity (0.38%) and vitamin C 23.07 mg/100g pulp were recorded. It is mid maturing variety (4th week of April), heavy yielder, compact canopy, cluster bearing, deep yellow colour of fruit. It is having excellent shelf life (15-20 days) after harvesting. It is highly suitable for pickle, candy and powder making.

CHESB-29 (IC-0629388)

In this promising genotype, average yield per plant 84.15 kg in 8th year (heavy yielder), fruit weight ranged between 0.65-0.78 kg, fruit size 11.15 x 10.24 cm, fruit girth 37.43-39.25 cm, shell thickness 0.16-0.19 cm, total number of seed 56.25, fibre weight 38.00g, shell weight 97.17-105.00g, locules in cross section 14-16, TSS pulp 32.47-35.15^{0}B, TSS mucilage 49.50^{0}B, acidity (0.35%) and vitamin C 21.63 mg/100g pulp were recorded. It is mid maturing variety (4th week of April). Compact canopy, very short spreading growth habit, cluster bearing, deep yellow colour of fruit. It is having very good shelf life (10-15 days) after harvesting. It is highly suitable for sharbat and slice. It is highly suitable for nuclear family being small in size.

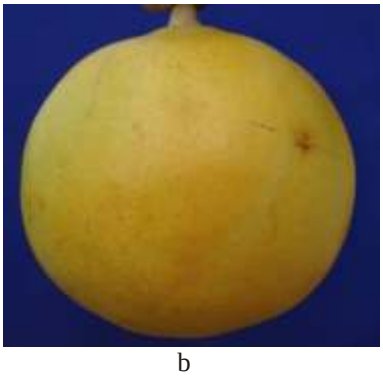
Striking features of newly developed bael varieties

Thar Prakriti

Based on desirable horticultural traits, it has been identified promising genotype, collected from Anand, Gujarat in 2010. Average yield per plant 115.75 kg in 12th year, fruit weight 1.40 kg, fruit size 14.05 x 15.10 cm, fruit girth 44.10 cm, shell thickness 0.14 cm, total number of seed 60.23, seed weight 0.20 g, total seed weight 17.40 g, fibre weight 28.42 g, shell weight 190.60 g.

It has TSS pulp 38.00 ^{0}Brix, TSS mucilage 51.00 ^{0}Brix, acidity (0.33%) and vitamin C 22.50 mg/100 g pulp. The fruits of this genotype are having good flavour and aroma and rich in antioxidants. It is highly suitable for sharbat, *murabba* and powder making and various ayurvedic medicines. Time taken from fruit setting to ripening is 315 days; fruits are round in shape with peculiar styler end cavity. It belongs to late maturity group (1st week of May) having uniform and peculiar roundish fruit shape and size. Distinct character of the variety is papery shell, very less seed, rich in fibre content and peculiar styler end cavity.

a



b

c

d e f

Fig. 8. Thar Prakriti (a) branches laden with uniform fruit shape and size, (b) Ripened fruit colour, (c) Transverse section of fruit,(d) fibre content,(e) vey less seeds in fruit and (f) Empty papery shell

Thar Shivangi

Average yield/plant is 109.15 kg in 11th year, fruit weight 1.35 kg, fruit size 15.50 x 12.87 cm, fruit girth 44.80 cm, shell thickness 1.9 mm, total number of seed 75.32, total seed weight 32.00 g, fibre weight 35.00 g, shell weight 190.21 g, locules in cross section 15.50, pulp 70.50%, TSS pulp 37.10 ^{0}Brix, TSS mucilage 50.50 ^{0}Brix, acidity (0.35%) and vitamin C 20.40 mg/ 100 g pulp were recorded. Luxuriant growth, peculiar leaf shape, drooping branches, curved petals and high phenolic content are the distinct traits of this variety. Being small in stature, it is highly suitable for high density planting (5 m x 5 m).

Fig. 9. Thar Shivangi: Drooping branches laden with fruits, ripened fruit on tree and cauliflorus flowering behaviour with curved petals

Identification of elite genotypes of bael

CIAH Bael-1: Based on the observations the average weight of fruit 1.33 kg, fruit size 125.7 x 147.5 mm, pulp weight 898 g, shell weight 0.430 g, seed weight 0.26 g, total number of seed 66.2, TSS of pulp 39.2 ^{o}Brix, TSS of mucilage 40.6 ^{o}Brix, fruit girth 43.53 cm, shell thickness 0.24 cm, total locule in cross section 14-16, It is medium season maturing genotype in hot arid ecosystem (3rd week of may) average yield (25-30 kg) per plant . Centric

Fig. 10. Elite germplasm of CIAH Bael-1

CIAH Bael-2: Based on the horticultural traits plant height (3.5 m), leaves medium size, drooping canopy structure and average weight of fruit 0.850 kg, fruit size 105.6 x 119.8 mm, pulp weight 0.430 kg, shell weight 0.300 kg, seed weight 0.56 g, total number of seed 99.2, TSS of pulp 36.6 °Brix, TSS of mucilage 51.4 °Brix, shell thickness 0.29 cm, total locule in cross section 17-19, It is medium season maturing genotypes (May month). Centric locule arrangement, odourless, greenish yellow colour of fruit surface, fruit shape round, pulp colour yellow, styler end cavity flatted, stem end cavity highly depressed, high mucilage content and cracking free in arid ecosystem are identical and distinct characters of the fruits. It is highly suitable for squash, candy making.

Fig 11. Elite bael germplasm CIAH Bael-2

Date palm (*Phoenix dactylifera L.*)

Evaluation of male date palms

The eight elite male date palms seedlings were evaluated and exhibited wide range of variability in terms of flower emergence ranges from January to March, time of spath opening (20.4-39.8 days), length of spath (32.8-122.4 cm), width of spath (12.4- 19.4 cm), number of spadix (15-26.8), weight of spadix (0.516-1.86 kg), weight of spath (0.259-0.875 kg), weight of inflorescence (0.257-0.990 kg), number of strands per spath (105-156.8), length of strands (13-33.6 cm), length of central axis (16.8-50.6 cm), length of peduncle (11.8-54.6 cm), number of flowers per strands (44-104.6), weight of pollen per spath (7.8-24.8 g) and pollen yield (129 -675 g). Among the seedlings, considerable variability with regards to chemical composition of pollen grains like phenolics (7.95-11.90 mg GAE/g), flavonoids (0.322-0.496 mg E.Cat./g DW), TAA (11.34-17.55 mg AAE/g DW), total soluble sugar (60.99-134 mg/g) and reducing sugar (3.46-11.63 mg/g). The time of flower emergence and opening may vary due climatic abbreviations.

Identification of elite male seedling of date palm for higher pollen grain production

Based on the observation on various aspects particularly pollen grain production attributes CIAH/DP/M-01, CIAH/DP/M-03, CIAH/DP/M-04 and CIAH/DP/M-06 were found to be superior under hot arid ecosystem.

CIAH/DP/M-01: A vigorous and promising seedling available in the field repository of date palm. This producing pollen grain 744.86 g per plant and analysed chemical parameters like phenolics (11.90 mg GAE/g), flavonoids (0.496 mg E.Cat./g dw) TAA (16.35 mg AAE/g dw), proline (0.61 µmol/g), TSS (80.90 mg/g), reducing sugars (11.63 mg/g).

Fig. 12. Elite male spathe of germplasm CIAH/DP/M-01.

CIAH/DP/M-03: This seedling has been identified promising on the basis of pollen production. The spath emergence takes place in second week of February to second week of March. This producing pollen grain yield per plant 444.60 g. The chemical analysis of pollen grain like phenolics (8.99 mg GAE/g), flavonoids (0.432 mg E.Cat./g dw) TAA (17.55 mg AAE/g dw), proline (0.56 µmol/g), TSS (133.05 mg/g), reducing sugars (5.18 mg/g) was also analysed.

Fig. 13. Elite male spathe of germplasm CIAH/DP/M-03.

CIAH/DP/M-04

It is identified promising based on horticultural traits; plant stature is semi vigorous and hanging branches with yellow colour and looking unique type comparison to other elite seedlings. The spath emergence takes place in second week of February to second week of March.

Fig. 14. Elite male spathe of germplasm CIAH/DP/M-04.

CIAH/DP/M-06

It is identified promising based on pollen production and semi vigorous in plant stature. The flower emergence was initiated in last week of January to third week of February

Fig. 15. Elite male spathe of germplasm CIAH/DP/M-06.

Evaluation of female date palm genotypes

Maintenance of sixty four date palm varieties/genotypes including exotics was carried out during the reporting period. The fruiting characters of date palm genotypes are recorded and found the maximum bunch weight was in Hayani (8.2 kg) and minimum in Gijaj (1.5 kg), maximum fruit weight in Medjool (17 g) and minimum in Tayer (3.3 g), maximum fruit length in Dhamas (45.7 mm) and minimum in Javantri (21mm), maximum fruit width in Medjool (26 mm) and minimum in Tayer (15 mm), maximum stone weight in Dayari (2.1 g) and minimum in Tayer (0.7 g), maximum pulp weight in Medjool (16 g) and minimum in Dayari (1.6 g), maximum pulp stone ratio in Medjool (11.8) and minimum in Dayari (0.8), maximum stone length in Dhamas (31.2 mm) and minimum in Tayer (16.9 mm), maximum stone width in Javantri (11.4 mm) and minimum in Chichap (7.6 mm) and maximum pulp thickness in Medjool (9.17 mm) and minimum Tayer (2.77 mm), fruit colour yellow, red, green yellow, dark red, light yellow, orange yellow, greenish red, maximum fruit yield per plant in Hayani (86.2 kg) and minimum in Zaglool (8.1 kg) and maximum TSS was in Medjool (52.6 ^{0}Brix)and minimum was recorded in Zaglool (19.6 ^{0}Brix).

Evaluation of genotypes received from ICARDA, Jordan

Three genotypes (MRKS, MHN/B and M1N1) of date palm received from ICARDA, Jordan are evaluated during reporting period. The higher number of bunches per plant in M1N1 (4.2), stalk length (48.0 cm), bunch length (18.20 cm), number of strands per bunch (40.6), strands length (26.0 cm), bunch weight (1.95 kg) and yield per plant (8.0 kg) was recorded. While, maximum fruit weight (12.8 g), fruit length (37.29 mm) and width (23.70 mm), stone weight (1.41 g) stone length and width (21.19 x 9.31 mm), TSS (44.74^{0}Brix) was recorded in MHN/B genotype.

Fig. 16. Date fruits of ICARDA genotypes

Table 2. Growth and yield attributing parameters of ICARDA genotypes

Genotypes	Stalk length (cm)	Bunch length (cm)	No. of strands/ bunch	Strands length (cm)	Fruit Weight (g)	Fruit length (cm)	Fruit width (cm)	Stone weight (g)	TSS (^{0}Brix)	Yield /plant (Kg)
MRKS	28.8	7.40	27.0	20.8	5.3	24.26	18.72	0.78	43.36	5.2
MHN/B	22.4	13.60	30.0	20.0	12.8	37.29	23.70	1.41	44.74	4.4
M1N1	48.0	18.20	40.6	26.0	6.9	26.98	20.49	0.96	29.72	8.0
SE.m±	4.23	1.80	1.24	0.85	0.50	0.42	0.60	0.08	0.50	0.38
CD at 5%	14.0	5.96	4.10	2.83	1.65	1.40	2.01	0.28	1.67	1.26

Guava

Germplasm collection, characterization and evaluation

One red fleshed local guava genotype was collected from Dhar, Madhya Pradesh. Fifty five guava accessions are being conserved in the field gene bank. Promising accessions were clonally propagated and planted in the field for further evaluation. During the reporting period 29 red fleshed and 24 white fleshed guava genotypes were evaluated for tree growth, yield and fruit quality characteristics.

Evaluation of white fleshed germplasm

Among evaluated white fleshed genotypes, CHESG-1 recorded the maximum plant height (4.67 m) and plant spread (5.13 x 4.95 m). However, Shweta recorded the minimum plant height (2.15 m) while Dhawal recorded the least spread (2.65 x 2.28 m). CHESG-29 recorded the highest stem girth (17.18 cm) while it was found the least in Shweta

(9.13 cm). The average fruit weight of white fleshed genotypes ranged between 120.20 g in MPUAT-1 and 256.90 g in CHESG-38. The maximum fruit length was recorded in CHESG-11 (11.36 cm) while the minimum fruit length was recorded in Dhawal (6.15 cm). The fruit width varied from 6.08 cm in MPUAT-1 to 7.67 cm in VNR followed by 7.63 cm in Thai guava. The maximum number of fruits/tree was observed in MPUAT-1 (146.70) followed by CHESG-38 (139) while it was found minimum in Dhawal (55). Similarly, the maximum fruit yield/tree was recorded in CHESG-38 (34.50 kg) followed by L-49 (27.20 kg) while Dhawal recorded the minimum fruit yield (7.35 kg).

The seed core diameter varied from 3.45 in MPUAT-1 to 5.75 cm in MPUAT-2. The highest pulp thickness was observed in Thai guava (1.65 cm) and least in CHESG-5 (1.20 cm). The maximum 100 seed weight was recorded in Dholka (2.05 g) followed by CHESG-11 and CHESG-29 (1.85 g) and VNR Bihi1 (1.56 g), while it was found minimum in Hyb 4/1 (1.25 g). The maximum seed hardness was recorded in CHESG-29 (23.83 kg/cm^2) followed by VNR Bihi1 (18.55 kg/cm^2) while Shweta recorded the minimum seeds hardness (12.98 kg/cm^2) followed by Hyb 4/2 (12.38 kg/cm^2).

The maximum TSS was recorded in CHESG-39 (14.55^{0}Brix) followed by MPUAT-2 (13.85^{0}Brix) while the minimum TSS was observed in Seedless (10.45^{0}Brix). The maximum acidity was recorded in CHESG-4 (0.69 %) while the minimum acidity (0.41 %) was observed in Seedless. The maximum ascorbic acid (298.85 mg/100 g) was found in CHESG-39 while it was recorded minimum in CHESG-29 (67.60 mg/100g). The highest TSS: acidity ratio was observed in CHESG-38 (26.96) followed by MPUAT-2 (26.73) while Hyb. 4/8 recorded minimum TSS: acidity ratio (18.23) followed by CHESG-17 (20.15). Dhawal recorded the highest total sugar (9.89 %) while CHESG-29 recorded the minimum total sugar (6.65 %). The pectin content was ranged in between 0.79 % in CHESG-1 to 1.55 in VNR Bihi1.

CHESG-38: It has medium tree vigour and compact semi-spreading canopy. Fruits are round in shape, bigger in size weighing around 230-250 g and average yield 34.50 kg/tree during 5th year). Fruit peel is whitish yellow in colour while pulp is whitish yellow at mature ripened stage. Keeping quality of fruits 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 have good taste with TSS: acidity ratio of around 26.25 . It is soft seeded with 100 seed weight of 1.23 g and having seed hardness of 12.52 kg/cm^2. Fruit pulp is rich in pectin (1.30%), TSS (13.70^{0}B) and total sugars (9.60 %).

CHESG-39: It has medium spreading canopy and bears near the trunk and in the periphery of canopy. Fruits are round in shape, medium in size weighing around 175-195 g and average yield 17.63 kg/tree during 4th year. Fruit peel is yellow in colour with white pulp. Ridges are prominent around pedicel end with rough peel. Keeping quality of fruits is good at ambient storage (4-5 days). At ripened mature stage fruit pulp is firm with less seeds of small size, having pleasant aroma and have good taste with TSS:acidity ratio of around 22.07 . It is soft seeded with 100 seed weight of 1.42 g and having seed hardness of 12.55 kg/cm^2. Fruit pulp is rich in pectin (1.39%), TSS (14.35^{0}B) and total sugars (9.82 %).

CHESG-38 CHESG-39

Fig. 17. Fruits of guava genotypes

Performance of F_1 progenies

Hybrid seedlings showed healthy and vigorous growth after establishment in the field. Plant height and spread were taken in the month of December, 2021 after completion of winter season harvesting. The three crosses Thai x SP, BL x SP and CHESG-32 x CHESG-28 had comparatively shorter plant height (2.28-2.42 m) while least plant spread recorded in SP x CHESG-28 (2.16 m) followed CHESG-28 x CHESG-32 (2.24 m) and BL x SP (2.29 m) in comparison to other crosses. However, MPUAT-2 x CHESG-15 (2.65) and CHESG-31 x Purple (2.60 m) and SP x CHESG-28 (2.59 m) produced the tallest canopy height in comparison to other crosses. The crosses CHESG-32 x CHESG-28 (2.46 m), CHESG-31 x TP (2.50 m) and CHESG-31 x TP (2.50 m) had moderately tall trees. The crosses CHESG-28 x CHESG-32 and CHESG-31 x TP showed spreading growth habit and rest of the crosses had upright to semi-spreading growth habit. The trunk diameter varied non-significantly in between 5.16 cm (Thai x SP) to 5.97 cm (Lalit x CHESG-28).

Progeny means and range for the different quantitative traits *viz.* - days to 1st winter harvest, per cent of bearing trees, fruit weight, fruits tree and yield/tree showed high variability among and within progenies. The progeny means for the days taken to first winter season harvest in the 3 crosses (SP x CHESG-28, CHESG-31 x TP and Thai x SP) took in between 454-459 days (around 15 months) and rest of other 7 crosses took 461-478 days. An extended period of harvest of more than 40 days was recorded in CHESG-31 x TP (439-481). In regard to per cent of bearing trees, above 75% of the trees within the progeny came in to bearing in 4 crosses (SP x CHESG-28, CHESG-31 x TP, Thai x CHESG-30 and Thai x SP) while reciprocal cross between CHESG-28 x CHESG-32 had only 33-36% offspring bearing crop. This kind of early bearing and variability present within and among progenies facilitated early selection of promising types comparatively in short period of time at this location that might be due to availability of plenty of sun shine in congenial range throughout the year along with interaction of other agro-climatic conditions and precocious genotypes selected for the crosses. The yield and number of fruits/tree varied widely among and within progenies. The 3 progenies namely SP x CHESG-28, Thai x CHESG-30 and CHESG-31 x TP recorded the higher mean yield (> 6kg/tree) and number of fruits/tree (> 25/tree) than the progenies of other crosses.

Fruit weight, size, seed core diameter, pulp thickness and number of seed/fruit also varied among and within progenies . The 6 progenies (BL x SP, SP x CHESG-28, Thai x SP, Thai x CHESG-30, CHESG-31 x TP and MPUAT-2 x CHESG-15) produced moderately heavier fruits (> 185g/fruit) than other crosses. The highest mean fruit length was recorded in Thai x CHESG-30 (90.75 mm) followed by CHESG-32 x CHESG-28 (83.46 mm) while lowest mean fruit length was observed in Lalit x CHESG-28 (64.30 mm) followed by CHESG-28 x CHESG-32 (70.07 mm) in comparison to others. However, the highest mean fruit width was recorded in Thai x SP (78.39 mm) followed by Thai x CHESG-30 (77.32 mm) while lowest mean fruit width was observed in Lalit x CHESG-28 (64.79 mm) followed by CHESG-32 x CHESG-28 (60.74 mm) in comparison to other crosses. The seed core diameter varied in between 3.38 cm in CHESG-32 x CHESG-28 to 4.27 cm in BL x SP. The maximum mean pulp thickness was recorded in Thai x SP (1.81 cm) followed by 1.72 cm in BL x SP while the least was observed in CHESG-32 x CHESG-28 (1.43 cm). Offspring of MPUAT-2 x CHESG-15 recorded the highest number of seed/fruit (367.80) followed by CHESG-31 x TP (274.40) while the lowest number of seed/fruit was observed in SP x CHESG-28 (158.40) followed by Thai x SP (175.60). However, the highest mean 100 seed weight was recorded in Thai x CHESG-30 (1.44 g) followed by Thai x SP (1.42 g) while the minimum mean 100 seed weight was observed in CHESG-31 x TP (1.03 g) followed by 1.06 g in MPUAT-2 x CHESG-15.

All kind fruit shape variation observed from round, oblong, elliptic and obovate, however, obovate shape dominated over others. Peel colour of ripe fruits showed considerable variation as light green, greenish yellow, yellowish green, yellow and red green. Pulp colour showed considerable variability from white, yellowish white, orange pink to pink. Maximum colour variation was observed in SP x CHESG-28 while all the progenies of CHESG-31 x TP and CHESG-31 x Purple showed pink flesh with variable colour intensities. The texture of pulp of the fruits of different crosses were crispy in Thai x SP, CHESG-31 x TP, medium crispy in BL x SP, SP x CHESG-28, medium soft in MPUAT-2 x CHESg-15, Lalit x CHESG-28 and Thai x CHESG-30, CHESG-32 x CHESG-28 produced soft textured pulp. The taste of fruit categorized as fairly sweet, sweet acidic, medium sweet and sweet.

Fruit quality attributes like TSS and TSS:acidity did not vary significantly, however, considerable variation among and within progenies

recorded for acidity and ascorbic acid. The mean TSS values ranged from 8.50^{0}B in Lalit x CHESG-28 to 11.18^{0}B in BL x SP. The lowest mean acidity was recorded in Lalit x CHESG-28 (0.28%) followed by CHESG-31 x TP (0.33%) while the highest mean acidity was observed in BL x SP (0.52%) followed by SP x CHESG-28 (0.48%). The TSS:acidity ranged in between 21.50 in BL x SP to 32.66 in CHESG-31 x TP. The highest mean ascorbic acid was recorded in BL x SP (169.05 mg/100g) followed by SP x CHESG-28 (150.17 mg/100g) while the minimum value was observed in Thai x CHESG-30 (89.78 mg/100g) followed by CHESG-31 x Purple (103.05 mg/100g). Lower values of TSS and ascorbic acid might due to prevalence of high humid conditions during October month as monsoon rained till first week of October unlike to other years.

Fig. 18. Variability in fruit shape, peel and pulp colour

Performance of F_1 progenies

Healthy seedling progenies of 5 crosses (15-20 cm) were planted on July 07, 2021, established seedlings showed vigorous growth under field conditions. The progeny of cross Purple 2 x SP had significantly shorter plant height (1.26 m) followed by MPUAT-2 x Purple 2 (1.33 m) and spread (0.92 m & 1.20 m, respectively) in comparison to other crosses. However, Thai x MPUAT-2 had the maximum plant height (1.60 m) spread (1.61 m).

Two hybrids (VNR x CHESG-15, Thai x MPUAT-2) flowered earlier (143-145 days) than other crosses with highest percentage of flowering seedlings in MPUAT-2 x Purple-2 (60.86%) and MPUAT-1 x MPUAT-1 (50.0%). Wide colour variation was observed in newly emerged leaf and shoot in comparison to parents used in crosses. Purple pigmentation in newly emerged leaves dominated in the crosses wherever Purple 2 and MPUAT-1 used in crosses. Offspring of Thai x MPUAT-2 also showed purple pigmentation in newly emerged leaves, though mother plants did not show much such kind of pigmentation in newly in newly emerged leaves.

Fig. 19. Flowering and fruiting in F_1 progenies (VNR x G-15 and MP-2xPur-2)

Acid Lime

Evaluation of acid lime genotypes under arid conditions

Twenty genotypes and eight national released varieties were observed and recorded for adaptability (growth), survibility, fruiting and quality parameters as well as canker infestation under natural sub and subra temperature conditions. CIAH AL-03 has semi vigorous plant. Fruits are harvested mainly in summer months during June-August and also continue in flowering and fruiting almost round the year. The fruits are oblong shape, medium size, pleasant flavour and greenish colour, fruit weight 56.18g. Fruits have 7.58 °Brix TSS and 6.22% acidity. The juice content is 56.21% by weight and 24.85 kg yield plant^{-1}; it is also very less affected by citrus canker. CIAH AL-11 has highly vigorous plant, Fruits oblong shape, medium size; pleasant flavors, light greenish colour and fruit weight 42.55g. Fruits have 7.41°Brix TSS and 5.62% acidity. The juice content is 51.81% by weight and fruit yield 17.48 kg yield plant^{-1}. The cultivars namely NRC-07, NRC- 08, Sai Sarbati, Vikram, Parmalini, and rest of genotypes were sensitive and damaged upto more than 90 percentages by frost, and not recovers from the frost. The CIAH AL-04, CIAH AL-05 genotypes and Balaji cultivar were damaged upto 60 per cent and recovered. However, CIAH AL-01, CIAH AL-03, CIAH AL-07 and CIAH AL-09 were found tolerant and not damaged upto significant level CIAH acid lime-06, CIAH acid lime-03the genotypes under natural frost/low temperature condition at Institute citrus site.

CIAH AL-09 CIAH AL-04 CIAH AL-05 CIAH AL-03 CIAH AL-07

Fig. 20. Evaluation of acid lime genotypes with frost injury under field condition

Germplasm collection, characterization and evaluation

Two genotypes of acid lime (PDKV lime & Kagzi lime) were collected from Jalgaon, Maharashtra. Thirty four acid lime accessions including varieties are being conserved in the field gene bank. Air-layers of promising accessions were clonally propagated planted in the field. During the reporting period 20 acid lime accessions including varieties were evaluated for tree growth, yield and fruit quality characteristics.

Among evaluated genotypes, CHESl-5 recorded the maximum plant height (3.85 m) followed by Sai Sarbati (3.65 m) and CHESL-13 (3.55 m) while Ganganagar-1 was found most dwarfing (2.15 m) followed by CHESL-31 (2.35 m). Canopy spread in both the direction was found maximum in CHESL-5 (4.90 & 5.25 m) followed by CHESL-13 (4.85 & 4.97 m) while the minimum canopy spread was observed in Ganganagar-1 (3.30 & 3.60 m). The maximum stem girth was recorded in CHESL-5 (15.20 m) followed by Pramalini (13.78 cm) and CHESL-22 (13.65 cm).

The data recorded on number of fruits and fruit yield/tree revealed that CHESL-27 (1425 & 60.15 kg), CHESL-12 (1340 & 55.65 kg), CHESL-29 (1425 & 48.75 kg), Pramalini (1350 & 45.90 kg) and CHESL-22 (1135 & 45.40 kg) were superior and recorded significantly higher yield as compared to remaining accessions and varieties.

However, Pusa Udit recorded lowest yield (335 & 11.75 kg/plant) followed by CHESL-13 (660 & 23.76 kg). Significantly highest average fruit weight was recorded in CHESL-22 (46.12 g) followed by CHESL-27 (42.57 g) and CHESL-12 (41.80 g) while minimum average fruit weight was observed in Ganganagar-1 (28.55 g) followed by CHESL-17 (34.56 g).

The highest fruit length was observed in CHESL-15 (46.36 mm) followed by CHESL-22 (47.19 mm) while it was found minimum in Pusa Udit (34.04 mm). However, significantly maximum fruit width was recorded in CHESL-15 (44.01 mm) followed by CHESL-22 (43.25 mm) while Pusa Udit (31.54 mm) recorded the minimum fruit width. The maximum peel thickness was noted in CHESL-22 (1.65 mm) followed by Pramalini (1.57 mm) while the minimum peel thickness was recorded in CHESL-7 (1.20 mm). The number of fruit segments varied in between 8 in Ganganagar-1 to 12 in CHESL-32. The maximum number of seeds/fruit was observed in CHESL-17 (14) followed by Ganganagar-1(12.55) while CHESL-22 recorded the minimum number of seeds/fruit (4.70) followed by CHESL-32 (6.70).

The highest juice content was recorded in CHESL-22 (52.90 %) followed by CHESL-29 (52.34 %) while CHESL-17 recorded the least juice content (45.65%). CHESL-7 recorded the maximum TSS (9.42 ^{0}Brix) followed by Pramalini (9.15 ^{0}Brix) while CHESL-29 recorded the minimum TSS (6.95 ^{0}Brix). The highest acidity was observed in CHESL-12 (8.53 %) followed by Vikram (8.33 %) while Ganganagar-1 recorded the minimum acidity (5.78 %). The highest ascorbic acid was recorded with CHESL-12 (57.82 mg/100 ml) followed by CHESL-22 (47.30 mg/100 ml) while Ganganagar-1 recorded the minimum ascorbic acid (26.29 mg/100 ml).

Promising genotypes

CHESL-22: It mostly bears inside the canopy and having spreading growth habit and fruits are almost free from citrus canker. Average yield/plant is 45.40 kg during 6th year of its age, fruit weight above 40 g, fruit size 47.19 x 43.25 mm, fruit axis solid, segment 10 no., peel thickness 1.65 mm and total number of seed/fruit 4-5**.** Fruit juice 52.90%, TSS 8.10^{0}Brix, acidity 7.08%, TSS: acidity 1.14 and ascorbic acid 47.30 mg/100 ml. Keeping quality of fruits is good at ambient storage (8-10 days) with attractive yellow smooth peel.$^+$

CHESL-29: It is having tall growing and spreading canopy with less thorn density with less incidence of citrus canker. Fruits are roundish, medium size with prominent green vescicles. It is cluster bearer with average fruit weight of 40.35 g having fruit size of around 42.08 x 38.90 mm. Average yield/plant is 48.75 kg during 6th year of its age, fruit axis solid, segment 11 no., peel thickness 1.35 mm and total number of seed/fruit 4-6**.** Fruit juice 52.34%, TSS 6.95^{0}Brix, acidity 6.53%, TSS: acidity 1.06 and ascorbic acid 41.28 mg/100 ml. Keeping quality of fruits is good at ambient storage with attractive yellow smooth peel.

Evaluation and characterization of pomegranate germplasm under hot arid climate

Pomegranate is an emerging fruit crop of hot arid and semi-arid regions. Pomegranate germplasm were evaluated for growth, fruit quality and aril attributes under hot arid condition. In plant vegetative characters, data were recorded on plant height, canopy spread, growth habit and behaviour. The fruit quality attributes were recorded during *mrig bahar*. Significant variations were recorded on plant growth attributes. The maximum plant height (258 cm) and canopy spread (249 cm N-S and 246 cm E-W) was recorded in Uthkal, followed by Yercaud with plant height (253 cm) and canopy spread (243 N-S and 240 cm E-W) as compared to minimum plant height (168 cm) and canopy spread (162 N-S and 158 cm E-W) was observed in AHPG-C4. Growth habit varies from dwarf, semi dwarf, semi vigorous, vigorous to very vigorous among different germplasm and germplasm Uthkal and Yarcud were found very vigorous. Growth behaviour was also varied from evergreen, semi deciduous and deciduous among different germplasm.

Fruit quality attributes were recorded on pomegranate germplasm during *mrig bahar* under hot arid condition. The number of fruits per plant, number of cracked fruits per plant, fruit weight and size were varied significantly among the germplasm (Fig.21).

Matured fruits harvest during December-January and analyzed for different bio-chemical quality attributes. Maximum total soluble solids was recorded in Saih Sirin (17.09°Brix) followed

by Jalore Seedless (16.35°Brix), Mridula (16.18°Brix) and G-137 (16.08°Brix) while minimum total soluble solids was recorded in Sirin (11.12°Brix). The minimum juice acidity was recorded in Jalore Seedless (0.40%) followed by G-137 (0.42 %), Ganesh (0.48 %), Mridula (0.50%) and Bhagwa (0.52 %) while maximum juice acidity was observed in Tujetis EC 4347 (3.91 %), followed by Jodhpur Collection (3.85%), Crenedode Elecho (3.64 %) and Dorsata malus (3.55%) . Arils colour was observed whitish, whitish pink, light pink, pink, light red, red, bright red to blood red while seed mellowness varies from soft, medium hard, hard to very hard among different germplasm. During *mrig bahar*, rind and aril colour was observed darker as compared to *ambe* and *hasta bahar* fruiting.

Fig.21. Variability in fruit size, shape, crown and rind colour of different pomegranate germplasm

Under hot arid climate, frost during December-January, high temperature during summer, high diurnal variation (> 18°C) are major abiotic challenges which hamper plant and fruit growth and causes twig drying, defoliation, sun scald and fruit cracking. While among biotic stresses, nematode and bacterial are becoming major challenges along with mite during April to October and fungal spot during rainy season (Fig 22.) Severe frost damage was observed during December 2021 in the pomegranate germplasm.

Fig. 22. Bacterial blight infected fruits and nematode infected roots of pomegranate cv. Bhagwa

Evaluation of promising pomegranate germplasm

CIAH PG-1: Plants are vigorous, evergreen and semi spreading type. It has fruit weight 258 g, fruit length 8.77 cm, fruit diameter 8.23 cm, aril weight 37.50 g/100 arils, aril length 11.49 mm, aril width 8.32 mm and TSS 14.15°Brix. It has 16.30 kg/plant fruit yield. Fruit are light reddish in colour, aril very bold with bright red colour. It found highly suitable for anardana purpose due to high yield, more anardana recovery and high acidity of juice .

CIAH PG-2: Plants are dwarf, evergreen, semi spreading type growth habit and fruits red in colour. It has fruit weight 228.25 g, fruit length 7.38 cm, fruit diameter 7.08 cm, aril weight 28.07 g/100 arils, aril length 9.10 mm and aril width 6.82 mm, TSS 16.20°Brix and juice 45.37% on fruit basis. Fruits are round in shape, dark reddish rind colour and dark pink aril colour. It has fruit yield 12.50 kg/plant. It found highly suitable for table purpose (fig. 23).

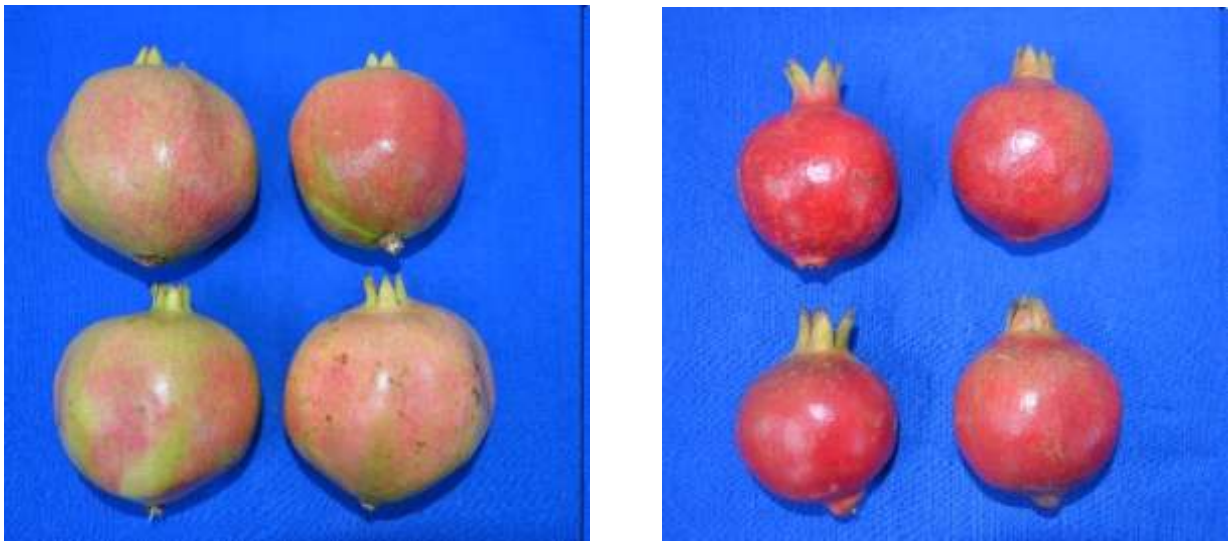


Fig. 23. Promising pomegranate germplasm CIAH PG-1 and CIAH PG-2

Gundi

Exploration and collection of *Cordia gharaf* in Bikaner District of Rajasthan was done on November, 2021. One accession of *Cardia gharaf* was collected from Surjasur area with geographical coordinates of 27°92' N, 73°31' E, and elevation of 235 meters above mean sea level. The morphological traits of mother plant and its fruits were recorded. The selected tree was approximately 25 years old with 7 feet height and 6.5 (E-W) to 7.0 (N-S) tree spread. The canopy of tree was almost round. The bark was brownish grey with deep longitudinal furrows.

Fig. 24. Leaf and fruits of collected accession of *Cordia gharaf*

Ker

An elite ker genotype 'AHCD/ MKJ/ BRC/ KK-10 was collected during September, 2021 from Khajuwala-Pakistan border having heavy fruiting load (>100 kg fruits/bush). Fruits were collected at green pea stage and red ripe stage for observations. At green pea stage, average fruit weight, length and diameter were 0.72 g, 0.81 cm and 0.74 cm, respectively while average fruit weight, length and diameter at red ripe stage were 5.54 g, 1.87 cm and 1.84 cm, respectively. Seeds were extracted and average seeds/ ripe fruit were counted 20.80. Seeds were sown in protrays for multiplication purpose.

Collection, introduction and evaluation of jamun, tamarind, Chironji , Mahua, khirni, karonda, phalsa and manila tamarind

Jamun

Total germplasm maintained in the field gene bank is 70. Twenty promising genotypes of jamun 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 highest in CHESJ-30. Fruit pulp and TSS was also found highest in CHESJ-30. Growth habit was recorded as spreading, upright and semi-spreading and upright, ripening period from third week of May to 4th week of June whereas fruit yield varied from 19.70 to 36.00 kg/plant under rainfed semi-arid conditions.

Qualitative characters in terms fruit weight ranged between 9.00-19.20 g, pulp weight (7.10-16.30 g, pulp percent (79.00-86.12), TSS (12.50-16.60 ^{0}Brix), acidity (0.35-0.42%), total sugar (8.12-12.20 per cent) and vitamin c (39.90-45.74 mg/100g) in different genotypes of jamun.

Fig. 25. Harvested fruit of CHESJ-30

Fig. 26. Fruiting behavior in tamarind

Tamarind

Promising genotypes (24) of tamarind were evaluated for growth, flowering, fruiting and fruit quality attributes. On the basis of fruit yield and quality attributes, CHEST-10 was found promising. It has up right growth habit, thick trunk and drooping branches. It recorded 811.00 kg fruit per plant. Peak period of ripening time was last week of March. It recorded 53.20 per cent pulp and 70.30^{o}Brix TSS during ripening.

Fig. 27. Fruit colour and pulp appearance of

Manila Tamarind

Total 30 germplasm have been established in the field. 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. Maximum panicle length, fruit weight 30.25 g with 73.10 per cent pulp was recorded in CHESM-4, while, highest TSS was recorded in CHESM-12 (24.50^{o} Brix).

Germplasm maintenance

Thirty promising genotypes of chironji, khirni and mahua, 40 genotypes of karonda and 25 genotypes of phalsa were maintained in the field gene bank.

Varietal trials

Varietal trial on Tamarind

Ten tamarind varieties, *i.e.* Pratisthan, T-263, PKM-1, Ajanta, DTS-1, Red Type, Sweet Type, Bantoor, Urigum and Goma Prateek were planted in randomized block design with four replications and observations on growth pattern and fruit quality attributes were recorded. Plant height

of Ajanta was observed maximum *i.e.* 5.98 m while least plant height was recorded in Sweet Type (3.80 m). Plant spread (E-W and N-S) was also found maximum in Ajanta. Maximum fruit yield was noted in Goma Prareek (45.90 kg / plant) Maximum pod length (14.50 cm) and pulp content (52.00 %) was recorded in Goma Prateek, while maximum TSS and total sugar was recorded in Urigum.

Fig. 28 Tamarind cultivars

Varietal trial in Jamun

The experiment has been laid out during July-2013 with 4 varieties (Goma Priyanka, CISHJ-37, CISHJ-42 and Konkan Bardoli) and 5 replications. Maximum plant height was recorded in CISHJ-37 (5.84 m) followed by CISHJ-42 and Goma Priyanka. Stock and scion girth was found to be maximum in CISH-37 closely followed by CISHJ-37. Fruit yield was found to be the maximum in Goma Priyanka followed by CISH 37. Minimum fruit yield per plant was noted in CISH 42. Maximum fruit weight, pulp content was recorded in Goma Priyanka closely followed by CISHJ-37

Fig. 29. Jamun var.Goma Priyanka

Varietal trial in sweet orange

Varietal trial on sweet orange with eight varieties was conducted including Valencia, Blood red, Daisy, Pineapple, Mosambi, Jaffa, Hemlin and Sathgudi. Growth performance is good. Maximum plant growth, and root stock girth was recorded in Sathgudi closely followed by Mosambi. Maximum TSS and juice content was also recorded in Sathgudi.

Wood apple

The existing old wood apple germplasm (16) were evaluated for their morphological, qualitative and yield characters, the fruit colour of genotypes was observed from dull white to greyish. Genotypes, CHESW-1, CHESW-3, CHESW-5, CHESW-6, CHESW-7, CHESW-8, CHESW-9, CHESW-11, CHESW-13 and CHESW-16 expressed round fruit shape while CHESW-2, CHESW-4 (Thar Gaurav) and CHESW-15 had oblong fruit shape. In addition, the genotype CHESW-10 was noted with peculiar flat fruit shape. The fruit pulp colure was noted pale gold to coffee brown. Among them, genotype CHESW-2, CHESW-6 and CHESW-10 were found to be promising on the basis of qualitative and yield traits. The maximum fruit weight was recorded in Thar Gaurav (452.53 g) followed by CHESW-6 (388.10 g) while it was found minimum in CHESW-7 (168.57 g) followed by CHESW-8 (220.0 g). Genotypes CHESW-6 was recorded with maximum fruit pulp percentage (58.42%) followed by CHESW- 10 (53.53%) and CHESW-15 (52.62%). The fruit yield per plant was estimated in all the genotypes, the highest yield per plant was noted in CHESW-6 (162.0 kg), followed by CHESW-4 (129.27 kg) CHESW-10 (123.96 kg) and CHESW-15 (115.43 kg) whereas it was found minimum in CHESW-1 (52.43 kg). The highest total soluble solid (TSS) was recorded in genotype CHESW-6 (19.80 ^{o}Brix) in fruit pulp.

CHESW-6

The genotype CHESW-6 noted with 388.10 g average fruit weight and having 19.80 ^{o}Brix TSS. The fruit start ripening from 2nd fortnight of December and it come under late maturity group. The average fruit yield per plant was recorded 162.00 kg/plant in 14th year plant age under rainfed conditions of hot semi-arid ecosystem.

CHESW-10

The average physio-chemical attributes of genotype CHESW-10 in respect of fruit weight, total number of seed/fruit, pulp per cent and TSS were recorded as (351.25 g), (518.20), (53.53%) and (17.50 °Brix) respectively. This genotype observed with flat-round fruit shape. Fruits ripening starts from 1st week of December and fruit yield per plant was recorded 123.96 kg/plant during 14th year of planting under rainfed conditions of hot semi-arid ecosystem.

The growth and fruiting characters of newly established germplasm block of wood apple were recorded, which were planted in 2015-16. The plant growth character and yield was recorded, plant root stock dia., scion dia., plant height, plant spread, total fruit and fruit weight were recorded 16.39-43.12 cm, 13.62-42.13 cm, 1.52-4.79 m, 0.97-3.96 m EW & 0.92-3.66 m NS, 8.56-65.23 and 220.23-319.53 g, respectively.

CHESW-27

This genotype was collected from Ghughambha, Panchmahal district of Gujarat, the plants have started bearing of fruit just after 4th year of planting and 65.23 fruits were harvested. The fruit morphological characters like fruit weight, fruit colour, pulp colour, TSS and acidity were observed as 319.53, greenish, creamy, 18.30 ^{0}Brix and 5.53%, respectively.

CHESW-22

Genotype, CHESW-22 was collected from Umreth, Kheda district of Gujarat. Bearing of fruit has initiated in 3rd year of planting and fruits bearing habit was observed as erect terminal. On average 38.63 fruits were harvested in 4th year. The fruit attributes such fruit weight, fruit colour, pulp colour, TSS and acidity were noted as 310.63, greyish, creamy, 18.12^{0}Brix and 5.10%, respectively.

CHESW-25

This was collected from Jambughoda, Panchmahals district of Gujarat. It has started fruit bearing in 4th year of planting and showed semi-spreading growth habit with both terminal and leteral fuiting. On average 44.00 fruits were harvested in 4th year. The fruit attributes such fruit weight, fruit colour, pulp colour, TSS and acidity were noted as 315.32, greyish, creamy, 17.62 ^{0}Brix and 6.20, respectively.

Fig. 30. Orchard/ fruit of wood apple (CHESW-6)

Custard apple

The existing forty seven (47) custard apple germplasm were evaluated for their qualitative and quantitative characters and significant variation was found during study such fruit weight (118.12-340.36 g), fruit length (5.42-8.16 cm), fruit diameter (5.02-8.31 cm), pulp weight (48.30-240.30 g), rind weight (40.28-135.20 g), pulp percentage (40.23-64.51%), rind thickness (2.33-4.48 mm), fruit pulp color (creamy white to dull white), fruit core length (1.23-3.45 cm), pulp texture (soft to gritty), total sugars (13.28-18.37%), reducing sugars (12.30-15.30%), ascorbic acid (16.93-38.38 mg), no. of flakes (40.87-90.20), no. of flakes with seed (35.25-80.12), firmness of flesh (firm to medium), TSS (23.27-30.15 °Brix), acidity (0.24-0.54%), pulp aroma (mild-strong), eating quality (good and very good), shelf life (3-5 days) and yield (10.37-26.58 kg/tree). Among the evaluated existing germplasm, CHESCA-4, 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 their morphological and fruit characters. The plant root stock and scion diameter varied from 18.30 to 30.60 cm and 16.14 to 27.35 cm respectively. The plant height recorded from 0.92 to 2.68m whereas it was the maximum in CHESCA-24 (2.68 m) and minimum in CHESCA-37 (0.92 m). The fruit weight ranged from 132.48-280.20 g. The pulp percentage of fruit was noted the maximum in CHESCA-21 (50.22%) whether it varied from 38.26 to 50.22%. The highest seed number was estimated in CHESCA-33 (71.33).

The attempt was made to cross between the elite gemplasm and superior variety. On average 230 crosses were made among the genotype and varieties. The crossed fruits were harvested after horticultural maturity and seeds were storage for sowing in next year.

Fig. 31. Elite genotype of custard apple (CHESCA-4)

Introduction, collection, characterization, conservation and evaluation of vegetable crops (Dolichos bean, Cluster bean and Cowpea) under rainfed semi-arid conditions of Western India

A total of 123 genotypes of dolichos bean (both pole and bush types), 181 genotypes of vegetable cowpea (both pole and bush types) and 62 genotypes of cluster bean were maintained and multiplied at ICAR-CHES (CIAH), Vejalpur, Gujarat. Allocated sixteen IC (Indigenous collection) number from ICAR-NBPGR for dolichos bean (13 genotypes) and bush vegetable cowpea (03 genotypes).

Evaluation of of dolichos bean (*Lablab purpureus var. typicus*)

The experiment was carried out to assess the variability for 120 genotypes of dolichos bean (bush and pole type) which were collected across the country. All the genotypes were evaluated for their morphological, yield and quality attributes under rainfed semi-arid conditions at Central Horticultural Experimental Station (ICAR-CIAH Regional Station, Vejalpur, godhra). The data wre recorded for growth, yield and quality parameters, incidence of pest and diseases. The identified promising genotypes for their different horticultural traits are given below.

CHESDB-50: The pods are very attractive green in colour. The pods are long having an averagepod length of 17.6 cm and an average pod girth of 5.2 cm with pod weight of 15.2 g. The fresh green pods were harvested at 98 to 105 days after sowing. A total of 800-1000 pods per plant were obtained with on an average yied of 8-9 kg/plant of fresh green pods.

Fig. 32. CHESDB- 50 (Long green pods, heavy bearer)

CHESDB07: The pods are medium having an average pod length of 10.6 cm and an average pod girth of 4.6 cm with pod weight of 7.0 g. The fresh green pods harvest was starts at 110 to 115 days after sowing. A total of 800-1500 pods per plant with on an average yield of 8-10 kg/plant of fresh pink pods. It is having field resistance to dolichos bean yellow mosaic virus disease.

CHESDB 31: The pods are attractive light greenish white in colour. The pods are long having an average pod length of 15.0 cm and an average pod girth of 4.2 cm with pod weight of 8.8 g. The fresh pods were harvested at 115 to 120 days after sowing. A total of 700-1200 pods per plant with on an average yield of 7- 9 kg/plant of fresh pods.

Fig. 33. CHESDB-31 (Attractive Whitish green pods)

Fig. 34. CHESDB-31 (Attractive whitish green pods)

CHESDB-01: The pods are very attractive green in colour. The pods are broad long having an average pod length of 13.5 cm and an average pod girth of 5.5 cm with pod weight of 10.0 g. The fresh green pods were harvested at 90 to 95 days after sowing. The total number of pods per plant was 700-880 with on an average yield of 7.0- 8.0 kg/plant of fresh green pods.

CHESDB-10: The pods are very attractive creamy white in colour. The pods are broad, having an average pod length of 16.00 cm and an average pod girth of 6.2 cm with pod weight of 11.5 g. The fresh creamy white broad pods were harvested at 115 to 120 days after sowing. The total number of pods per plant was 750-900 with on an average yield of 7.5-8.2 kg/plant of fresh pods

CHESDB-40: The pods are light pink in colour. The pods are sickle shaped having an average pod length of 15.5 cm and an average 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 pods per plant was 900-1400 with an average yield of 7.0 to 8.5 kg/plant of fresh green pods. It is having field resistance to dolichos bean yellow mosoic virus disease.

Fig. 35. Pod bearing in CHESDB-40

Comparative studies of Dolichos bean

Comparative mean performance for growth and yield parameters of elite lines with existing varieties in dolichos bean was done. The varieties from ICAR-IIHR, Bengaluru, ICAR-IARI, New Delhi and SAU's like DPKV, Akola, Maharastra were augmented and evaluated with elite lines of CHES, Vejalpur (ICAR-CIAH).

Vegetable cowpea (pole type)

Evaluation of elite lines of for earliness, quality and yield

The experiment was carried out to assess the variability for 180 genotypes of vegetable cowpea (bush and pole type) which were collected across the country. All the genotypes were evaluated for their morphological, yield and quality attributes under rainfed semi-arid conditions at Central Horticultural Experimental Station (ICAR-CIAH) Vejalpur, Godhra, Gujarat. The data were recorded for growth, yield and quality parameters, incidence of pest and diseases. Among them, the genotypes (pole types) like CHESVC-01, CHESVC-15, CHESVC-16, CHESVC-22, CHESVC-27, CHESVC-46 and CHESVC-45 and bush types viz., CHESVC-33, CHESVC-24 and CHESVC-20 are superior with respect to fresh number pods and pod yield. The variable quantitative parameters of superior genotypes are as followed below. The promising genotypes for their different horticultural traits are given below.

CHESVC-01: The pods are very attractive parrot green in colour. The pods are long having an average pod length of 66 cm and an average pod girth of 3.4 cm with pod weight of 45.2 g. The fresh tender green pods were harvested at 55-60 days after sowing. The total number of pods per plant varies 80-120 pods/plant with an average yield of 2.5 to 3.0 kg/plant of fresh green pods.

Fig. 36. CHESVC-01 (Parrot green attractive long pods)

CHESVC-2: The pods are attractive red in colour. The pods are long having an average 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: The pods are attractive red in colour and cluster bearing genotype with four pods/cluster. The pods are medium long having an average pod length of 31.0 cm and an average 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.

Fig. 37. CHESVC-22 and CHESVC-45 (Heavy bearer and red colour pods)

Early maturing genotypes of Yardlong bean

CHESVC-15: The pods are dark red in colour. The pods are long having an average pod length of 52-54 cm and an average pod girth of 2.6 cm with pod weight of 20-22 g and days taken for first flowering is 38-40 days. The total pod per plant varies 180-220 pods/plant with an average yield of 3-3.5.0 kg/plant.

CHESVC-16: This is early flowering genotype with attractive light green colour pods, having an average pod length of 50-52 cm and an average pod girth of 3.2 cm with pod weight of 28-30 g and days taken for first flowering is 29-30 days. The total number of pods per plant varies 150-180 with an average yield of 3.5- 4.0 kg/plant of fresh pods.

CHESVC-16 CHESVC-16 & CHESVC-15 CHESVC-15

Fig. 38. Pods bearing pattern of Yardlong bean

Comparative studies of vegetable cowpea (pole type)

Comparative mean performance for growth and yield parameters of elite lines with existing varieties in dolichos bean was done. The varieties from ICAR-IIHR, Bengaluru and KAU-Thrissir, Kerala were augmented and evaluated with lite lines of CHES, Vejalpur (ICAR-CIAH).

Vegetable cowpea (Bush type)

CHESVC-33: This genotype is photo-insensitive with attractive green colour pods, having an average pod length of 26.50 cm and an average pod girth of 2.5 cm with pod weight of 9.65 g and days taken for first flowering is 42-45 days. The total number of pods per plant varies 140-150 with an average yield of 1.5 to 2.0 kg/plant of fresh pods.

Fig. 39 Pods bearing of Cowpea-CHESVC-33

CHESVC-20: This genotype is also photo insensitive with pale green colour pods, having an average pod length of 17.50 cm and an average 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 an average yield of 1.0 kg/plant of fresh pods.

Fig. 40. Pods bearing of Cowpea-CHESVC-20

Comparative studies of vegetable cowpea (Bush type)

Comparative mean performance for growth and yield parameters of elite lines with existing varieties in vegetable cowpea (Bush type) was done. The varieties from ICAR-IIVR, Varanasi, and ICAR-IARI, New Delhi were augmented and evaluated with lite lines of CHES, Vejalpur (ICAR-CIAH).

Evaluation of clusterbean germplasm for growth and yield parameters

The experiment was carried out to assess the variability for 62 genotypes of clusterbean which were collected across the country. All the genotypes were evaluated for their morphological, yield and quality attributes under rainfed semi-arid conditions at Central Horticultural Experimental Station (ICAR-CIAH) Vejalpur, Godhra, Gujarat. The crop was raised in RCBD design with three replications. The data were recorded for growth, yield and quality parameters, incidence of pest and diseases. The promising genotypes for their different horticultural traits are given below. Among them, the genotypes like CHESCB-60, CHESCB-59, CHESCB-25 and CHESCB-24 are superior with respect to fresh number pods and pod yield.

CHESCB-25: It is single stem growth behavior with green colour pods, having an average pod length of 11.00 cm and an average pod girth of 2.5 cm with pod weight of 3.93 g. The total number of pods per plant varies 280-320 with an average yield of 1.2 kg/plant of fresh pods.

CHESCB-24: It is single stem growth behavior with green colour pods, having an average pod length of 11.02 cm and an average pod girth of 2.8 cm with pod weight of 3. 12 g.The total number of pods per plant varies 300-320 with an average yield of 1.0 kg/plant of fresh pods.

Bio chemical analysis

Biochemical analysis like estimation of antioxidant activity (by DPPH scavenging assay method), total phenols and ascorbic acid, nitrogen and crude protein, plant nutrients (Macro, secondary and micro nutrients) were done in vegetable cowpea and dolichos bean.

Table 3. Plant nutrient composition and antioxidants activity in vegetable cowpea pod

Genotype	Plant nutrients (mg/100g)						Antioxidants	
	Ca	Mg	P	Na	K	Fe	Phenols (mg/g)	DPPH (µ. mol trolox.equi./g)
CHESVC-01	420.30	248.6	258.84	22.0	186.0	4.93	0.9165	1.27
CHESVC-15	365.2	156.3	102.95	24.0	184.0	3.96	1.20	3.08
CHESVC-16	463.0	260.32	80.2	19.0	113.0	3.89	0.66	2.32
CHESVC-27	376.80	198.8	115.25	35.0	143.0	4.56	1.38	2.6
CHESVC-62	298.60	138.5	110.36	64.0	109.0	9.32	1.06	2.8
CHESVC-20	440.0	229.36	78.79	36.0	114.0	4.50	0.85	2.88
CHESVC-24	390.0	145.87	99.84	34.0	200.0	3.70	0.88	2.8
CHESVC-33	480.0	252.12	67.88	51.0	97.0	5.20	0.65	3.5
Kashi Kanchan	430.0	243.12	80.35	37.0	94.0	4.65	0.58	1.55
Pusa Komal	310.60	278.48	82.50	34.0	126.0	4.8	99.52	4.7

Table 4. Plant nutrient composition and antioxidants activity in vegetable cowpea seed

Genotype	Plant nutrients (mg/100g)						Antioxidants	
	Ca	Mg	P	Na	K	Fe	Phenols (mg/g)	DPPH (µ. mol trolox.equi./g)
CHESVC-01	253.5	250.2	258.84	31.0	403.0	5.66	2.79	16.20
CHESVC-15	238.5	286.54	212.86	24.0	458.0	5.76	3.17	19.24
CHESVC-16	268.32	262.5	155.96	20.0	361.0	4.40	7.58	21.35
CHESVC-27	350.2	298.50	181.68	31.0	365.0	6.94	3.1	21.21
CHESVC-62	248.2	140.2	148.16	29.0	422.0	4.08	2.89	12.88
CHESVC-20	226.48	243.12	155.18	74.0	382.0	4.60	3.31	20.92
CHESVC-24	200.4	121.5	150.73	18.0	293.00	4.12	4.2	16.33
CHESVC-33	440.8	218.8	143.48	43.0	316.00	4.9	4.22	24.53
Kashi Kanchan	240.48	271.7	171.54	28.0	316.0	4.7	4.32	21.65
Pusa Komal	320.6	218.8	138.48	33.0	431.0	3.28	1.20	14.26

Introduction, collection, characterization, conservation, evaluation and utilization of drumstick, bottle gourd, pumpkin, spine gourd, ivy gourd and tomato

Germplasm maintenance: A total of 50 genotypes of drumstick, 28 genotypes of ivy gourd, 25 genotypes of spine gourd, 7 genotypes of bottle gourd, 3 genotypes of tomato and 4 genotype of pumpkin were maintained and multiplied at the station. The evaluation of promising lines of bottle gourd, drumstick, ivy gourd, spine gourd, pumpkin and tomato for various horticultural traits at ICAR-CHES (CIAH), Vejalpur, Gujarat exhibited wide range of variability with respect to growth, yield and quality attributes under dryland semi-arid condition.

Recommendation/release of varieties

Drumstick var. **Thar Harsha:** It is recommended/ released by State seed Sub-Committee, Gandhinagar Gujarat in 2021. It is an annual type having densely foliaged with dark green broad leaves (54.5 cm long and 35.2 cm width), possessing drought tolerance. The plants grows up to 405.6 cm and spreads 330.2 cm (E-W) and 390.4 cm (N-S). It is a comparatively late flowering and late maturing comes to harvest during March-May. Each plant produces about 314 fruits in a year, and its yield potential of 53-54.7 t/ha. It is superior in fruit size and yield (185.6%) over PKM-1. No fled infestation of leaf eating caterpillars and pods are least affected by fruit fly resulting higher per cent of marketable pods (20 and 30%) as compared to the commercially popular varieties like PKM-1 and PKM-2, respectively. This variety suits for table/export purpose due to uniformly parrot green and very long pod having more flesh content with seeds uniformly spaced. It has high protein (9.3 g), vitamin A (9783 IU) and ascorbic acid content (246 mg) per 100 g of fresh edible pods. It also have recorded highest antioxidants contents and activity *viz*. total phenols, total flavonoids, DPPH, FRAP and CUPRAC in pods as well as leaves as compared check. It also

recorded highest dry matter (85.84%), protein (10.25 mg/100g), nitrogen, potassium, calcium (438.38), sulphur (4397.18), iron (44.6), zinc (3.79), manganese (20.55) and cu (1.15) in (mg/100 g dry leaves powder) as compared to check.

Pumpkin var. Thar Kavi: It is recommended/ released by State seed Sub-Committee, Gandhinagar Gujarat in 2021. It is developed through hybridization followed by selection from the segregating population of cm16 x cm19. It is a medium vine type hence more plant population can be accommodated by closer spacing. It is a sturdy, drought tolerant type due to thicker leaves. This variety required 1-2 less irrigation as compared to the other varieties. It produces comparatively higher number of female flowers than male flowers and set 7-9 fruits/plant. Fruits are of small, flat round, dark green with greenish lines at styler end of the fruits, ready for 80-85 days after sowing (at green stage) having consumer preferential size for marketing. Shows no field incidence of powdery mildew and pumpkin mosaic virus at initial harvesting, and moderately resistant to fruit fly under field condition This variety suits for culinary/export purpose as an icebox type, which possess High TSS (8.5 ^{0}Brix), with orange flesh colour having rich carotene content (2.36 mg/100 g). It also recorded highest protein (10.25 mg/100 g), ascorbic acid (11.34 mg/100 g) and phenols (0.54 mg/100 g) in marketable fruits as compared to check.

Bottle gourd var. Thar Avani: This variety is developed hybridization followed by selection from the segregating population of LS-4 x LS3-2. Plants are highly vigorous with dense foliage, male and female flowers emerge from 7 th and 11th nodes, respectively. Each plant produces about 24-32 female flowers and set harvestable sized fruits between 57-62 days after sowing. The fruits are round in shape, with 22.8 cm in length and weight of each fruit layed between 750-860 g. The fruits are characterized with high flesh thickness, high TSS (8.1-8.7 ?Brix), with attractive creamy white flesh colour. Each plant produces about 12.91 kg with per ha yield potential of 43.0 t under rainfed semi-arid conditions. Fruit attain harvestable stage at 54-63 days after sowing for green/edible/tender fruits and 120-140 days for seed purpose.

Fig. 41. Pumpkin var. Thar Kavi

Fig. 42. Edible fruit and first female flower emergence of Thar Avani

Ivy gourd var. Thar Sadabahar: It is having high yield potential with the maximum fruit weight (29.3g) as compared to other genotypes with identical appearance in form of attractive dark green shining colour with discontinuous strips, round oblong fruit shape without neck under the dryland semi arid conditions. Its fruiting behavior is round the year. The vine grows up to 3.76 m with pentalobed leaves. It requires support for higher yield with better quality fruit production. The vines are vigorous in growth, dense foliage with dark green leaves. It is having high yield potential with the maximum fruit weight (29.30 g) as compared to other genotypes with identical appearance in form of attractive dark green shining colour fruits with discontinuous strips, round oblong fruit shape without neck under the dryland semi arid conditions. It's flowering and fruiting is round the year. Fruit attain harvestable stage at 54-60 days after planting of cuttings for culinary purpose. While, fruits mature in 43-52 days after pruning of the vine. The attractive dark green shining colour fruits with discontinuous strips, round oblong fruit shape without neck under hot semi-arid conditions. The fruits are rich in vitamin-C (49.2 mg/100 g). The yield potential tested from 2016-21 at regional level indicated each plant recorded 32.9 kg by producing 1118-1189 fruits per plant and weighing average 29.3g each fruit with yield potential of 26.86 t/ha. This genotype is superior for yield (67.01%) as compared to the check variety Indira Kundru-35.

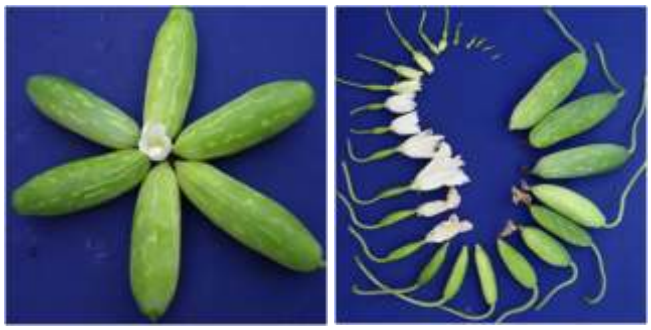


Fig. 43. Edible fruits and different stages of Thar Sadabahar

Advancement and evaluation of promising lines

Carotenoid rich orange fleshed pumpkin-CM 35: The promising line identified from the segregating population of Thar Kavi and advanced for homogeneity. The test weight of 100 seeds recorded 6.046 g over the parent 16.01 g. The seed thickness (mm), seed length (mm) and seed width (mm) ranged from 2.11 to 2.61, 10.27 to 11.35 and 5.40 to 6.08, respectively. It has higher carotenoid content, deep orange flesh colour, and small seeds over the parent. The flesh of the fruit is firm and crispy with average weight ranging from 1.15 to 1.26 kg under rainfed semi-arid conditions. The β-carotene is a precursor of vitamin A, powerful oxidants and help in protection from eye disorders, macular region degeneration, cancer and aid maintenance of healthy skin.

Fig. 44. Variation in seed shape, size, colour & texture of CM35 & Thar Kavi (L to R)

Drumstick-CHESD-40: It is dual purpose (pod and leaf) medium dwarf promising genotype of drumstick having peculiar parrot green colour with liking of consumers rich in micronutrients and antioxidant. CHES D-40 recorded 2.74 m plant height, 245 pods, parrot green colour, 218 g each pod weight, fruit length 45-48 cm and 9-10 seed per pod under dryland semi arid conditions. The fruit length was recorded 33-42 cm at tender stage with 258.9 mg/100 g vitamin C, 0.017% acidity and 9.0°Brix TSS. The 100 g dry leaves contains 173.96 mg phosphorus, 1843.12 mg potassium, 5052.12 mg calcium, 1134.17 mg magnesium, 4544.75 mg sulphur, 94.29 mg iron, 7.20 mg zinc, 32.89 mg manganese and copper 3.74 mg. In the entire samples analyzed, leaves of CHES D-40 have significantly higher total phenolics content than their pod, pulp and skin. While, CHES D-34 is medium dwarf tree, soft skinned purple colour pods at tender stage; medium length pods rich in anthocynin, magnesium and zinc content. Among drumstick germplasm leaves, the highest antioxidant potentiality was observed in CHES D-45 followed by CHES D-34 and CHES D-40, whereas in drumstick germplasm pod, CHES D-34 had higher antioxidant potentiality followed by CHES D-40 and CHES D-45. The maximum protein content was observed in pods of CHES D-40 (18.00 g/100 g) followed by CHES D-34 (17.36 g/100 g).

Fig. 45. Tender pods and Soft skinned purple of CHESD-40

Ivy gourd-CHESIG-3: A promising genotype with round shape fruit having continuous white stripes and high yield potential under dry land semi-arid conditions was identified. The total number of fruits per vine and length of fruit was 1262 and 5.6 cm, respectively. The single fruit weight was recorded 18.5 g with total yield 23.3 kg per plant.

Ivy gourd-CHESIG-4: A unique clone of ivy gourd was identified with deep penta-lobbed leaf character under the hot semi arid conditions. The fruit are medium oblong, lush green with discontinuous stripes. It is having 1320 fruits per vine/year. The average fruit weight, fruit length and fruit yield per plant was recorded 21.4 g, 7.3 cm and 28.3 kg, respectively. It was found tolerant to powdery mildew under field condition.

Ivy gourd-CHESIG-7: It is developed through clonal selection and multiplied by vegetative propagation. It have attractive shining dark green stripeless fruit appearance, trilobe leaf shape, small-medium size and pointed styler end character. The vine grows up to 3.15 m with trifoliate leaves. The total number of fruits par vine were 1489. The average fruit weight and length of fruit was recorded 14.2 g and 4.7 cm, respectively, with total yield 21.1 kg per plant. This genotype was found tolerant to both powdery mildew and fruit fly under field conditions and suitable for growing in summer season.

Ivy gourd-CHESIG-8: A promising genotype with shouldered oblong shape fruit, light green fruit

colour having continuous white stripes and high yield potential (31.01 kg/plant) was identified under dry land semi-arid conditions. The fruits have the lowest TSS (1.4 °Brix) among all the genotypes and it may be recommended for diabetic patients.

Ivy gourd-CHESIG-9: A unique ivy gourd with less seeded, spindle shape clone having natural green colour, pointed styler end and deep shoulder was identified. It is having 1146 fruits per vine/year. The average fruit weight, fruit length and fruit yield per plant was recorded 25.1 g, 25.1 kg and 7.8 cm, respectively.

Ivy gourd-CHESIG-10: A promising genotype having heart shape leaf, small size lush green colour fruit with sparse white stripes, high yield potential, tolerant to draught and suitable for growing in winter season under the hot semi arid conditions. The vine grows up to 3.12 m with cordate leaves. The plant has 1423 total number of fruits in a year. The average weight of single fruit weight was recorded 18.7 g with 26.1 kg total yield per plant. The average length of fruit was recorded 4.2 cm.

CHESIG-9 (Spindle shape fruit)

CHESIG 2, 7 & 9 (leaf and fruits left to right)

CHES IG-3 (Fruit shape change round to oblong)

Fig. 46. Elite germplasm of Ivygourd

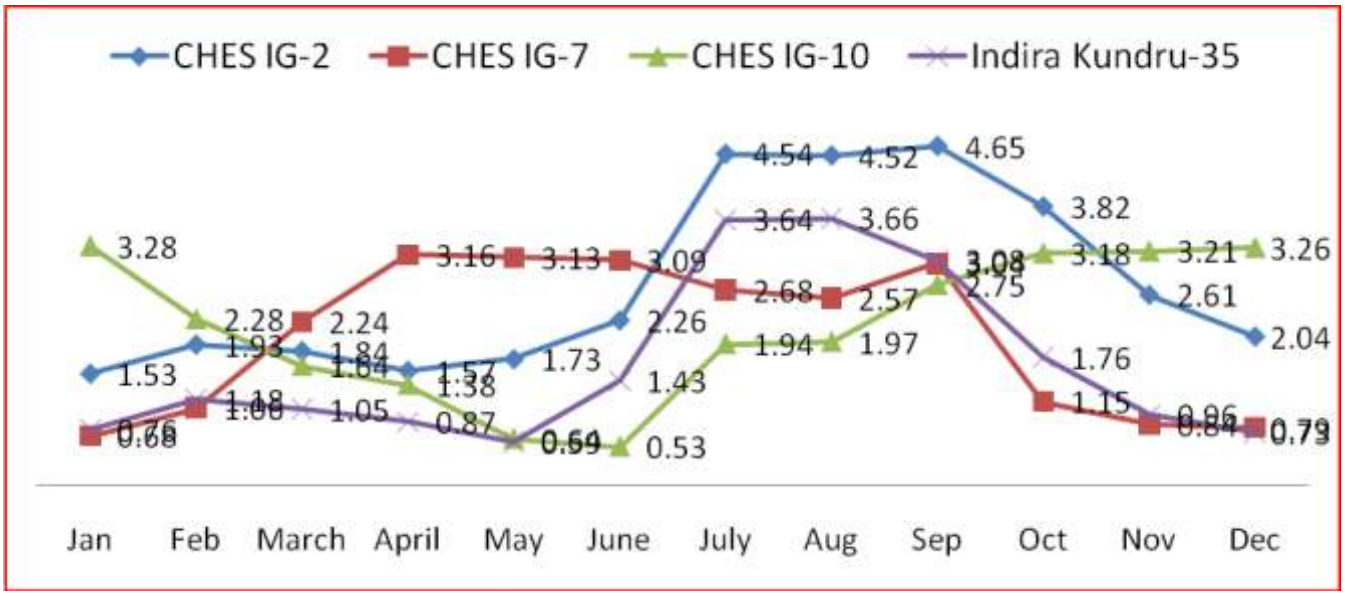


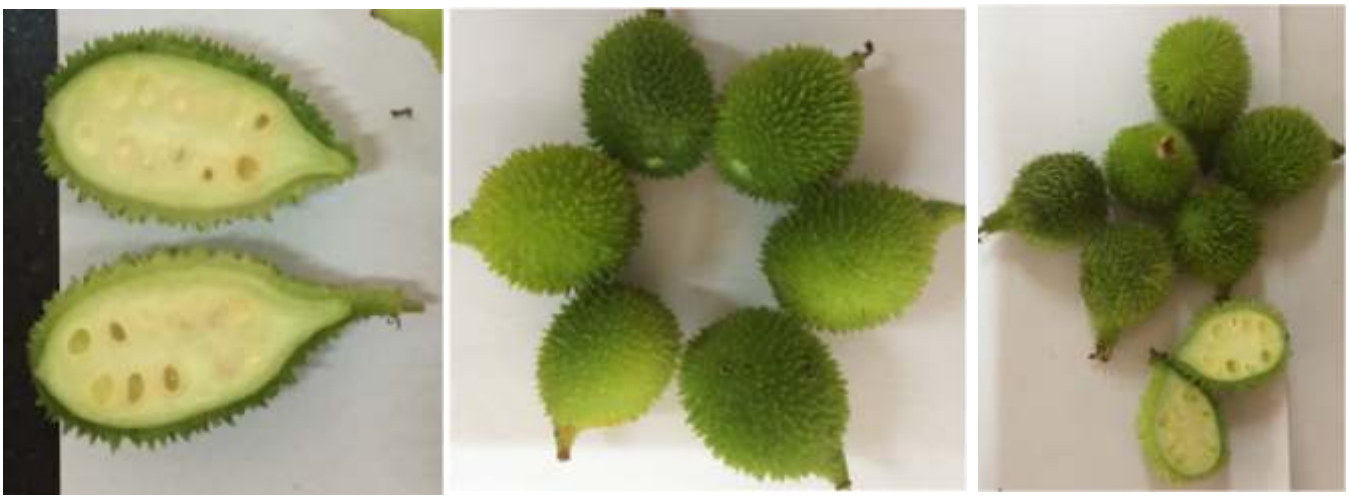
Fig.47. Monthly fruit yield (kg/plant) in promising lines of ivy gourd

Spine gourd- CHESSG-1: A promising genotype with attractive dark green colour, medium round shape fruit, very small and soft spines was identified. The maximum fruit yield (2.81 kg per plant) was observed among all the genotypes with average fruit weight (24 g), and number of fruits par vine (117) fruit yield per plant.

Spine gourd- CHESSG-11: An extra large in size, shape, natural dark green colour, styler end deeply pointed tolerant to draught was identified under the hot semi arid conditions. The fruit yield (2.59 kg per plant) was observed with average fruit weight (30.5 g), and number of fruits par vine (85) fruit yield per plant.

Spine gourd- CIAH/CHES/LPY/CHESSG-15: A promising spine gourd genotype having conical shape fruit, small sized fruit, very small and soft (feathery) spines, and soft seeded character was identified under the hot semi arid conditions. The total number of fruits par vine were 276. The

average fruit weight and length of fruit was recorded 5.5 g and 2.3-2.8 cm, respectively, with total yield 1.52 kg per plant. This genotype was found tolerant to drought, powdery mildew and fruit fly under field conditions.



CHESSG-1 CHESSG-11 CHESSG-11

Fig. 48. Elite germplasm of Spine gourd

Comparative evaluation and purification of yellow tomato

The yellow tomato genotype AM-47 was tested and evaluated for yield, quality and nutritional attributes with control. The genotype is semi determinate type, each fruit weight about 105-110 g, attractive yellow fruits of flat round in shape. Each plant yields from 3.2 to 3.9 kg. The genotype suits for table/processing/export purposes. It has high flesh thickness and high carotene content with medium acidity (0.38%).

Comparative antioxidant potentiality and nutrient content of drumstick variety Thar Harsha under rainfed semi-arid conditions

Thar Harsha has high protein (9.3g), vitamin A (9783 IU) and vitamin C content (246mg) per 100 g of fresh edible pods. The concentration of ascorbic acid ranged from 354.72 to 458.10 mg/100 g in leaves, whereas in pod, it ranged from 227.85 to 248.98 mg/100 g. The highest ascorbic acid content was observed in leaves of Thar Harsha (458.10 mg/100 g). In pod, the maximum ascorbic acid content was observed in Thar Harsha (248.98 mg/100 g) followed by PKM 1 (235.29 mg/100 g) and CHES D-27 (227.85 mg/100 g). The total phenolics content ranged from 523.16 to 657.69 mg GAE/100 g in leaves, whereas it was ranged from 29.63 to 36.23 mg GAE/100 g in pods. Among leaves, the maximum phenolic content was observed in Thar Harsha (657.69 mg GAE/100 g). Similarly, in pods, the highest phenolic contents were observed in Thar Harsha (36.23 GAE mg/ 100 g) followed by PKM 1 (31.18 GAE mg/ 100 g) while, the lowest phenolic contents was observed in local check of drumstick germplasm CHES D-27 (29.63 GAE mg/ 100 g). The total flavonoids content among in leaves was ranged from 348.75 to 406.28 CE mg/100 g, whereas in pods it was varied from 231.77 to 298.46 CE mg/100 g. The maximum flavonoids content was recorded in Thar Harsha leaves (406.28 CE mg/100 g). Similarly, the highest flavonoids contents were observed in pods of Thar Harsha (298.46 CE mg/100 g) followed by PKM 1 (248.24 CE mg/100 g). It also have recorded highest antioxidants activity *viz*. DPPH, FRAP and CUPRAC in pods as well as leaves as compared check. The concentration of N P, K, Ca, Mg, S, Fe, Zn, Mn and Cu was ranged from 3289.4 to 3868.03, 102.59 to 209.63, 759.6 to 1714.12, 1465.2 to 4318.38, 310.53 to 929.45, 1539.16 to 4397.18, 26.52 to 44.62, 0.94 to 3.79, 8.93 to 20.55 and 0.68 to 1.15 mg/100 g, respectively, in pods and leaves. The variety recorded highest dry matter (85.84%), protein (10.25 mg/100 g), potassium, calcium (438.38), sulphur (4397.18), iron (44.6), zinc (3.79), manganese (20.55) and Cu (1.15) in (mg/100 g dry leaves powder) as compared to checks.

Antioxidants and nutritional properties of drumstick (*Moringa oleifera* L.) germplasm from arid and semi-arid region

Thirty four genotypes including one variety of drumstick were evaluated for their antioxidants and nutrient content in leaves and pods. Among the antioxidants, total phenolics and ascorbic acid were quanti?ed. Besides, antioxidant activities in leaves

of the moringa germplasm were also measured using in vitro assays-2,2-diphenyl-1-picrylhydrazyl (DPPH). In addition to this, the elements were also estimated.

Maintenance and use of vegetable genetic resources for crop improvement

(A) Monitoring for maintenance and conservation of arid vegetable germplasm

During 2021, regular monitoring of arid vegetable genetic resources (500 lines) which mainly consisted of desert melons (125), non-dessert melons (161), gourds (60), chillies (45), tomato (14), brinjal (30), cluster bean and beans (35) was done for their safe conservation in gene-bank facilities at ICAR-CIAH, Bikaner. In addition, germplasm of khejri, sehjan, guarpatha, kundru, kakoda, phog and other perennial crop-plants of vegetable significance were maintained in the field repository. Under maintenance, tumba, velvet bean and chilli were taken. A total 45 chilli genotypes supplied as breeding material to the institute crop-curator (as base germplasm for start of new research work) and enhanced seeds is stored for conservation.

(1) Maintenance of velvet bean germplasm: Velvet bean AHVB-1 is unique germplasm and evaluated seed was conserved with varying conditions and studied after 10 years. During rainy-winter season of 2021, it was evaluated for plant growth, pod bearing and quality attributes. Very few seed is enhanced due to crop damage from frost conditions on 17.12.2021 at CIAH farm.

Flowering and pod setting (AHVB-1)

Pod bearing pattern (AHVB-1)

Fig. 49. Elite germplasm of velvet bean

(2) Evaluation of cluster bean germplasm: During the rainy season of 2021, seventeen cluster bean genotypes were assessed for vegetable-use pod quality and yield potential over the years. The germplasm were characterized for agro-morphological and pod quality component both under rainfed and limited irrigation situations (during dry-spell of rains) at CIAH, Bikaner. Potential material is isolated and further advanced for season-wise testing. Consequently, a trait-specific line of fresh and dehydrated vegetable preference pod quality is identified as AHG-23. The line exhibited superiority for plant growth performance, tender pods and marketable harvest under hot arid environment.

Cluster bean AHG-23: It is trait-specific selection from the native germplasm and medium sized sickle shaped pods are of fresh & dehydrated vegetable-

use quality, and genotype is suitable for rainfed cultivation under resource constraints hot arid environment. Medium growth plants having single stem produces vegetable quality pods for prolong period under abiotic stressed conditions. It is early to first pod harvesting (56-60 DAS) and bears 10.2-16.5 clusters/plant and 80-130 pods/plant. Marketable pod yield potential is 114.5-170.8 g/plant. Tender pods at marketable stages are light green in colour and 7.67 cm length, 0.70 cm width and 1.34 g weight.

Fig. 50. Pod bearing pattern in cluster bean line AHG-23

Fig. 51. Marketable stages of vegetable use pods of cluster bean line AHG-23

(B) Utilization of genetic resource for crop improvement

Round melon *(Praecitrullus fistulosus)*

Breeding for high temperature tolerant and fruit quality: During the summer and rainy season of 2021, twenty seven round melon genotypes which consisted of institute breeding lines, AICRP (VC) varieties and checks were evaluated for vine growth, flowering, fruit-set and yield component characters. Observations were recorded on 25 minimal characters and range values for the important traits such as days to germination (7-10 days after sowing), days to opening of first male flower (29.04 - 32.26 DAS), days to opening of first female flower (31.80 - 34.75 DAS), leaf length (6.49 - 9.38 cm), leaf width (6.72 - 10.05 cm), petiole length (5.04 - 7.92 cm), tender fruit length (3.53 - 5.10 cm), fruit diameter (3.92 - 6.28 cm), fruit weight (30.17 - 95.53 g), number of fruits/plant (5.53 - 13.36) and marketable yield (40.14 - 76.54 q/ha) is found to be appreciable for comparative analysis of material.

Two advanced breeding material of round melon (AHRM-1/2017/17-a/whitish-green-Bikaneri type series) were also studied and both the lines exhibited variations with seasons in their plant growth and fruiting attributes. However, in rainy season, good plant growth, fruit-set and yield was recorded. It took 45 DAS for first marketable harvest. Based on fruit quality attributes, individuals selected for advancement of the material. A small fruited type progeny is advanced which is unique for dehydration quality.

Fig. 52. Variability in fruit shape & colour in roundmelon

Khejri (*Prosopis cineraria*)

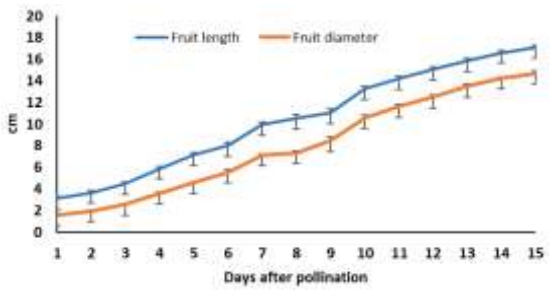
(a) Maintenance and evaluation of khejri genotypes: Fourteen elite genotypes identified by CIAH from 2000-2005 and collected clonally for *ex situ* conservation in *khejri* germplasm plot were maintained with good management practices. Khejri variety Thar Shobha and Selection-2 studied in reference to growth, pod yield and bio-mass production over the years under rainfed conditions. Khejri Selection-2 was also studied for picking intervals and sangri yield in response to training-pruning. About 10 years old seedling plant which designated as Khejri Selection-3 and bearing very long pods is under seasonal growth parameters study.

(b) Maintenance of khejri based crop production site: A two ha production site area maintained, and annual plant growth and total bio-mass harvest component was studied in native crop-plant species of horticultural significance. Phog was studied in response to training-pruning and management practices for monsoon support natural bio-mass harvest including vegetable-use phogla. The 10 years data of phog with reference to propagation, growth, training-pruning, lopping and bio-mass harvest is compiled. During 2021, phog was studied for leaf-foliage and seed harvest. Its modified leaf is known as phylloclades. It bears flowers and fruits on phylloclades. It bears single seeded fruits. Seed is small, and 0.194 to 0.286 mm (average 0.223 mm) length and 0.078 to 0.116 mm (average 0.099 mm) width. Individual seed weight ranged from 0.006 to 0.015 g and 100 seed weight is 1.26 g (range 0.63 to 1.58 g). Requisite quantity of CIAH-PHOG-1 seed produced for conservation of germplasm and also deposited to NBPGR for obtaining IC number.

Fruit setting and growth and development study in bottle gourd

Bottle gourd (*Lagenaria siceraria)* is one of the most important cucurbit and widely used in vegetable and sweet preparations. During rainy season of 2020 and 2021, fruit setting and growth development study was carried out with variety Thar Samridhi. The crop was sown with the on-set on monsoon rains during July months. Opened female flowers were tagged periodically when the peak of fruit setting was observed during the second week of October. Fruit growth and maturity observations such as length, diameter, weight, firmness, texture and colour were recorded after pollination at one day interval in the tagged fruit-set. Five fruits of each stage were harvested for taking observations. Results revealed that fruit length increased continuously up to 13 days of pollination after that it was slowed down. A sudden increase in growth of fruit length was observed between 6 - 7 days and second sudden increase was in between 9 - 10 days after pollination. Fruit diameter followed almost same growth pattern. Similarly, fruit weight was also increased with slow rate during initial 6 days after pollination and faster increase in weight was recorded during 7 to 13 days of pollination. Fruit firmness was also changed during the growth and development. During first 3 days of pollination, firmness was recorded less than 5 kg/cm^2 which indicate hyper tenderness due to presence of less fibre and high moisture content in the initial growth of fruits. After 3 days, firmness was continuously enhanced up to 15 days. A rapid increase was observed from 4th day after pollination. With respect to fruit surface texture, tiny hairs were observed during first 5 days of pollination after that they were disappeared. After 15 days fruit surface become comparatively hard due to tissue hardening and thickening of fruit peel.

On the basis of morphological and visual observations, maturity indices standardized for the fresh vegetable purpose harvesting (grade 'A') and fruits should be harvested after 9-11 days of fruit setting, and this stages firmness range 9-10.5 kg/cm^2 and fruit weight ranging 400-800 g and smooth surface.



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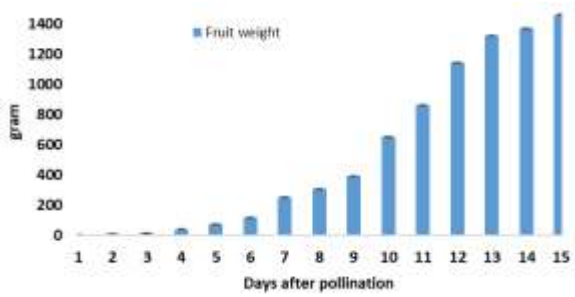

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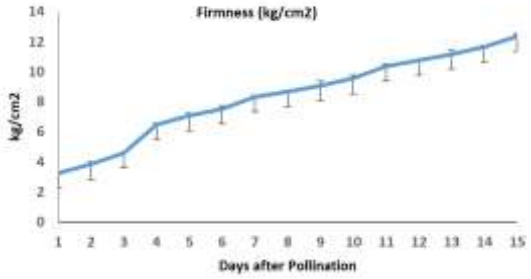


c

d

Fig. 53 (A&B): Dynamic changes in fruit length, diameter and weight from fruit set to 15 days; (C) Changes in fruit firmness from fruit set to 15 days; (D) : Fruit developmental stages of bottle gourd at one day interval. (Each value is the mean ±SE of 5 fruits)

Khejri based natural farming studies: Boundary side and naturally maintained kheemp shrubs were studied for growth, flowering and tender pod (khipoli) harvesting. With good management practices, the shrubs exhibited prolonged period of flowering and tender pod harvesting. The seedlings of native crop-plant species such as ker, jharber, rohida, lasora, kumat and khejri were observed as inter-crop / boundary side plantations, and studied with HBCPSMA concept to promote desert horticulture under rainfed and natural production situations. A phog plot is established with innovative techniques standardized at CIAH for natural production system.

Varietal maintenance and seed production in vegetable crops (R/F)

During 2021, seed production of snap melon (AHS-82, 11 kg), kachri (AHK-119, 32.5 kg), sponge gourd (Thar Tapish, 27 kg), cluster bean (Thar Bhadavi, 112 kg), palak (Thar Hariparna, 16 kg), Indian bean (Thar Kartiki and Thar Maghi, 0.125 kg), brinjal (Thar Rachit, 2.3 kg) and other arid vegetable crop varieties was done under revolving funds of ICAR seed programme. About 205 kg seed of varieties / genotypes of arid vegetables was produced for distribution to farmers, NGO's, KVK's and national, state and private agencies for spread of the crop-varieties and further seed-chain from CIAH.

Field-view of khejri and phog under natural production system

Mature seeds of phog a multiple use shrub of desert ecology

Fig. 54. Field view of khejri and phog and mature seed of phog.

Sponge gourd: During rainy season of 2021, sponge gourd var. Thar Tapish was taken for varietal maintenance breeding and 27.0 kg seed was produced and made available to farmers for promotion of variety. The variety Thar Tapish was also studied for standardization of seed standards for quality seed production.

Indian bean: During rainy season of 2021, Indian bean var. Thar Maghi and Thar Kartiki were taken for varietal maintenance breeding and seed production.

Guarpatha: During 2021, native germplasm namely AHAB-S-1 (sweet), AHAB-B-1 (bitter) and AHAB-B-2 (bitter) were submitted for IC numbers, and total five accessions were evaluated and maintained in the field.

Sehjan: During 2021, seed propagated progeny of sehjan genotype AHMO14s was studied for growth,

flowering, pod setting and pod yield potential. The progeny was tested with varying production situations and adopting training-pruning and management practices as mechanism of protecting plantations from low temperature and frost conditions during winter in arid region. The seed enhancement of sehjan (AHMO-1) was done to deposit to NBPGR for obtaining IC number.

Evaluation and characterization of watermelon

AHW/BR-22: Fruits are ice box type and found promising with respect to days to 50% pistillate flowers (35-40 DAS), days to first fruit harvesting (75-80 DAS) and TSS (11.5-12%). Ovary is hairy and 2.5-3.0 cm long. The fruit weight, fruit length and fruit diameter varied from 2.0-2.5 kg, 25-28 cm and 14-18 cm, respectively with red flesh and small seeds. The fruit rind colour was attractive and dark green devoid of stripes.

AHW/BR-43: Collected from Diggi, Tonk (Rajasthan) in 2019 and purified the segregating material through selfing exercising single plant selection. It is characterized by 25-30 cm long fruits having light green rind with very narrow stripes, dark red flesh, bold seeds, hairy and 3.0-3.5 cm long ovary. The fruit weight, fruit diameter and rid thickness varied from 2.5-3.0 kg, 11.5-14.0 cm and 1.3-1.8 cm, respectively. Fruits were sweet and TSS ranged from 12-13%.

AHW/BR-22

AHW/BR-43

Fig55. Promising germplasm of watermelon

Evaluation and characterization of muskmelon

AHMM/BR-35: It is an advance line characterized by round fruit shape, netted rind, devoid of sutures, salmon orange flesh and small seed cavity (4-5 cm width). The fruit weight, TSS and flesh thickness ranged from 500-700 g, 11-12% and 2.4-3.0 cm, respectively. Fruits ready to harvest in 85-90 days after sowing.

AHMM/BR-47: A promising muskmelon genotype characterized by having salmon orange flesh colour, netted rind with clear sutures. It is early and fruits ready for harvesting in 75-80 DAS which produced 4-5 fruits per plant weighing 750-980 g with 11.0-12.4 % TSS. Flesh thickness varied from 2.3-3.4 cm.

AHMM/BR-35

AHMM/BR-47

Fig 56. Promising germplasm of watermelon

Evaluation and characterization of *Momordica balsamina* L. (*Jhaar karela*)

Momordica balsamina L. is a local type of bitter gourd belongs to family Cucurbitaceous and commonly known as *Jhaar karela*. During rainy season of 2021 evaluated seven germplasm for fruiting and yield traits which were collected from different places of Rajasthan.

Among the evaluated genotypes, CIAHMB-1 performed best under hot arid conditions. CIAHMB-1 produced first female flower on lower nodes (8.2) and registered maximum fruit length (3.49 cm), fruit diameter (2.63 cm), number of marketable fruits per plant (212.4) and fruit yield per plant (1.05 kg). Fruits are spindle shaped and attractive green green in coour at tender stage.

Seed | Flowering pattern | Tender fruits ready for sale | Mature fruits

Fig.57. Seed, flowers and fruits of jhar karela

Fig. 58. Profuse flowering and fruiting in *M. balsamina* on trellis system

The non-targeted phytochemical profiling of marketable sized fruits of *M. balsamina* was also carried out. The methanolic extract of marketable size fruits of *M. balsamina* was subjected to Gas Chromatography Mass spectroscopy (GC-MS/MS) analysis and detected >100 compounds. The detected phytochemicals were identified based on retention time and matching their mass spectra to spectra in NIST 14 library. The results revealed presence of fatty acids, phenolics, terpenoides, flavanoids, alkaloids, tannins, esters and amino acid derivatives, which comprises of 100 compounds. In the detected compounds major part was fatty acid (about 60%), which comprises of MUFA's and PUFA's along with some unusual fatty acid with odd number carbon compounds. Most of the detected compounds have been proved to have important bio-activities like anti-microbial, anti-inflammatory, anti-cancer, analgesic, anti-pyretic, anti-diabetic, hepatoprotective, cardiovascular, antioxidant, anti-mutagenic, *etc*. Some important phytochemicals like 3',5'-Dimethoxyaceto-phenone, Ar-tumerone, Ascorbic acid, Heptadecanoic acid, Cyclopropanedecanoic acid 2-hexyl, Cyclononasiloxane, octadecamethyl-, 4,7,10-Hexadecatrienoic acid, 8,11,14-Eicosatrienoic acid, (Z,Z,Z)-, 2-(Dimethylamino) ethyl adamantanecarboxylate, Dotriacontane, 2,6,10,14,18,22-Tetracosahexaene, 6,9,12,15-Docosatetraenoic acid, Bisabolen-12-OL, *etc*. were detected in *M. balsamina* fruits which proved the pharmaceutical applications against major diseases like cancer, diabetics, cardiovascular and some other chronic diseases.

Performance studies on predominant gynoecious ridge gourd

During rainy season of 2021, an advance breeding line of ridge gourd AHRG-15-4-1 was further studied and advanced. The predominantly

gynoecious sex form which had female flowers first at lower nodes was advanced by crossing with male flowers of the same plants which appeared later at higher nodes. The absolute gynoecious sex forms which only had female flowers in clusters were maintained by crossing with male flowers of monoecious line. Induction of male flowers through application of plant growth regulators was also investigated and its standardization is under process. The line exhibited earliness for days to first harvest of tender fruits and potentiality for marketable fruit quality yield under hot arid environment.

Enhancements of genetic potency of tomato and chilli under heat stressed environment

Collection and evaluation of chilli germplasm

Chilli (*Capsicum annum* L.) is one of the most prioritized crop for hot arid climate of N-W parts of India. For evaluation of chilli genotypes, the available chilli germplasm (45) maintained under -20°C at the institute was taken for the storage and germination studies. In addition, two new collection and three varieties were also assembled for the evaluation programme. The genotypes took 7 to 16 days for germination and out of them, 35 genotypes were germinated. A good amount of variation was observed for plant height (29.5 86.67 cm), plant canopy width (24.17 70.67 cm), Number of primary and secondary branches (2 4.5 and 4 11.8 respectively), number of fruits per plant (12.5 76.5), fruit length (4.4 13.05 cm), fruit diameter (0.69 1.43 cm) and average fruit weight (1.14 8.19 g). Selections were also made for yield and marketable quality traits under abiotic stressed conditions.

Fig. 59. Variability in fruit size, shape and colour among chilli genotypes

AICRP (Vegetable Crops) trials

AVT-II varietal trial longmelon

Five entries of longmelon were evaluated during summer season of 2021. The entry 2018/LGMVAR-2 produced maximum number of fruits per plant (18.15), fruit length (30.09 cm) and marketable yield (172.30 q/ ha). Segregation has been observed in 2018/LGMVAR-5 and 2018/LGMVAR-6.

AVT-I varietal trial-ridge gourd

Evaluated a total of seven entries of ridge gourd during summer 2021 and found that entry 2019/RIGVAR-6 produced maximum fruit weight (130.57 g), number of fruits/ plant (17.77) and marketable fruit yield (136.33 q/ ha).

AVT-II hybrid trial-ridge gourd

Conducted AVT-II hybrid trial of ridge gourd during summer season of 2021 comprising seven entries. Maximum fruit weight (139.77 g), number of fruits/ plant (23.00) and marketable yield (169.33 q/ ha) was recorded in 2018/RIGHYB-3.

AVT-I hybrid trial-ridge gourd

During summer season of 2021 evaluated a total of eight entries (hybrids) of ridge gourd and recorded maximum fruit weight (141.95 g), number of fruits/ plant (23.47) and marketable yield (166.67 q/ ha) in 2019/RIGHYB-6.

IET varietal trial-watermelon

Conducted IET varietal trial of watermelon comprising five entries during summer season of 2021 and recorded the maximum TSS (11.35%) and marketable fruit yield (241.15 q/ ha) in 2020/WMVAR-3. Observed the segregation in 2020/WMVAR-1 with respect to flesh colour and rind colour.

AVT-II varietal trial-watermelon

Conducted AVT-II varietal trial of watermelon comprising five entries during summer season of 2021 and found that entry 2019/WMVAR-5 produced the maximum TSS (12.15%) and

marketable yield (245.35 q/ ha).

Sponge gourd (AVT-II) varietal

Seven entries of sponge gourd were evaluated during summer season of 2021. Among the evaluated entries, the entry no. 2018/SPGVAR-1 performed the best with respect to marketable fruit yield (142.72 q/ha) followed by the entry no. 2018/SPGVAR-3 (118.29 q/ha).

Fig. 60. AICRP (VC) AVT-II trial on sponge gourd

Sponge gourd (AVT-II) hybrid

Seven entries of sponge gourd hybrids were evaluated during summer season of 2021. Among the evaluated entries, 2018/SPGHYB-2 performed the best with respect to marketable fruit yield (120.82 q/ha) followed by the entry no. 2018/SPGHYB-3 (114.26 q/ha).

Round melon (IET) varietal

Five entries of round melon were evaluated during summer season of 2021. Among the evaluated entries, the entry no. 2020/RMVAR-3 was found the best entry with respect to marketable fruit yield (74.09 q/ha) followed by the entry no. 2020/RMVAR-5 (63.21 q/ha) .

Brinjal (IET) varietal

Thirteen entries of brinjal were evaluated during rainy season of 2021. Among the evaluated entries, the entry no. 2021/BRRVAR-5 was found the highest yielder (640.2 q/ha) followed by the entry no. 2021/BRRVAR-1 which recorded the fruit yield of 502.8 q/ha.

Cowpea (IET) varietal

Seven entries of cowpea were evaluated during rainy season of 2021. Among the evaluated entries, the entry no. 2021/COPBVAR-5 was found the highest yielder (172.5 q/ha) followed by the entry no. 2021/COPBVAR-7 which recorded the pod yield of 170.2 q/ha.

Fig. 61 AICRP (VC) IET trial on brinjal

Fig. 62. AICRP (VC) IET trial on cowpea

CROP MANAGEMENT & AGRO-TECHNIQUES

Production system management in *ber* (*Zizyphus mauritiana* Lamk.) under hot arid ecosystem

(i) Ber varieties under training systems

Four training systems (Y shape, espalier, telephone, and modified centre leader) were imposed on four ber varieties (Gola, Thai, Goma Kirti & Thar Sevika) in lieu of the performance study on growth and production aspects.

Among the varieties, canopy volume maximum in Gola (4.51 m3), fruiting density in Goma Kirti (787.8 fruits per m3), and yield (20.46 kg/plant & 11.35 t/ha) in Thai. Corresponding all parameters were minimum in variety Thar Sevika.

In the tune of training systems, canopy volume (3.4 m^3) and yield (21.21 kg/ha & 11.77 t/ha) both under Y-shape and fruiting density (681.9 fruits per m^3) in espalier system of training.

Table 5. Effect of ber varieties and training systems on fruit yield

Variety	Fruit yield (kg) per plant					Yield (t/ha)				
	Y Shape	Espalier	Telephone	Control	Mean	Y Shape	Espalier	Telephone	Control	Mean
Gola	22.75	19.40	16.90	15.50	18.64	12.63	10.77	9.38	8.60	10.34
Thai	23.37	22.50	18.75	17.20	20.46	12.97	12.49	10.41	9.55	11.35
GomaKirti	19.31	18.50	18.00	17.75	18.39	10.72	10.27	9.99	9.85	10.21
T. Sevika	19.40	20.15	16.50	14.20	17.56	10.77	11.18	9.16	7.88	9.75
Mean	21.21	20.14	17.54	16.16		11.77	11.18	9.73	8.97	
	SEm±		CD (P=0.05)			SEm±		CD (P=0.05)		
V	0.41		1.20			0.23		0.67		
T	0.41		1.20			0.23		0.67		
VxT	0.88		NS			0.49		NS		

Gola on espalier system

Thai on Y shape system

Goma Kirti on espalier system

Thar Savika on Y shape

(ii) Spacing trial in Thai ber

Thai ber planted in different spacing (6 x 6, 6 x3 & 3 x3 m) significantly influenced the growth, fruiting, yield and interaction with frost and bird damage. Maximum canopy spread was recorded in wider spacing (6x6 m) and least in closer spacing (3x3 m). As far as fruit retention and yield per plot is concerned, spacing 6 x3m recorded maximum fruit retention and yield with moderate damaged by bird and frost injury.

(iii) Nutritional trial in Thai ber:

Nutritional trial in thai ber imposed on uniformly selected ten plants of each treatment at 6x6 metre spacing during July. The plant received different nutritional doses and observed variations in trunk cross sectional area and yield. Maximum both values in plant that received 75 % RDF (300 g urea, 375 g DAP & 300 g MOP) with 25 kg FYM followed by T_2 and least in T_4 (100% organic). Frost injury observed on the fruit, leaf, branches and limbs at varying level and registered maximum damaged in T_2 treatment and least in T_4 and T_5 treatment.

Table 6. Vegetative characteristics of selected plants for nutritional experiment

Treatments	TCSA (cm^2)	Canopy volume (m^3)	Leaf chlorophyll ($g^{-1}fw$)	Yield $plant^{-1}$ (kg)	Frost damage level
T_1-100 % RDF (400 g Urea, 500 g DAP & 400 g MOP)	67.75	4.51	0.20	12.10	Up to tertiary branches
T_2-50 % RDF (200 g Urea, 250 g DAP & 200 g MOP) with 50 kg FYM	69.95	4.53	0.18	12.22	Up to secondary branches maximum damaged occurred
T_3-75 % RDF (300 g Urea, 375 g DAP & 300 g MOP) with 25 kg FYM	73.03	4.60	0.19	14.21	
T_4-100 % organic as 125 kg FYM	51.82	4.02	0.17	10.45	Top canopy only
T_5 T_5-80% RDF through water soluble fertilizers (eight split each with 150 g)	59.69	4.10	0.19	11.15	Tips & terminal growth
SEm±	3.62	0.25	0.04	1.02	--
CD (P=0.05)	10.86	NS	NS	3.06	-

Micronutrients and PGRs influence on fruit set of ber cv. Gola

To find out the response of micronutrients and plant growth regulators on fruit set, a preliminary trial was conducted in the ber cv. Gola. Foliar spray of micronutrient (B - 0.1% & Zn - 0.5%) and graded doses (10, 20 & 30 ppm) of plant growth regulators (GA_3, NAA, kinetin & benzyladenine) were applied at BBCH stage 54 (green bud) and 67 (flower fading *i.e.* most petal fall). The lowest concentration (10 ppm) of GA_3, NAA, and kinetin was found more effective than higher. On the other side, a higher concentration of BA was found more effective (fig. 63). Among the different treatments, the maximum fruit set was recorded with the application of 0.1 per cent boron (B) at BBCH stage 67 (11.42%) followed by application of 10 ppm GA_3 at BBCH stage 67 (10.94%). Further, application of 30 ppm BA (10.07%), 10 ppm kinetin (9.21%), 20 ppm BA (9%) at BBCH stage 67 and 0.1 per cent B (9.17%), 30 ppm BA (8.97%) at BBCH stage 54 also results in considerably higher fruit set compared to control (3.76%).

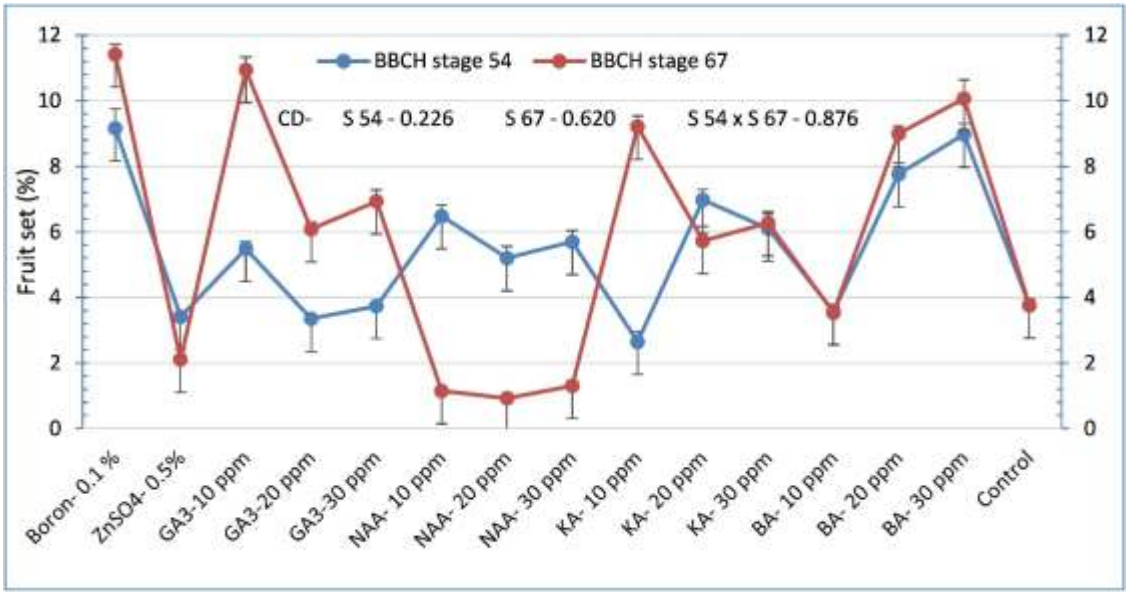


Fig.63. Effect of micronutrients and PGRs on fruit set in ber cv. Gola (bars represent ±S.E)

Standardization of production technology of bael under rainfed semi-arid conditions of western India

Efficacy of plant growth regulator and chemicals on fruit drops and sun scald

Among the various treatments combination (gass mulch + NAA 15 ppm + coarse cotton cloth, grass mulch + NAA 15 ppm + Kaolin 1% , grass mulch + NAA 15 ppm + Ascorbic Acid 1000 ppm, grass mulch + NAA 15 ppm + KH_2PO_4 500ppm, Grass mulch + Zn SO_4 1000 ppm + coarse cotton cloth, grass mulch + Zn SO_4 1000 ppm + kaolin 1%, grass mulch + Zn SO_4 1000 ppm + KH_2PO_4 500 ppm, grass mulch + Zn SO_4 1000 ppm + ascorbic acid 1000 ppm and control) to control fruit drop and sunscald, the minimum fruit drop (93.87%) and sun scald (19.00%) and the highest fruit retention (6.15%) were recorded with grass mulch + NAA (15ppm) + course cotton cloth followed by grass mulch + NAA (15ppm) + ascorbic acid (96.10, 25.30 and 4.00%) and grass mulch + Zn SO_4 (1000 ppm) + Coarse cotton cloths (97.50, 27.00 and 3.38), whereas fruit drop and sunscald affected fruits were recorded maximum in control (98.61% and 48.21%) while fruit retention was also recorded minimum (1.98%) in control. Qualitative attributes in terms of TSS, total sugar and vitamin C were recorded in Grass mulch + NAA 15 ppm + coarse cotton cloth and these parameters was recorded the least in control.

Efficacy of canopy management on growth, yield and quality of bael var.Goma Yashi

Various pruning treatments were imposed during 2021, observations related to growth, flowering and fruiting were recorded. The maximum number of shoots (3.65) was recorded with treatment 3m plant height + 25 per cent AGE). However the length of shoot (44.67cm) was recorded the maximum in 3m plant height + 50 per cent AGE. Average yield per plant was recorded highest with 3m plant height + 25% AGE (78.50kg) followed by 2.5m plant height +25% AGE (72.55 kg), whereas the lowest yield per plant was observed with 2.5m height +75 % AGE (57.00 kg) among the different combination of plant height and pruning intensity. Fruit weight (1.37 kg) and fruit size and TSS (38.00 ^{0}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).

Response of date palm cultivar to pollen sources, pollen quality, quantity and suitability under hot arid ecosystem.

Date palm (*Phoenix dactylifera* L.) 2n=36, is dioecious in nature which, produced male and female flowers in separate plants. This study used four male (Ghanami, M1, M3 and AI-Ain City) date palm trees as a tester and four female (Halawy, Khalas, Barhee and Medjool) as lines that are healthy and nearly uniform in vigour and commonly adopted cultural practices in the orchard. Male plants (Ghanami, M1 and M3) were available in the field repository of ICAR-CIAH whereas pollen grains of Al-Ain City were collected from mechanized agriculture state government farm Khara, Bikaner. The male palm was selected on the basis of higher pollen production, early spath cracking and compatibility with each female line. Female varieties were selected that are suitable under hot arid ecosystem, early and late ripening types and can be utilized for fresh fruit consumption as well as preparation of soft and dry dates.

The mature male spathes were cut off from the tree at spathe cracking stage and pollen grains were collected on the clean plastic silpaulin sheet after air dried properly. Harvested dried pollen grains were collected in air tight plastic container for making the crosses with each one selected female lines. The hand pollination method was adopted for pollination with the help of cotton plug followed by placing the three cotton plug on top, mid and lower portion within the strands of the female spathe. Each spathe was pollinated with an equal amount of pollen grains (approximately 1.0 g each). The male pollinizers namely CIAH/DP/M-1 and Ghanami males showed a highly metaxinic effect and gave the highest fruit set as compared to other male parents. The CIAH/DP/M1 pollens recorded the highest significant fruit set percentages followed by Ghanami. Al-Ain-City pollens resulted minimum fruit set in same varieties.

Studies of compatibility and adaptability of Kinnow, sweet orange, lime and lemon scions on different rootstock

In arid region, citrus cultivation is found highly suitable under irrigated condition with the problems of salinity, drought, scarcity of irrigation water and poor nutrients medium of soil. Citrus is covering highest area and production among the fruit production in Rajasthan state but productivity is still low due to lack of suitable varieties and

rootstocks. With this view, various combinations (forty two) of scions and rootstocks were made and planted in the field as Kinnow, Sweet orange cv. Mosambi and Sathgudi were grafted on Pectinifera, Karna Khatta, Rangpur lime, Volkamericana, Rough lemon, Cleopatra, Macrophylla, Sour orange and Carrizo rootstocks; lime (Sai Sarbati and Kagzi lime) and lemon cv. Pant lemon on Karna khatta, Rangpur lime, Volkamericana, Rough lemon and Macrophylla rootstocks. All the combinations were transplanted in the field and growing well. The compatibility and adaptability parameters are recorded in second year under field condition.

Studies of compatibility and adaptability of sweet orange cv. Mosambi scions on different rootstocks of citrus

Different rootstocks significantly influenced compatibility index of sweet orange cv. Mosambi under hot arid climatic conditions Maximum plant height of sweet orange was registered (129.50 cm) on Rangpur lime rootstock followed by Karna khatta (125.33 cm) whereas minimum plant height was recorded in Pectinifera (57.17 cm). Maximum canopy spread (EW & NS) was registered (150.0 and 164.95 cm) on Volkamericana rootstock followed by Rangpur lime (146.67 and 161.67 cm) while minimum canopy spread (EW & NS) was recorded in Pectinifera (73.17 and 75.00 cm), respectively. The highest scion rootstock (SR) ratio was recorded on Karna khatta (0.96) rootstock followed by Volkamericana (0.93) as compared to minimum recorded on sour orange (0.81) rootstock.

Fig.64. Field view of Sweet orange cv. Mosambhi on different rootstocks

Studies of compatibility and adaptability of sweet orange cv. Sathgudi scions on different rootstocks of citrus

The vegetative growth and compatibility index of sweet orange cv. Sathgudi were significantly influenced by different rootstocks under hot arid climatic conditions. Maximum plant height of sweet orange was registered (111.69 cm) on Karna Khatta rootstock followed by Rangpur lime (110.83 cm) and minimum plant height was recorded in Pectinifera (64.67 cm). Maximum canopy spread (EW & NS) was registered (130.0 and 120.83 cm) on Karna Khatta rootstock followed by Rangpur lime (112.50 and 111.67 cm) while minimum canopy spread (EW & NS) was recorded in Pectinifera (74.50 and 69.58 cm), respectively. The highest scion rootstock (SR) ratio was recorded on Rough lemon (0.97) rootstock followed by Macrophylla (0.94) as compared to minimum recorded on Cleopatra (0.82) rootstock.

Studies of compatibility and adaptability of lemon cv. Pant lemon scions on different rootstocks of citrus

Compatibility index of lemon cv. Pant lemon was significantly influenced by different rootstocks under hot arid climatic conditions. Maximum plant height of lemon was observed (103.33 cm) on Karna khatta rootstock followed by Volkamericana (85.33 cm), and minimum plant

height was recorded in Rangpur lime (68.83 cm). Maximum canopy spread (EW & NS) was registered (120.83 and 134.17 cm) on Karna Khatta rootstock followed by Volkamericana (113.33 and 105.50 cm) while minimum canopy spread (EW & NS) was recorded on Rangpur lime (82.0 and 95.17 cm), respectively. The highest scion rootstock (SR) ratio was recorded on Rangpur lime (0.93) rootstock followed by Rough lemon (0.91) as compared to minimum recorded on Karna Khatta (0.81) rootstock.

Performance and evaluation of sweet orange varieties under hot arid region of Rajasthan

Ten sweet orange cultivars were evaluated for growth, yield and fruit quality attributes under hot arid region of Rajasthan. Sweet orange cultivars namely Washington Navel, Blood Red, Newhall Navel, Jaffa, Sathgudi, Hamlin, Mosambi, Pineapple, Valencia Olinda and Lane late on rough lemon rootstock were evaluated at 6x6 m spacing and uniform intercultural operations were followed. The plant height (315.45 cm), canopy spread N-S (325.58 cm) and E-W (322.80 cm), scion diameter (113.45 mm) and rootstocks diameter (118.19 mm) were found maximum in Satgudi followed by Hamlin and Jaffa. The S:R ratio (0.96) was found highest in Sathgudi however, it was recorded lowest in Valencia Olinda and Pineapple. During forth year, maximum average number of fruits per plant was recorded (130.40) in Sathgudi followed by Hamlin (118.60) as compared to lowest (30.38) in Pineapple, while no fruit set and fruiting was observed in Washington variety. Fruit weight was ranged from maximum 230.98 g in Pineaaple to minimum 138.46 g in Jaffa. The highest TSS was recorded in Newhall Navel (15.43°Brix) followed Mosambi (15.13 °Brix) and Pineapple (14.03 °Brix). Acidity was found minimum in 0.45 % in Sathgudi and maximum 0.60 in Valencia Olinda. Ascorbic acid content varied from 35.60 to 42.74 mg/100 g among different varieties. In conclusion, Satgudi was found significantly superior as compared to other cultivars of sweet orange varieties under arid region climatic conditions.

Evaluation of new interspecific hybrid Mandarin cv. Fremont on different rootstocks under hot arid region

The present trial aimed to evaluate the horticultural performance of interspecific Mandarin hybrid cv. 'Fremont' on four rootstocks under typical conditions of arid region for maximizing the production and quality fruits. The six years old Fremont plants budded on Rough lemon, Karna Khatta, Pectinifera and Troyer rootstocks were evaluated under field conditions. Fremont scion grafted onto Karna Khatta rootstock demonstrated vigorous growth having the greatest plant height and canopy volume followed by Rough lemon rootstock, while the lowest scion growth was observed when Pectinifera was used as rootstock. Pectinifera rootstock resulted in minimum vegetative growth of the scion with a 19.48 and 22.68 & 14.25 per cent lower plant height, canopy spread (N-S & E-W), respectively in comparison to Karna Khatta rootstock. The stionic difference was greatest in Fremont/Troyer citrange combination, whereas, the lowest was noticed in the Fremont/Pectinifera combination. The scion rootstock ratio was greatest in the Fremont/Pectinifera, while the lowest was found in the Fremont/Troyer citrange combination.

Fig. 65. Performance of Fremont mandarin on different rootstocks under hot arid region

Table 7. Effect of rootstocks on fruit yield attributes of Fremont mandarin

Rootstocks	No. of fruits/tree	Fruit weight (g)	Fruit dia. (cm)	Fruit index	Fruit yield (kg/tree)
Rough lemon	210.30	140.10	6.21	0.85	29.46
Karna khatta	241.25	145.98	7.81	0.79	35.22
Pectinifera	174.12	134.05	6.85	0.75	23.34
Troyer citrange	150.76	125.74	6.10	0.83	18.96
SEm+	3.10	1.21	0.72	0.01	1.25
CD at 5%	9.31	3.64	2.17	0.03	3.78

The effects of rootstocks on yield and production traits of Fremont were found to be significant in this study (Table 27). Karna Khatta rootstock found to produce the greatest no. of fruits, fruit weight, fruit diameter and fruit yield followed by Rough lemon and Pectinifera. While the lowest these fruit yield parameters were observed in Troyer citrange. Furthermore, Fremont scion on Karna Khatta rootstock appeared to be more productive in terms of number of fruits/tree (12.82%), fruit weight (20.48%) and fruit yield (19.55%) as compared to the commercially adopted rootstock (Rough lemon).

Table 8. Fruit quality attributes of Fremont mandarin as affected by rootstocks

Rootstocks	Fruit juice (%)	TSS (°Brix)	Acidity (mg/100 ml)	Ascorbic acid (mg/100 ml)	Rind thickness (mm)	Ripening index
Rough lemon	50.35	11.89	1.05	55.60	3.15	11.32
Karna Khatta	51.87	13.10	1.09	48.33	3.31	12.02
Pectinifera	55.60	13.62	0.91	61.45	3.10	14.97
Troyer citrange	53.15	12.57	1.05	58.09	3.09	11.97
SEm±	0.63	0.08	0.02	0.51	0.03	0.10
CD (5%)	1.89	0.25	0.06	1.53	0.09	0.31

The rootstocks used in this study exhibited significant effects on most of the biochemical properties of Fremont scion's fruits. The greatest juice content was observed when Fremont was budded on Pectinifera followed by those on Troyer citrange and Rough lemon, while it was least in fruits harvested from Fremont/Karna Khatta combination. Further, TSS, ascorbic acid, ripening index and organoleptic scores were also greatest on Pectinifera rootstock followed by Troyer citrange, whereas these were least on Karna Khatta rootstock. However, total acidity was recorded greatest on Karna Khatta followed by Rough lemon. Similarly, other quality parameters of Pectinifera rootstock were also found to be better than other rootstocks.

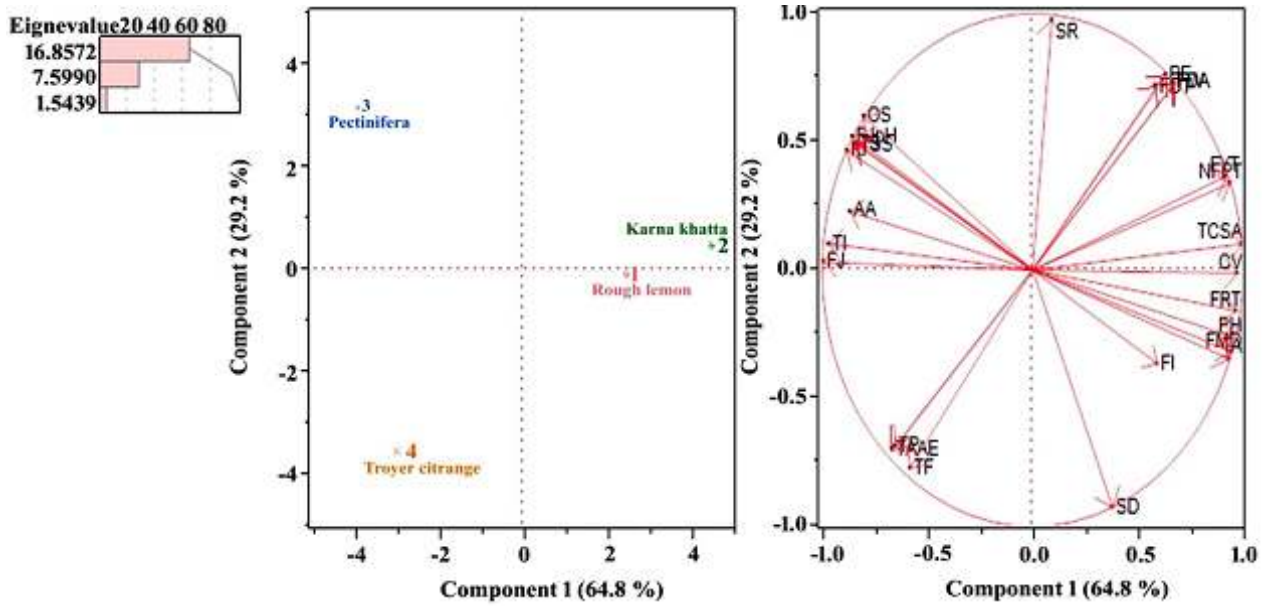


Fig. 66. Principal component loading plot for plant canopy, stionic compatibility, fruit yield and quality traits of Fremont mandarin budded on different rootstocks

Principal Component Analysis

A broader view of rootstocks effect on the scion growth, fruit yield, quality and nutritional characteristics of Fremont was obtained through Principal Component Analysis (PCA) of the means. The first three PCs were associated with Eigen values >1, and explained 100% of the total variance with PC1 accounting for 64.83%, PC2 for 29.23% and PC3 for 5.94%. The PC1 was positively and significantly correlated with CV, FMD, FRT, FYT, NFPT, PH, TCSA and TA; whereas, it was negatively and significantly correlated with AA, FJ, FJpH, OS, RI, TI, TS and TSS. The PC2 was positively correlated with FDA, FDT, FJpH, FW, OS, PE and SR; however, it was negatively and significantly showed high loadings of CV, TCSA

and FRT with a positive effect while FJ, TI, AA and RI had a negative effect. PC2 showed high loadings of OS, FJpH, TSS, SR, PE, FDA and FW with a positive effect, and TAAE, TP, TF and SD with negative effects. The angle between the variables FJpH, OS, TSS and RI are small, indicating a higher correlation among them. This group of variables has little to no correlation with the TAAE, TP, TF, PE, FDA and FW group of variables because the angles among the variables between these two groups are close to 90°. The angles between the variables group OS, FJpH, TSS, RI, FI, TA and PH are near to 180°. Therefore, the variations between these two groups of variables are negatively correlated.

Evaluation of new interspecific hybrid Mandarin cv. Daisy on different rootstocks under hot arid region

The present experimental aimed to performance evaluation of interspecific hybrid of Mandarin cv. Daisy on five rootstocks under typical conditions of arid region for obtaining the higher production and quality fruits. The six years old Daisy mandarin plants budded on Rangpur lime, Sour orange, Karna Khatta, Pectinifera, Rough lemon and Troyer citrange rootstocks were evaluated under field conditions. The variables collected over fifth years vegetative growth and stonic interaction on measurable growth, fruit yield and quality parameters. The results revealed a significant effect of rootstocks on all the variables studied.

Tree height (3.09 m) and canopy spread (2.91 & 3.10 m) were found highest on Rough lemon followed by Troyer citrange and Rangpur lime, whereas, these parameters were found lowest in Sour orange and Pectinifera rootstocks. The stonic difference was found highest in Troyer (13.39 mm) followed by Rangpur lime (10.56) and Sour orange (9.10 mm); and scion rootstock ratio Rough lemon (0.94) and Pectinifera (0.92). The no. of fruit and fruit yield were obtained maximum in Rough lemon (98.18 & 22.11) followed by Pectinifera (91.51 & 21.10) and Sour orange (68.47 & 16.12), respectively while it was minimum in Troyer citrange and Rangpur lime; Whereas, Karna Khatta produced heaviest fruits (238.47g) and fruit diameter (8.20 cm). All fruit quality parameters were observed highest in Pectinifera as juice percentage (58.60), TSS (13.95 ^{0}B), acidity (0.80 mg/100ml^{-1}), ascorbic acid (63.57 mg/100ml^{-1}), rind thickness (2.12 mm) and ripening index (17.44) as compared to other rootstocks.

Table 9. Fruit quality attributes of Daisy mandarin as affected by different rootstocks

Rootstocks	Fruit juice (%)	TSS (° Brix)	Acidity (%)	Ascorbic acid (mg/100 ml)	Rind thickness (mm)	Ripening index
Kharna Khatta	52.68	12.80	1.02	58.64	2.23	12.55
Rangpur lime	55.87	13.50	0.96	57.87	2.26	14.06
Sour orange	57.60	13.12	0.95	52.33	2.54	13.81
Troyer citrange	55.15	13.68	0.84	61.25	2.29	16.29
Pectinifera	58.60	13.95	0.80	63.57	2.12	17.44
Rough lemon	57.45	12.96	0.91	58.67	2.25	14.24
S Em±	0.61	0.11	0.02	0.42	0.01	0.23
CD (5%)	1.83	0.32	0.06	1.26	0.03	0.71

Effect of mulches, manure, biofertilizer and fertilizer on soil properties, growth, yield and quality of bael

Among different combination of mulches, biofertilizer and fertilizer, plant height (3.91m) was recorded maximum in standard dose of NPK followed by grass mulch + FYM + neem cake + 50% recommended dose of NPK + *Azotobactor* + VAM culture; grass mulch+ FYM + 25% recommended dose of NPK + *Azotobactor* + PSB Culture; and it was recorded minimum in FYM (20kg/ plant, whereas plant spread (4.27m), stem girth (31.60) and fruit retention (14.23 fruits/plant) was also recorded the maximum with Grass mulch + FYM + neem cake + 50% recommended dose of NPK + *Azotobactor* + VAM culture under rainfed semi-arid conditions. Results of study revealed non significant differences for fruit weigh and size, but exhibited considerable variation in quality attributes.

Effect of plant architectural engineering on fruit cracking and quality of pomegranate

Pomegranate plants were trained in different canopy management system of one, two and four stem training system and branching were

allowed at one and two feet height along with 10 and 20 % pruning of growth during winter after fruit harvest for management of cracking and improvement of canopy, yield and quality. The experiment was comprised of thirteen treatments *i.e.* T_1-Single stem branching at 1 foot + 10 % pruning, T_2-Single stem branching at 1 foot + 20 % pruning, T_3-Single stem branching at 2 feet+ 10 % pruning, T_4-Single stem branching at 2 feet+ 20 % pruning, T_5-Two stem branching at 1 foot + 10 % pruning, T_6-Two stem branching at 1 foot + 20 % pruning, T_7-Two stem branching at 2 feet+ 10 % pruning, T_8-Two stem branching at 2 feet+ 20 % pruning, T_9-Four stem branching at 1 foot + 10 % pruning, T_{10}-Four stem branching at 1 foot + 20 % pruning, T_{11}-Four stem branching at 2 feet+ 10 % pruning, T_{12}-Four stem branching at 2 feet+ 20 % pruning and T_{13}-Control without any training and pruning. Significant differences were observed on plant growth and yield attributes. Among all the treatment, maximum plant height (2.07 m) was recorded in T_1-Single stem branching at 1 foot + 10 % pruning followed by T_2-Single stem branching at 1 foot + 20 % pruning (2.04 m) as compared to minimum in control (1.51 m). Canopy spread N-S and E-W was recorded maximum (2.10 and 2.07 m) in treatment T_{10}-Four stem branching at 1 foot + 20 % pruning followed by T_9-Four stem branching at 1 foot + 10 % pruning (2.01 and 2.06 m) as against minimum recorded in control (1.55 and 1.50 m), respectively. Canopy volume was recorded highest (3.63 m^3) in T_9-Four stem branching at 1 foot + 10 % pruning followed by T_5- Two stem branching at 1 foot + 10 % pruning (3.44 m^3) as compared to minimum canopy volume recorded in T_{13}-Control without any training and pruning (1.86 m^3). Maximum number of fruits and yield per plant (39.50 and 9.44 kg) was recorded in T_9-Four stem branching at 1 foot + 10 % pruning followed by T_{10}-Four stem branching at 1 foot + 20 % pruning (34.50 and 78.70 kg) and minimum number of fruits and yield per plant were found in control (20.67 and 3.83 kg), respectively. Fruit weight was ranged from minimum 185.27 g in T_{13}-Control without any training and pruning to maximum 252.15 g in T_{10}-Four stem branching at 1 foot + 20 % pruning.

Flower regulation and identification of suitable *bahar* in pomegranate under hot arid condition

In pomegranate, plants were subjected to flower regulation treatments i.e. withholding of irrigation for one month prior to *bahar* and 2 ml/l ethrel (40%) application for defoliation in different bahar/first bahar for standardized flower regulation treatment to reduce cracking and improve yield. There were ten treatment combinations including T_1-*Ambe bahar* (Jan.-Feb.), T_2-Late *ambe bahar* (March-April), T_3-*Mrig bahar* (June-August), T_4-*Hasta bahar* (Sep.-Oct.), T_5- *Ambe + Mrig bahar*, T_6-*Ambe + Hasta bahar*, T_7-Late *ambe + Hasta bahar*, T_8-*Mrig + Hasta bahar*, T_9-*Ambe + Mrig + Hasta bahar* and T_{10}-Control (Natural flowering).

Among all the treatments, maximum number of fruits per plant were observed in T_8-*Mrig + Hasta bahar* (46.33), followed by T_3-*Mrig bahar* (40.25) and T_4-*Hasta bahar* (38.50) as compared to minimum in control T_{10} (23.50) treatment. Among all the treatments, maximum fruits yield per plant were observed in T_4-*Hasta bahar* (10.34 kg) followed by T_8-*Mrig + Hasta bahar* (10.27 kg), T_3-*Mrig bahar* (10.10 kg) as compared to minimum in control T_{10} (4.33 kg), respectively. Fruit cracking was varied significantly among different flower regulations treatments. The minimum fruit cracking was observed in T_1-*Ambe bahar* (10.15%) followed by T_2- Late *ambe bahar* (12.18%) while maximum fruit cracking was observed in control (29.25%) followed by T_9-*Ambe + Mrig + Hasta bahar* (25.87 %). Fruit juice TSS and maturity index were observed maximum (17.10°Brix and 47.50) in T_4-*Hasta bahar* followed by T_3-*Mrig bahar* (15.73°Brix and 41.50) followed by T_8-*Mrig + Hasta bahar* (15.60°Brix and 41.49) as against minimum TSS and maturity index recorded in T_{10}-control (12.19°Brix and 24.48), respectively. Aril colour was varied from light pink to dark red while rind colour varied from light red, red to dark red among different flower regulation treatments.

Fig. 67. View of pomegranate experimental field cv. Bhagwa

Protected cultivation of vegetables under hot arid conditions

Identification of brinjal genotype CIAH-22

Brinjal is indigenous and most accepted vegetable crop of year-round production but its fruits have regional preferences. On the basis of intensive native germplasm utilization, a promising brinjal genotype CIAH-22 (AHB-03) was identified, evaluated and advanced further during spring-summer and rainy season of 2021. The plants are moderate in growth and have prickles (thorns) on their stem, leaf and fruit calyx. Number of prickles on leaf and calyx ranged from 4.70-5.62 and 12.36-19.75, respectively. Leaf blade lobing and leaf blade tip angle is intermediate. It took 56-62 days from transplanting for first marketable fruit harvest. Tender fruits at marketable stages are oblong, bluish-purple in colour, 7.62-8.57 cm in length, 6.94-7.38 cm in diameter and 145.2-154.5 g in weight. Fruit length-breadth ratio is slightly longer than broad. It has the marketable yield potential of 2.323.68 kg per plant and 394.2-510.7 q/ha per season. The genotype has the ability to tolerate high temperature (up to 46 °C) as there was continuous fruiting during hot summer months (April-June). It is also tolerant to fruit and shoot borer which is a major pest of brinjal. Based on performance over the season, the genotype has potential for cultivation during both rainy-winter and spring- summer season under hot arid environment. The genotype was also evaluated under multi-location trials of AICRP (VC).

Fig. 68. Field view and fruits of brinjal genotype CIAH-22

Performance studies on brinjal under protected condition

To understand growth, fruitingand qualityin brinjal under protected condition, the genotype AHB-03 (CIAH-22) was evaluated with varying environments (open drip, open mini-sprinkler and shade net) during spring-summer season of 2021. The plant growth and fruit yield parameters except leaf length, width, petiole length, fruit length, diameter and weight were significantly influenced by the varying environments. Numbers of fruits per plant were found maximum under open mini-sprinkler followed by shade net and minimum under open drip. The fruit yield per plant ranged from 2.32 to 3.68 kg per plant under varying environments. The highest fruit yield per plant was recorded under open mini-sprinkler followed by shade net and the lowest was recorded under open drip environment. The other fruit yield attribute as average fruit weight followed the similar trend. Based on performance studies, the genotype has the potential for cultivation under hot arid environment.

Performance studies on tomato under protected condition

To understand growth, fruiting and quality in tomato under protected condition, the genotype AHSL-1 was evaluated with varying environments (open drip, open mini-sprinkler and shade net) during spring-summer season of 2021. Observations were recorded on growth and yield parameters of the crop. The plant growth and fruit yield parameters except branches per plant, fruit length and diameter were significantly influenced by the varying environments. The ripe fruits were medium in size and reddish in colour. The fruit yield per plant ranged from 2.14 to 3.56 kg per plant under varying environments. The highest fruit yield per plant was recorded under open mini-sprinkler followed by shade net and the lowest was recorded under open drip environment. The other fruit yield attributes as number of fruits per plant, fruit length, fruit diameter and average fruit weight followed the similar trend. Based on performance studies, the genotype needs further improvement for cultivation under hot arid environment. Son under hot arid environment. The genotype was also evaluated under multi-location trials of AICRP (VC).

Standardization of sowing date and covering material in watermelon

Watermelon was sown on four different date of sowing *i.e.*20th December, 30th December,10th January under tunnel and10th February under open conditionto standardize the sowing date and covering material under tunnel for early season harvest. Two types of covering material *i.e.* biodegradable plastic sheet of 25 micron and non-woven cloth (25 gsm) was used. The covering was completely removed after gradual hardening of the plants during second week of February when the outside temperature increased. It was found that germination was earlier in biodegradable plastic sheet of 25 micron than non-woven cloth (25 gsm)

because the temperature inside the tunnel with polythene cover was comparatively higher than the non-woven cloth. The crop raised under tunnel (20th December with polythene covering) attained the harvestable maturity on 8th March in comparison to open field sowing (second week of February), which came in harvesting during first week of May which was 61 days later than the tunnel. Tunnel facilitated the early harvest of crop which earn higher market price in off-season than the normal season.

Data recorded on fruit and yield attributes revealed that number of fruits per plant, fruit weight, fruit yield per plant and fruit yield per hectare were significantly influenced by the sowing date and covering material. Number of fruits per plant ranged from 2.64 to 3.78. Fruit diameter ranged from 15.4 to 18.3 cm. The mean weight of fruit ranged from 2.28 to 2.85 g. The fruit yield ranged from 5.72 to 8.61 kg per plant and 156.78 to 256.32 q per ha. The sowing on 10thJanuary with polythene covering recorded the maximum fruit yield (256.32 q/ha) followed by sowing on the same date with non-woven covering (232.64 q/ha) and the minimum was recorded in sowing under open condition (156.78 q/ha). Higher yield under tunnel than open field condition was also supported by fruiting duration as it was observed that the treatment having the highest yield had 26 days of fruiting duration in comparison to open field condition which had 16 days of fruiting duration only. With the use of tunnels, it is possible to harvest warm season crops up to 50-60 days earlier in the spring and extend the growing season. This is where low tunnel made the difference in comparison to open field because the produce harvested during first week of March from low tunnel is sold at Rs. 15-30 per kg against Rs. 05-10 per kg from the produce harvested during first week of May from open field. Net income and cost benefit ratio of sowing under low tunnel was significantly higher than the sowing under open field condition and the highest economics (B:C ratio of 2.00) was achieved by sowing the crop on 10th January under tunnel with non-woven cloth followed by polythene sheet.

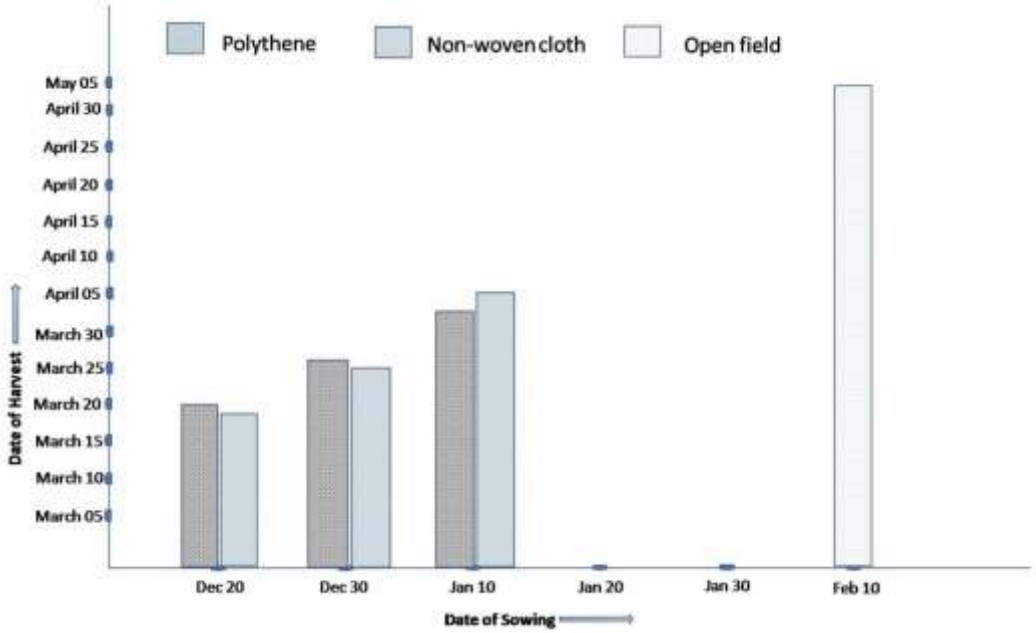


Fig. 69. Effect of sowing time on harvest of water melon under tunnel and open field

Performance and evaluation of onion varieties under hot arid conditions

Different varieties of onion *viz*. Bhima Subhra, Bhima Raj, Bhima Supar, Bhima Kiran, Bhima Shakti, Bhima Safed, Bhima Shweta, Bhima Red, Bhima Dark Red, Bhima Light Red from ICAR-DOGR and RO-252 from RARI, Durgapura were evaluated during *rabi* season of 2021 under hot arid conditions to identify the suitable variety under hot arid agro-ecosystem. Significant variations were observed among varieties with regard to growth and yield attributes. The highest bulb yield was recorded by the variety Bhima Red (44.85 t/ha) closely followed by Bhima Kiran (41.47 t/ha) and Bhima Shakti (41.00 t/ha) which were statistically at par with each others. The variety Bhima Shubhra registered the lowest bulb yield (19.14 t/ha) which was statistically at par with Bhima Light Red (19.27 t/ha) and RO-252 (20.10 t/ha). The highest yield of bulbs from these varieties can be attributed to higher polar and equatorial

diameter of bulb and bulb weight which are major yielding contributing components. On the basis of performance study, varieties *viz.* Bhima Red, Bhima Kiran and Bhima Shakti are identified as high yielding for cultivation under hot arid conditions during *rabi* season. During late *kharif* season of 2021, the varieties *viz.* Agrifound Dark Red and Line-883 from NHRDF, New Delhi were also evaluated and the trial is in progress.

Fig. 70. Evaluation of onion varieties under hot arid conditions

Study on seed longevity and germination per cent of ker 'AHCD-1':

Fruits of ker (*Capparis deciduas* Edgew (Forssk.) were harvested at red ripe stage and extracted seeds. Seeds were dried at room temperature. There were two sets of treatments. In first set, there were five sowing periods *viz*., seeds sown immediately after extraction, three months, six months, nine months and twelve months storage at room temperature. In second set, there were four sowing periods after refrigerator storage conditions at 4 ^{0}C temperatures namely three months, six months, nine months and 12 months after refrigerator storage. Seeds were sown in protrays prefilled with vermiculite, cocopeat and perlite (1:1:1) media for studying germination percent and seed longevity under green house condition.

In first set of treatment *i.e.* seed storage at room temperature, maximum average germination (64.53%) of ker seeds was observed when seeds were sown immediate after extraction while it was gradually declined prolonging to storage period from 45.53% (three months storage) to 3.67% (twelve months storage). In second set of treatments (refrigerator storage at 4 ^{0}C), highest germination (58.87 %) was recorded after three months of storage followed by six (47.47 %) nine (40.00 %) and 12 months (34.20 %) after refrigerator storage at 4 ^{0}C temperature. While, in first set, seed longevity/ germination was much reduced after three months of storage at room temperature and it was negligible (only 3.67 % germination) at twelve months after storage that has no use. Therefore, it is evident that seed longevity and germination of ker can be enhanced using refrigerator technology for year round sowing and multiplication of quality planting material of ker.

Standardization of propagation technique in pilu (*Salvadora sp.*) through cutting

An experiment was undertaken for studying sprouting, rooting and plant success percent on two genotypes (pink and white fruited) of pilu. Pilu cuttings were taken during September 2020 and February, 2021 and planted under green house conditions. Cuttings of pilu were planted in media containing soil, cocopeat, vermicopost (2:1:1). Cuttings were selected from sprouts arising from trunk near to ground level. The length of cuttings was 30-35 cm with pencil thickness (10-15 mm diameter) having 2-3 pairs of leaves. Cuttings were putted keeping 2/3rd portion below in media. Watering was given twice in a week. Cuttings were sprouted two- three weeks (14-18 days) after planting. Twenty seven cuttings (63.27%) in pink fruited genotypes and 13.50 (62.00%) cuttings in white fruited pilu were sprouted. Out of which, rooting was occurred in 64.81% cuttings of pink fruited and 80.11% cuttings of white fruited (from sprouted cuttings) pilu. Well rooted plants out of rooted plants of the both genotypes 44.87% and 40.58% were survived, respectively.

It was evident that white fruited genotype has comparatively more average plant height and number of branches per plant (81.81 cm and 4.60) than pink fruited pilu (74.92 cm and 4.30). Average number of major roots and minor roots were observed 6.60, 5.50 and 18.40, 20.60 in pink fruited and white fruited pilu genotypes, respectively. Average lengths of major and minor roots were measured 53.88, 48.85 cm and 19.66, 24.29 cm in both the genotypes, respectively. Average minor root lengths (32.24 and 40.42 cm) were much higher than second year planting (7.08 and 8.06 cm) in pink and white fruited genotypes of pilu, respectively.

Planting material standards of pilu

Planting material standards of pilu require following prerequisites for production of quality planting material such as (1) take 30-35 cm length's sprouts arising from trunk near to ground level having pencil thickness with 2-3 pairs of leaves, (2) cuttings should be planted keeping 2/3rd portion of cuttings below in media during September/ February month in green house/ mist chamber, (3) potting media should be Soil, cocopeat, vermicopost (2:1:1), (4) sprout and rooting success should be =50%, (5) plant survival should be =20%, (6) plant height after six months should be =40 cm having 2-4 branches with 3-4 major roots.

Field establishment of three elite lasoda germplasm

Six budded plants of elite lasoda genotype 'AHCM/KK/SMH 19' surveyed from Sikar, six plants of elite type 'AHCM/KK LP 9' and four plants of elite lasoda 'AHCM 22' genotypes were successfully established in the field for studying growth, flowering, fruiting and quality parameters. Average plant height, canopy spread and stem girth were recorded 1.87, 2.02, 1.58 meter; 2.74 x 2.47, 2.24 x 2.22, 1.98 x 1.80 meter and 10.73, 11.00, 10.03 cm in these three elite lasoda germplasm, respectively.

Intensification of research on tissue cultured date palm in hot arid region

Standardization of pit size for plant growth of tissue culture date palm cultivars

Maximum plant height (325 cm) in Khalas and Barhee cultivar with 1 x 1 x 1 m pit size while minimum plant heights (150 cm) in Khuneizi cultivar with 0.5 x 0.5 x 0.5m pit size. The maximum leaf emergence was also recorded in cultivar Barhee and Khalas cultivar in the bigger size pit while minimum leaves were emerged in cultivar Khuneizi with small pit size and same trend was also recorded in plant spread. Fruiting in some plants have been set during the report period. The effect of pit size was recorded only on the growth performance while on reproductive phase pit size did not show any effect on emergence of spathe. In all cultivars *i.e.* Khuneizi, Khalas, Barhee and Medjool of date palm, impact of spacing (row to row and plant to plant) *i.e.* 6 x 6m and 8 x8m was not been seen and survival, plant height and spread were not differed significantly in both the spacing. From the eight year data on the performance of tissue culture date palm cultivars (Barhee, Khalas, Khuneizi and Medjool), pit size with the dimension of 1 x 1 x 1m size with filling mixture composition (50 kg FYM + 50 Kg Pond silt and 75 Kg soil) gave the best survival (95%), growth increment rate (23% growth per year) in respect of plant height and spread.

Standardization of crop geometry

Plant growth parameters

In all cultivars *i.e.* Khuneizi, Khalas, Barhee and Medjool of date palm, impact of spacing (row to row and plant to plant) *i.e.* 6 x 6m and 8 x8m have been recorded and observed that in 6 m spaced side difference between canopy was in the range of 1.5-2.0 m while in 8m spaced difference between canopy was in the range of 3.25-4.0 m in different cultivars. In cultivar Khalas and Barhee cultivars, 8-10 new leaves were emerged while in Medjool it was 6-8 and minimum leave emergence *i.e.*3-4 was in Khuneizi cultivar. In cultivar Khalas, Barhee and Medjool, 8-10, 2-3 and 5-6 suckers were emerged, respectively while in Khuneizi 1-2 suckers were emerged. In Khalas and Barhee in some plants spathe has been emerged in the month March. In Khalas, 45% plants spathe emerged in the IIIrd week of February while in Barhee 28% plants spathe emerged in last week of March while in Medjool 7-10th March 30% plants spathe emerged. Among all the cultivars, the overall performance was graded as >Khalas > Barhee > Medjool > Khuneizi.

Nutrient concentration in leaf tissue of tissue cultured plants of different date palm cultivars

Total nitrogen in leaves was determined according to kjeldahl method. Total P was measured by calorimetrically after digestion with perchloric-nitric acid method. The total K was measured using flame emission spectrophotometer. The concentration of N in leaves was significantly higher (1.48%) in Khalas cultivar and minimum was recorded in Barhee (1.28%). The phosphorus content was at par in leaves of different cultivars date palm. The potassium content was also differed significantly among the different cultivars and maximum K content (1.55%) was recorded Khalas followed in Medzool (1.49%) and minimum content was recorded in Barhee (1.33%). Likewise iron and zinc contents were also differed significantly in different date cultivars and maximum iron (160 ppm) and zinc (48.22 ppm) in cultivar Khalas of date palm.

Standardization of nutrient requirement

A field trial was conducted and deployed in Barhee cultivar of 6 year old palm with different

nutrient treatments. The treatments were applied in the month of October 2021 as per technical programme. Results revealed that maximum plant height (2.05 m), spread (1.45 x 1.55 m) were number of leaves (15) with NPK (1000g each) along with 80 kg FYM with BF consortia in Barhee cultivar.

Effect INM treatments on nutrient status in leaf tissue of Barhee tissue cultured cultivar

Leaf nutrient status of Barhee cultivar of tissue culture derived plants under different INM treatments were analyzed following the standards procedures. The results revealed that nitrogen content in leaf tissue was ranging from 1.25 to 1.55% and significantly maximum N content was recorded in those treatments where higher dose of nitrogen (1000 g per plant) was applied. The phosphorus contents were recorded in leaf tissue of Barhee cultivar in the range of 0.25 to 0.30% and significantly maximum P content was recorded where BF consortia were given with higher dose of phosphorus fertilizer. The potassium and zinc contents were ranging from 1.48 to 1.65 % and 35.50 to 42.50 ppm, respectively and statistically at par in all the INM treatments. The iron content was in the range of 135 to 155 ppm and significantly higher iron contents were higher N dose was combined with FYM doses.

Effect INM treatments on chlorophyll contents in leaf tissue of Barhee cultivar

The Chlorophyll a, Chlorophyll b, total chlorophyll and ratio of Chl.a and Chl. b were measured in different plants receiving different INM treatments. The Chl. a and total Chlorophyll were recorded statistically differed in different treatment and statistically maximum Chlorophyll a and total Chlorophyll was recorded in T6 to T11 treatments. The Chlorophyll b and ratio of Chl.a and Chl. b were not differed statistically among the INM treatments. Initial results revealed that application of N and FYM is increasing the Chlorophyll a and total Chlorophyll contents.

Snepmelon yield (q/ha) and yield response (%) under saline water

The field experiment was conducted at ICAR-CIAH, research farm with cucurbitaceous crop to investigate the effect of different level of salinity ($0.5EC_{IW}$ and $4EC_{IW}$) with the combination of amendments for Snapmelon crop performance. The application of saline water with amendments increased yield of snepmelon as compared to control. The data revealed that with the two salinity level the highest yield was observed under the treatment of IW @4EC(dSm^{-1}) + FYM @15 ton/ha (186.78 q/ha) followed by IW @4EC(dSm^{-1}) + vermicompost @10 t/ha (171.60 q/ha), and lowest 137.77 q/ha yield of snepmelon in control treatment (IW@4EC(dSm^{-1}) and with the salinity level of 0.5EC (dSm^{-1}) the maximum yield was observed with the treatment of IW@0.5EC(dSm^{-1})+ Vermicompost @10 ton/ha was (198.56 q/ha) and followed by IW @ 0.5EC (dSm^{-1}) + Gypsum @5ton/ha (188.88 q/ha) and lowest 152.90 q/ha in control treatment (IW @ .5EC (dSm^{-1}). Maximum percent yield response 29.88% was observed where IW@.5 EC (dSm^{-1}) +Vermicompost @ 10 t/ha was applied With the 4EC saline water the maximum percent yield response 35.27% was observed, where the treatment of IW@ 4EC (dSm^{-1}) + FYM @15 ton/ha was applied (35.27%). The treatment of IW@ 4 EC + FYM @15 t/ha was good for yield as well as yield response of snepmelon crop production under arid region. It was also observed that the yield response (%) under 4EC salinity level of irrigation water with amendment was good as compared to .5EC salinity level. The treatment of VC@10 ton /ha with .5EC and 4EC level were recorded maximum leaf area (59.10 cm and 58.92 cm), leaf area index (0.59 and 0.59) while maximum TSS (5.17 and 5.35) were recorded in treatment of FYM @ 15 ton/ha with.5EC and 4EC salinity level respectively and the dry matter percentage were recorded maximum in treatment of gypsum @ 5t/ha in both salinity level i.e.5EC and 4EC.

Kachri yield (q/ha) and yield response (%)

The data revealed that with the two salinity level the highest kachri yield was observed with the treatment of IW @ 4EC (dSm^{-1}) + Gypsum @ 5ton/ha that was (50.00 q/ha) followed by IW @ 4EC(dSm^{-1}) + vermicompost @10 ton/ha (45.83 q/ha) and the lowest 36.66 q/ha yield of kachri in control. While with the salinity level of 0.5EC the highest yield was observed with the treatment of IW @ 0.5EC + FYM @15 t/ha (69.83 q/ha) followed by IW@ 05EC (dSm^{-1}) + vermicompost @10 t/ha) (64.67q/ha) and lowest in control (IW@ 0.5EC(dSm^{-1}) was (42.00 q/ha). Under saline water the treatment of IW@ 4 EC +Gypsum @5 t/ha was good for yield as well as yield response for kachri crop production under arid region. . The treatment of Gypsum @5 t/ha with 0.5EC and 4EC were registered good for leaf area, TSS and DM%.

Ridge gourd yield and yield response

The growth and yield attributes of cucurbitaceous crops varied with the application of organic and inorganic sources of nutrients with the different level of salinity level in irrigation water. It was observed that increasing the salinity level of irrigation water did not significantly affect the growth parameter like number of vine, number of leaf/vine, vine length, leaf length, leaf width, number of male and female flowers but significantly affected the yield parameter. The maximum yield of ridge gourd was observed in treatment of IW @ .5EC (dSm^{-1}) + 50% organic + 50% inorganic (99 q/ha) followed by IW @ 2 EC (dSm^{-1}) + 50% organic and 50% inorganic (87.33q/ha) and IW @ 4EC (dSm^{-1}) + 50% organic and 50% inorganic (78.00q/ha) and yield response also followed same treatment.

Water melon yield and yield response

The maximum yield of watermelon was observed in treatment of IW @ 0.5EC (dSm^{-1}) + 50% organic + 50% inorganic (420 q/ha) followed by IW @ 2 EC (dSm^{-1}) + 50% organic and 50% inorganic (420 q/ha) and IW @ 4EC (dSm^{-1}) + 50% organic and 50% inorganic (300.00 q/ha) and it was observed that the increases the salinity level of irrigation water significantly affect the yield parameter like fruit weight, fruit length and fruit diameter. The maximum fruit weight, length and diameter were significantly different with the increasing salinity levels of irrigation water.

Nutrient management in chironji, custard apple, jamun and tamarind

DRIS indices were calculated for custard apple, chironji and jamun which can be used for judging the nutrient requirement. DRIS indices were calculated based on the following equation.

NUTRIENT INDEX

$$N \text{ index} = \frac{[\, f(N/P) + f(N/K) + f(N/Ca) + f(N/Mg) + f(N/S)\, f(N/Fe) + f(N/Mn) + f(N/Cu) + f(N/Zn) + f(N/Y)\,]}{Z}$$

Where,

when $N/P \geq n/p$ & $f(N/P) = \{(N/P / n/p)\, 1\}\, 1000/CV$

when $N/P < n/p$ & $f(N/P) = \{(1 - (n/p / N/P)\}\, 1000/CV$

Where

1) N/P is the value of the ratio of two elements in the tissue of the plant being diagnosed.
2) n/p is the optimum value or norm for that ratio.
3) CV is the coefficient of variation associated with the norm.
4) Z is the number of functions comprising the nutrient index.

A nutrient index is a mean of functions of all ratios containing a given nutrient. For custard apple the calculated DRIS indices were given in the table 29. Based on the above table Fe is most limiting and most required element with iron index -132 to apply to increase the yield of the tree. Later potassium [-30] is most required element, then phosphorus [-10] and lastly sulphur with DRIS index -3.

Fertilizer trials have been implemented in custard apple, chironji, and jamun with following treatments.T_1 Control. T_2 N50- P_2O_5 50- K_2O 50,T_3- N100- P_2O_5 100- K_2O 100,T_4 N150- P_2O_5 150- K_2O 150,T_5 N50- P_2O_5 50- K_2O 50 (50% N-organic),T_6- N100- P_2O_5 100- K_2O 100 (50%-N-organic),T_7- N150- P_2O_5 150- K_2O 150 (50%-N-organic),T_8 N50- P_2O_5 50- K_2O 50 (50% N-organic)+NPK-Biofertilizers,T_9- N100- P_2O_5 100- K_2O 100 (50%-N-organic)+NPK-Biofertilizers,T_{10}- N150- P_2O_5 150- K_2O 150 (50%-N-organic)+NPK-Biofertilizers,T_{11} Application of Compost Tea prepared from weeds,T_{12} Based on DRIS indices, Design-RBD, Replications-3,Nutrient doses are in (ppm) in root zone in soil application, Source: Urea, DAP, KCl, FYM, NPK mixed liquid bio-fertilizer.

In order to utilize the water and land resources of CHES, Vejalpur farm and to test the suitability of soils for different horticultural plants especially with respect to nutrient management a special study is going on the physical and chemical properties of soils of CHES, Vejalpur farm and to prepare soil fertility map the following parameters were estimated in waters of different wells in CHES, Vejalpur farm. Irrigation water was analyzed for EC and pH in different with following details with their geographical location in CHES, Vejalpur farm. Maximum salt content (1840 ppm) was observed in W-3, which is at weather station in second block of CHES, Vejalpur. Lowest salt content (207 ppm) was observed in W-2, which was located in first block of CHES, Vejalpur.

Table 10. Calculated DRIS indices in custard apple based on above procedure

ITEM	N	P	K	Ca	Mg	S	Fe	Mn	Zn	Cu
DRIS NORMS	2.51	0.15	0.79	1.87	1.16	0.37	226.5	283	47	28.5
TEST CROP	5.75	0.161	0.57	4.73	4.01	0.40	175	150	40	30
INDICES	80	-10	-30	52	132	-3	-132	28	266	21

Table 11. Water quality parameters of different wells in CHES,Vejalpur farm.

Well NO	LOCATION	Latitude	Longitude	Altitude (m)	Salt (ppm)	EC ($dSm^{-1)}$	pH
W-1	BLOCK-1-T-GH	22^0 40' 47"-N	73^0 33' 5.9"-E	113	1380	2.16	7.58
W-2	BLOCK-1-O	22^0 40' 43.8"-N	73^0 32' 55.6"-E	113	207	0.32	7.18
W-3	BLOCK-2-O-WS	22^0 40' 45.2"-N	73^0 32' 39.12"-E	112	1840	2.88	7.86
W-4	BLOCK-2-O-KVK	22^0 40' 47.7"-N	73^0 32' 24.68"-E	110	694	1.08	7.42
W-5	BLOCK-2-T-KVK	22^0 40' 48.9"-N	73^0 32' 29.75"-E	110	635	0.99	7.93
W-6	BLOCK-3-O-LAB	22^0 41'10.29"-N	73^0 31' 22.35"-E	106	1040	1.63	7.33
W-7	BLOCK-3-O-19P	22^0 41' 29.4"-N	73^0 31' 47.71"-E	103	458	0.72	7.23
W-8	BLOCK-3-O-AKS	22^0 41' 44 "-N	73^0 32' 11.02"-E	107	987	1.54	7.58
W-9	BLOCK-4-O-73P	22^0 41'51.04"-N	73^0 31' 22.35"-E	95	337	0.53	7.81
W-10	BLOCK-3-O	22^0 41'32.68"-N	73^0 31' 49.43"-E	99	524	0.82	7.84
W-11	BLOCK-4-O	22^0 41'33.41"-N	73^0 31' 01.82"-E	101	402	0.63	7.64
W-12	BLOCK-3-O-SAN	22^0 41'38.75"-N	73^0 31' 40.10"-E	97	402	0.63	7.30
W-13	BLOCK-3-O-VEG	22^0 41'42.77"-N	73^0 31'52.34"-E	98	458	0.72	7.31
W-14	BLOCK-3-O-36P	22^0 41'38.75"-N	73^0 31' 40.10"-E	96	337	0.53	7.51
W-15	BLOCK-2-T-OFF	22^0 40'47.46"-N	73^0 32' 42.22"-E	112	1470	2.30	7.21

Note: W-1, W-5 and W-15 are tube wells

Fig. 71. ICAR-CIAH Regional Station, CHES, Vejalpur Block-III & IV

Plot wise soil samples were collected from 3rd block of CHES, Vejalpur and 3 of their properties like pH and salt content in ppm in 1: 2.5 soil water ratio in table 31 and bulk density (g/cm^3) by measuring the weight of unit soil volume of soil powder were represented in table 32. Maximum bulk density (1.215 g/cm^3) in plot no 28 and minimum bulk density (1.015 g/cm^3) in plot no 5 was observed. Maximum p^H (7.97) and maximum salt (81 ppm) were observed in plot no 31 and lowest pH (6.07) was observed in plot no 30 and lowest salt content (20 ppm) was observed in plot no 33

Nutrient estimation (P, K, Ca, Mg, S and Fe) and biochemical parameters like acidity, ascorbic acid, phenols and anti-oxidant activity by DPPH method in different fruit crops like guava, citrus, wood apple, custard apple, jamun, mango bael and vegetables like cowpea, moringa, coccinia, spine gourd was also carried out.

Table 12. pH and salt content (ppm) (1:2.5 soil water ratio) of soils of different plots in block -III of CHES,Vejalpur farm.

Plot No.	Salt	P^H	Plot No.	Salt	P^H	Plot No.	Salt	P^H	Plot No.	Salt	P^H
	PPM			PPM			PPM			PPM	
	1:2.5	1:2.5		1:2.5	1:2.5		1:2.5	1:2.5		1:2.5	
1	41	6.59	11	71	7.58	21	42	6.89	31	81	7.97
2	29	7.07	12	36	6.58	22	61	7.49	32	56	6.93
3	34	6.69	13	61	7.81	23	56	6.82	33	20	6.12
4	29	6.86	14	43	7.50	24	36	6.18	34	27	6.08
5	46	6.75	15	39	7.32	25	39	7.43	35	29	6.51
6	46	6.21	16	45	7.66	26	25	6.36	36	34	7.67
7	67	7.36	17	67	7.47	27	46	6.89	37	50	7.70
8	59	7.45	18	80	7.71	28	27	6.41	38	29	6.57
9	56	7.01	19	48	7.70	29	31	6.70	39	25	7.60
10	67	7.06	20	36	6.76	30	22	6.07			

Table 13. Bulk density of powdered soils in laboratory from different plots in block -III of CHES, Vejalpur farm.

Plot No.	BD (g/cm^3)	Plot No.	BD (g/cm^3)	Plot No.	BD (g/cm^3)	Plot No.	BD (g/cm^3)
1	1.122	11	1.080	21	1.017	31	1.145
2	1.030	12	1.105	22	1.100	32	1.140
3	1.050	13	1.105	23	1.135	33	1.200
4	1.088	14	1.085	24	1.135	34	1.145
5	1.015	15	1.111	25	1.170	35	1.145
6	1.122	16	1.175	26	1.155	36	1.195
7	1.043	17	1.125	27	1.140	37	1.165
8	1.122	18	1.100	28	1.215	38	1.210
9	1.135	19	1.090	29	1.125	39	1.210
10	1.130	20	1.155	30	1.125		

BD=Bulk Density

Surveyed area

A systematic soil survey was carried out during 2021 in arid vegetable growing areas of Bikaner district. Analysis the soil samples those collected from adopted village of CIAH, Bikaner and 60 soil health card were prepared and distributed among farmers (Gigasar village) during International soil health day 2021. The soil samples were analyzed through the standard method and results revealed that the soils were neutral to alkaline in reaction with an average pH of 7.68. The organic carbon content ranged from 0.05 to 0.13 with an average value of 0.1, available nitrogen, phosphorus (P) and potassium (K) content of these soils ranged from 115.48 to 285.80, 7.70 to 18.71 and 136.76 to 292.68 kg ha^{-1} with an average value of 211.27, 12.48 and 217.18 kg ha^{-1}, respectively. Among major nutrients, about 95.29% of the soil samples were low, whereas, rest of the samples (4.71 %) were found to be medium in available nitrogen, 32.65 and 65.35% soil samples were observed to be low and medium in available P_2O_5, whereas, 95.19 and 4.81% samples were in medium and high in available K respectively.Nutrient indexing of the areas was low for N (1.05) and phosphorus (1.66), whereas, it was medium in case of potassium (2.05). With respect to micro-nutrients 99.04, 14.42 and 19.23% samples were found to be deficient in DTPA-Zn, Cu, and Fe, respectively. Soil health cards were distributed among farmers during International Soil health day 2021-22.

Biotechnology/ Biochemistry and crop physiology

DNA Fingerprinting, molecular diversity and population structure analysis in ber cultivars

For the molecular characterization of ber genotypes, thirty four SSR markers were selected from public literature and validated through PCR amplification on genomic DNA of 37 ber cultivars. Out of 34 markers, thirty three markers were got amplified on genomic DNA. Based on the significant number of bands produced, the SSR markers were categorized as highly, medium, low and monomorphic types of SSR during the molecular characterization of ber. Among 33 amplified SSR, thirteen, fourteen and 3 each were found highly, medium, low and monomorphic SSRs, respectively. The SSR markers possessed high and medium polymorphisms i.e. 27 were taken for further analysis in the course of study. The low and monomorphic types of SSR were excluded from the study.

Thirty three markers were resulted into 61 polymorphic alleles with range of 2 to 3 alleles per locus. The Polymorphism Information Content (PIC) value was ranged from 0.41 to 0.69 with an average value of 0.55. Similarly, the expected heterozygosity (He) level was observed in a rage of 0.09 to 0.64 with an average of 0.37. The UPGMA phylogenetic tree classified 37 genotypes into two major groups. The group I is further divided into three sub-groups namely sub-group Ia, sub-group Ib and sub-group Ic consisting of 10, 15 and 11 genotypes, respectively. The group II is consisted with only one genotype (B20). The clustering analysis further revealed that the genotype sets viz., B28 & B29, B30 & B31 and B36 & B37 showed high level of homozygosity index. Further, the 61 alleles generated by 26 SSR markers were utilized for population structure analysis in ber. Consequently, two major populations with some extend of admixtures were assessed in 37 ber genotypes. The population 1 is consisted with 18 ber genotypes; whereas population 2 is consisted with 19 genotypes. The assessed genetic diversity and population structure analysis in ber can be employed for crop improvement in Indian ber.

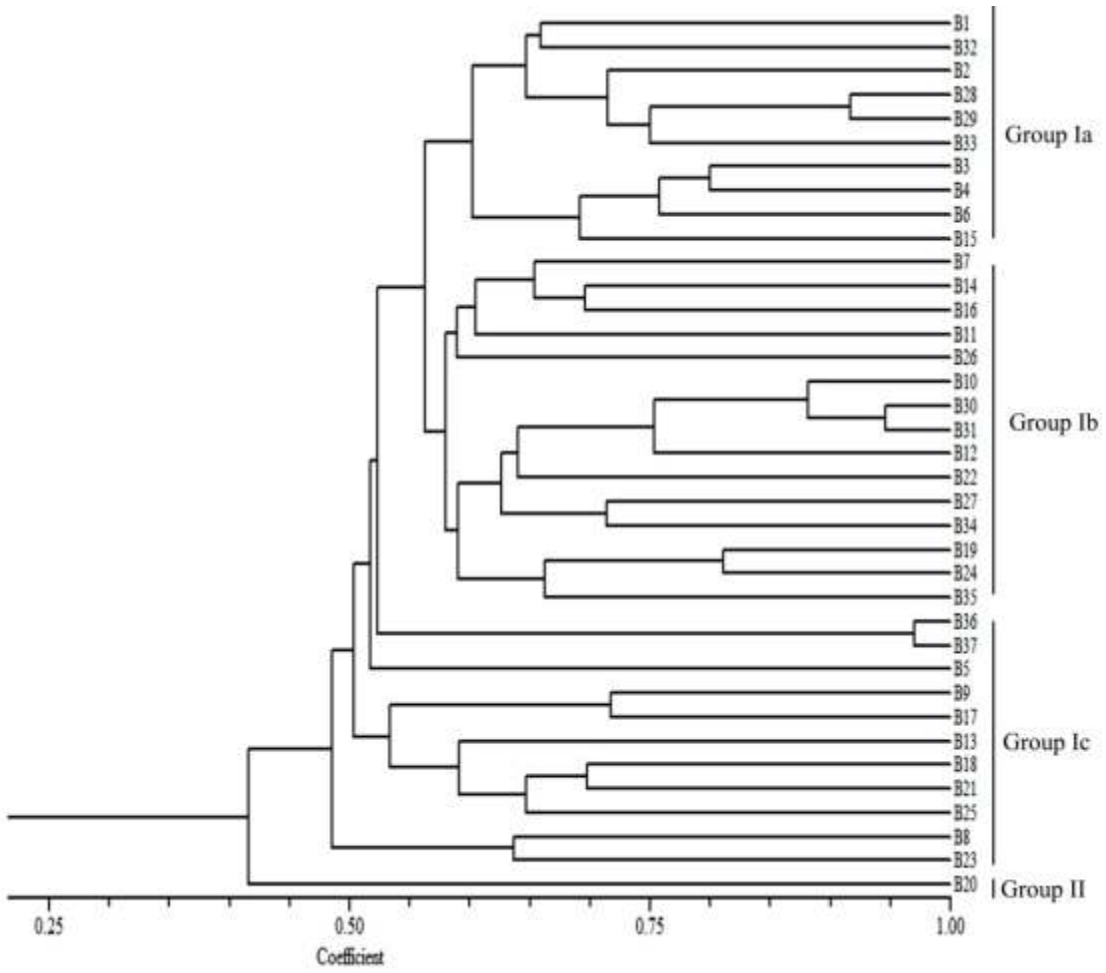
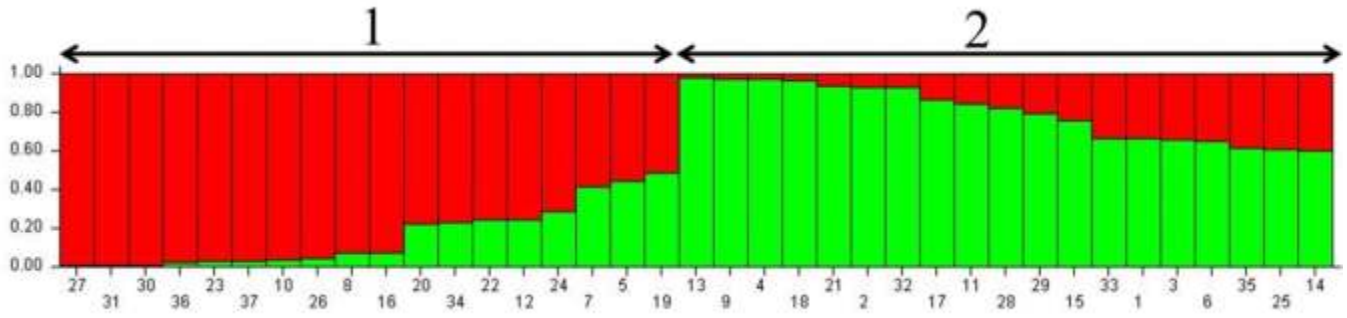


Fig. 72. Phylogenetic analysis of ber genotypes



Assessment of molecular diversity in Gola strains

Out of 34 markers, the best 13 markers are used to determine the clonal fidelity and duplicacy in 16 Gola strains. Amplified markers show very low level of polymorphism. Though the polymorphism was shown by some primers (Zma168, Zma189 and Zma195) [Fig. 4] but the level of polymorphism was very low. This discrepancy due to either low level of polymorphism in all Gola clones or they are genetically similar. Therefore, the further analysis of phylogenetic and population structure analysis was not done because it need to validate more number of SSR markers.

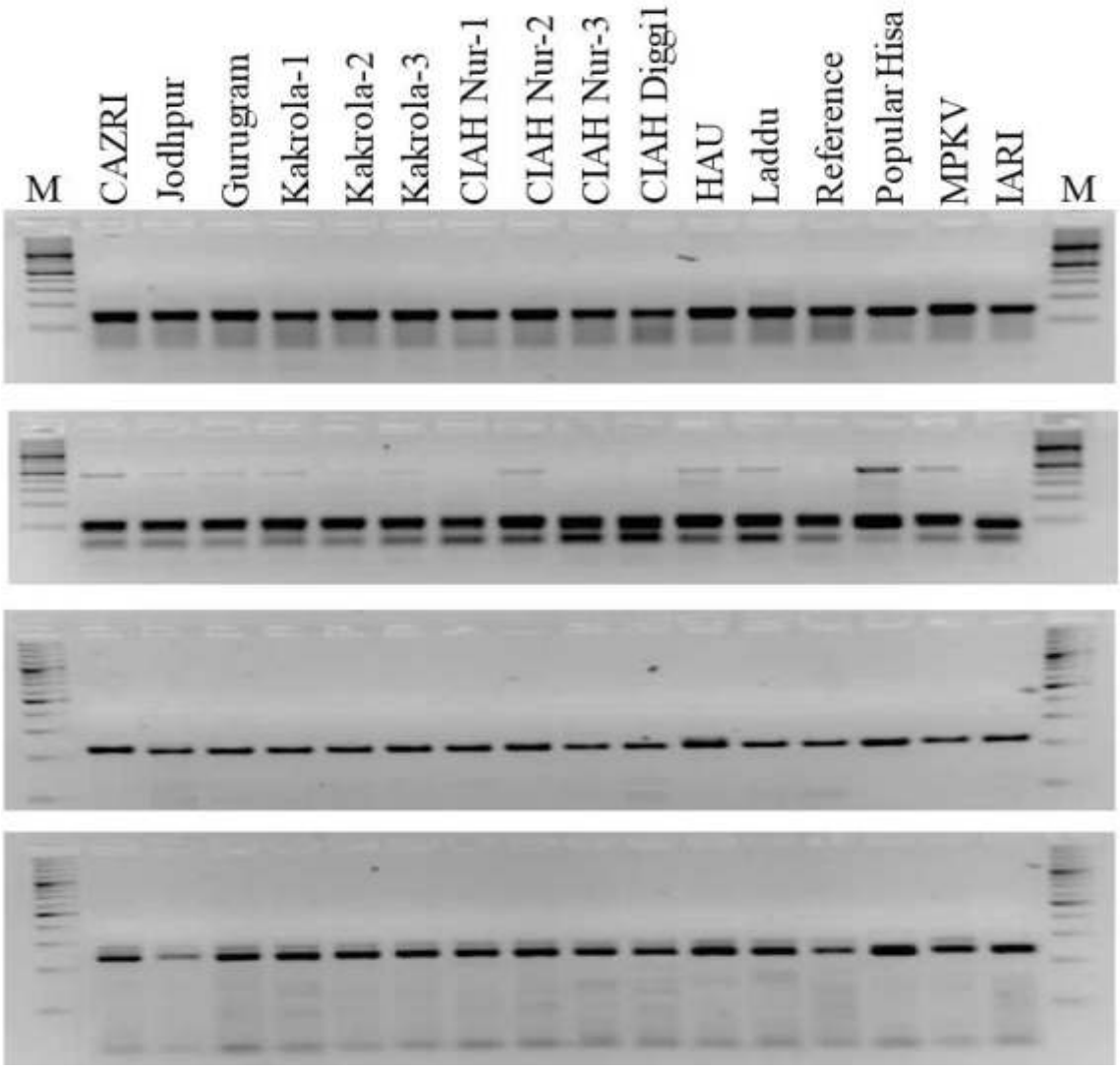


Fig. 73. Assessment of clonal fidelity in Gola strains.

Assessment of molecular diversity in cowpea genotypes

For molecular characterization of cowpea genotypes, ten each ScoT and CBDP markers were profiled on genomic DNA of cowpea genotypes. The markers were amplified significant number of polymorphic bands and thus differentiated the genotypes clearly (Fig. 5). Twenty used markers produced 165 polymorphic alleles with range of 2 to 6 alleles per locus. The Polymorphism Information Content (PIC) value was ranged from 0.39 to 0.65 with an average value of 0.52.

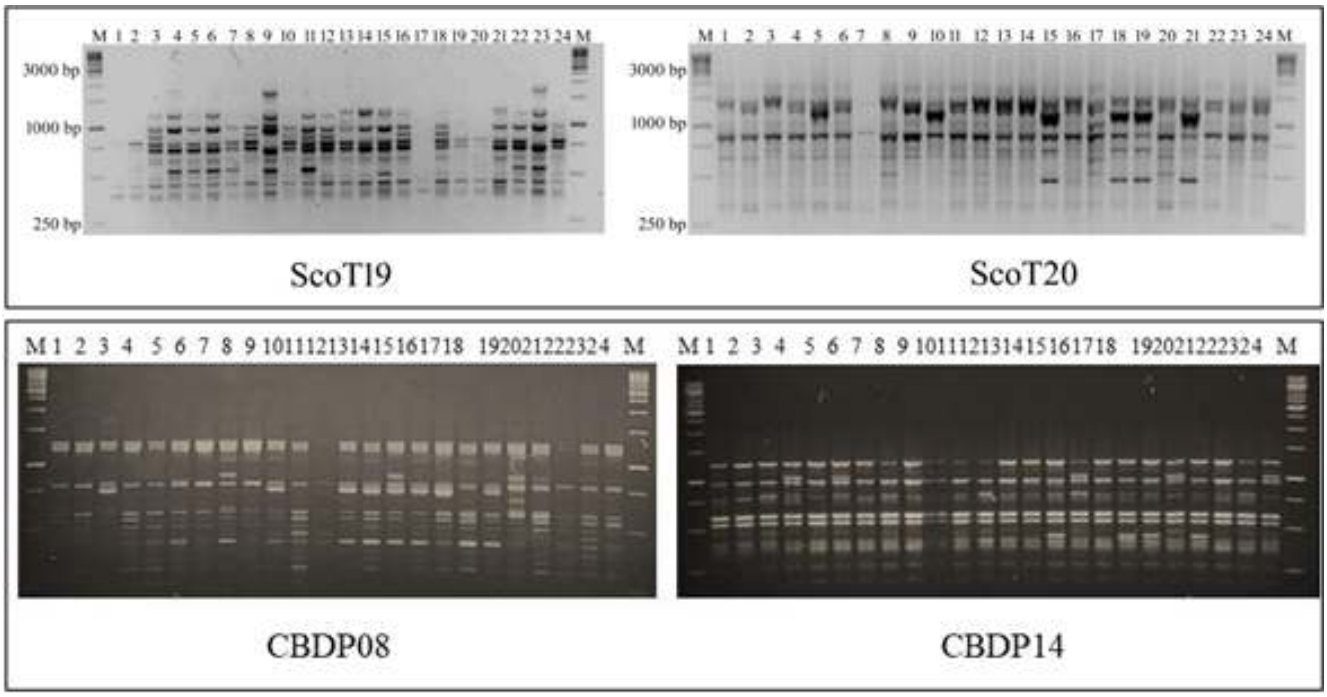


Fig. 74. Profiling of ScoT and CBDP markers in cowpea genotypes. M indicates 1 Kb DNA ladder. The numerical 1-24 indicate the cowpea genotypes.

5. Identification and characterization of Respiratory Burst Oxidase Homologs (*RBOH*) genes from genomic database of watermelon

To identify the Respiratory Burst Oxidase Homologs (*RBOH*) genes in watermelon, the BLASTp search was performed against the genomic database of watermelon using *Arabidopsis* RBOH protein as a query sequence. Consequently, nine putative *RBOH* genes were identified in watermelon. Based on the species belong and their chromosomal position, the *RBOH* genes were named as *ClaRBOH* genes and nomenclatured as *ClaRBOH01* to *ClaRBOH09*, respectively (Fig. 6).

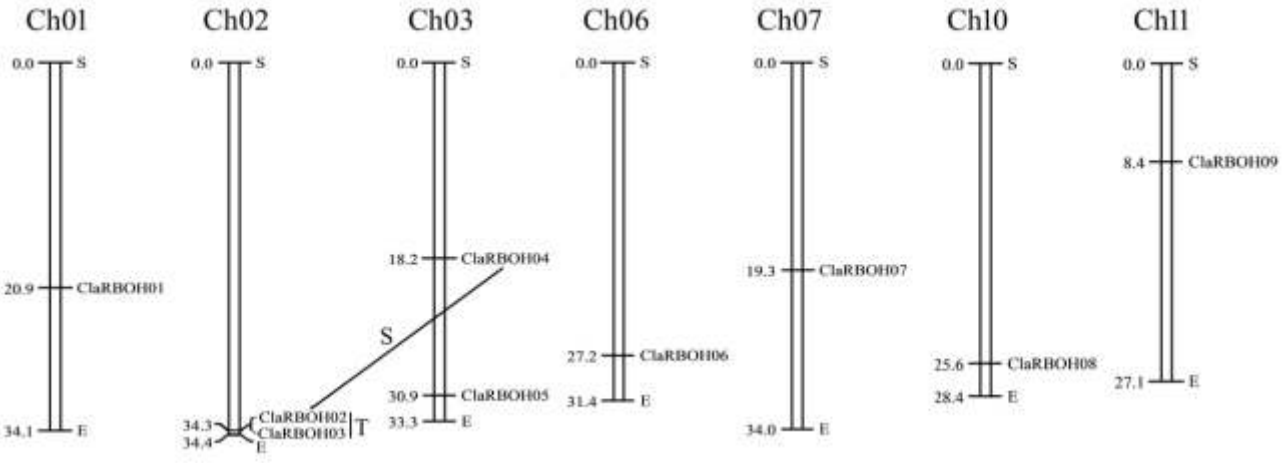


Fig. 75 . Chromosomal positions of ClaRBOH genes in watermelon genome.

For assessing the sequence conservation among the *ClaRBOH* genes, multiple sequence alignment (MSA) was carried out using amino acid sequences of ClaRBOH proteins. The MSA analysis revealed the significant peptide sequence conservation along with conserved domains among the ClaRBOH proteins. The evolutionary relationship among the *ClaRBOH* genes and *RBOH* genes of other cucurbits and *Arabidopsis* was demonstrated by phylogenetic analysis in MEGA 7.0 software. The phylogenetic tree constructed with deduced amino acid sequences of *RBOH* genes classified them into 4 major groups. The *ClaRBOH* genes showed close proximity with bottle gourd *RBOH* genes. To validate the tissue-specific expressivity governed by *ClaRBOH* genes, the RNA-seq data sets pertaining to different tissues and environmental conditions (osmotic and salt stress) were analysed using SRA Blast tool of NCBI. During the *in silico* gene expression analysis, the *ClaRBOH* genes clustered the tissues and conditions into 6 major groups and *ClaRBOH* genes itself clustered into two major groups. The *ClaRBOH06* and *ClaRBOH08* were found most up-regulated genes comparatively . Furthermore, the inducibility of ClaRBOH genes were analysed during drought and salinity stress in watermelon using semi-qRT-PCR analysis. The ClaRBOH genes were showed differential expression pattern accordance with time course of stress treatment

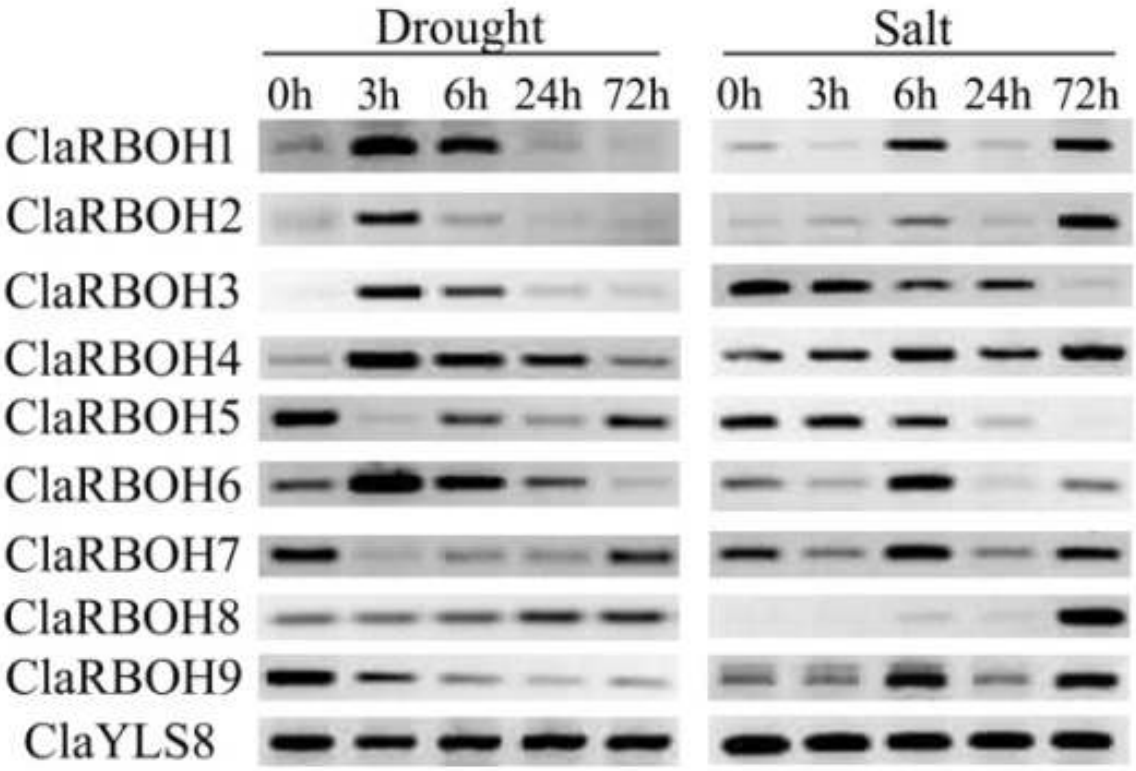


Fig.**76**. Semi-qRT-PCR analysis of *ClaRBOH* genes during drought and salinity stress in watermelon.

Bottom-up mechanism of tolerance against concurrent abiotic stresses in khejri (*Prosopis cineraria*) under hot arid region

Abiotic stress tolerance is a complex phenomenon, expression of which depends on accomplishment and interaction of various morpho-physiological and biochemical traits like antioxidant defense bio-molecules and strength of antioxidant enzyme system. Khejri (*Prosopis cineraria*) belongs to family Fabaceae, is one of very important multiple abiotic stress tolerant perennial tree of The Thar Desert. The genus *Prosopis* has attracted attention because of its ability to survive in extremely hot-arid, saline and inhospitable locations, sometimes being the only trees able to do so. To elucidate the "Bottom-up" (intrinsic) mechanism of tolerance in Khejri against concurrent Abiotic stresses occurs naturally in hot arid region, the present study was conducted to evaluate the pattern of stress responsive metabolites like phenol, flavonoids, tannins, pralines, MDA, chlorophyll content and Total antioxidant activities

along with antioxidant enzymes like SOD, APOX and Catalase in leaves collected during different months from two genotypes (Thar shobha and Wild). A significant seasonal variation was observed in all evaluated parameters like chlorophyll, MDA, phenolics, flavonoids, TAA, and antioxidant enzymatic activities. The Principle component analysis (PCA) carried out with the assayed parameters like phenol, flavonoids, tannins, pralines, MDA, chlorophyll content and Total antioxidant activities along with antioxidant enzymes like SOD, APOX and Catalase for wild as well as Thar Shobha variety.

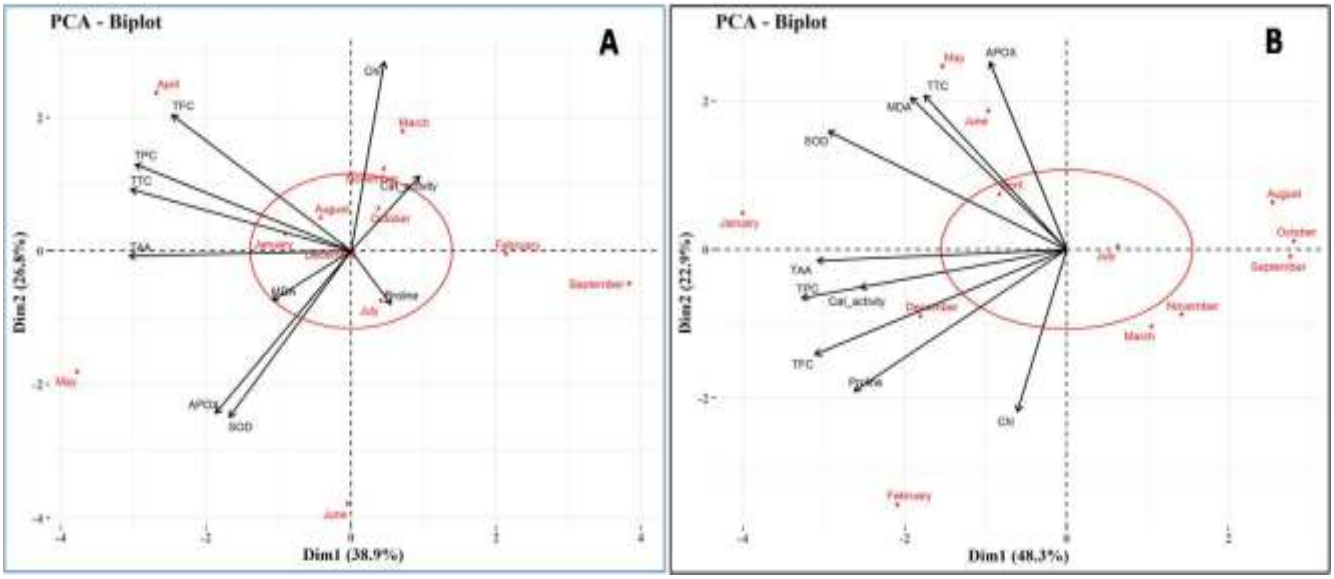


Fig. 77. Principal Component Analysis (PCA) for Assayed parameters in respect of sampling months

A - Wild Khejri; B - Thar Shobha Khejri .

In wild khejri PCA explained 65.7% of variability and in Thar Shobha it explained 71.2% of variability in axis one and two (Figure 1). In wild khejri the PC1 explained 38.9% of the combined variance and the PC2 explained 26.8% while in Thar shobha the PC1 explained 48.3% of the combined variance and the second component (PC2) explained 22.9%. This clearly demonstrated that there is variability in the parameters assayed in relation to the sampling months or environmental temperature. The biplot graph from this analysis confirmed the occurrence of seasonality in antioxidant responses in Khejri leaves, marked by all the assayed parameters. The sampling units of summer months (April to June) and winter months (December and February) were grouped on the negative side of axle one and characterized by the highest values for TAA, phenolics, flavonoids, and tannin content. On the other hand, the sampling units of the remaining months were generally grouped at the opposite side of this axle. Plants generally produce more antioxidants under oxidative stress conditions and in the hot arid region; the environmental conditions are highly toward extreme sides. During summer months the environmental temperature remains as high as 48 ?C with very high radiations and winter with extremely low temperature reaching to subzero ?C. The extreme summer and winter seasons creates sever oxidative stresses in plant metabolism, and require maximum amount of stress scavengers to cope with the generated oxidative stress. This study demonstrated that khejri plant has strong Bottom-up (intrinsic) antioxidant defense mechanism which responds quickly towards elicitors/ signals generated under concurrent abiotic stresses in different months. Seasons under hot arid region and make this plant tolerant against multiple Abiotic stresses.

Non-Targeted metabolite profiling of Khejri (Thar Shobha) leaves through GC_MS/MS under concurrent Abiotic stresses

The non-targeted metabolites profiling of khejri leaves (Thar Shobha) was done through GC-MS/MS during January, March, June, August, October and November which represents almost all seasonal environmental conditions of the region. Under GC-MS chromatogram more than 100 metabolites were detected during different months and the major metabolites whose expression pattern varied with seasons are presented with heat map in

Figure 2. Expression of 1,3-Dioxolane-4-methanol, 2-ethyl-; Benzofuran, 2,3-dihydro-; Cyclohexasiloxane, dodecamethyl- and 3-O-Methyl-d-glucose increased drastically during summer month (June) while 3-O-Methyl-d-glucose increased during winter month (January) and the expression of Hexadecanoic acid, 9,12-Octadecadienoic acid (Z,Z)- and stigmasterol was highest during sever winter as well as sever summer months. These particular metabolites might play a vital role in tolerance against specific Abiotic stresses.

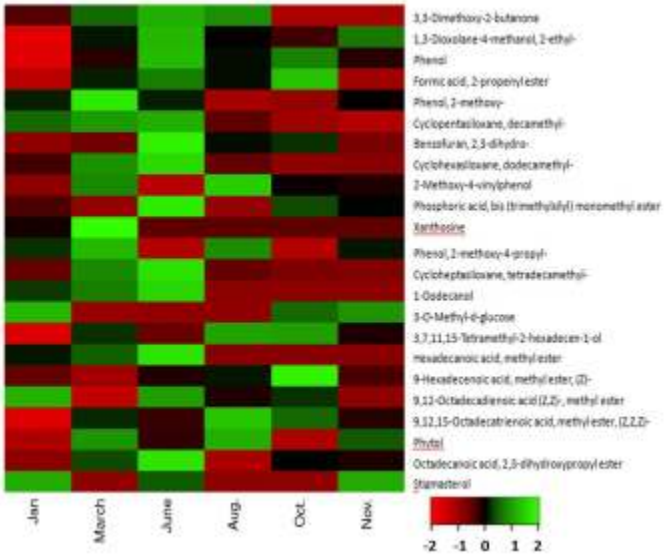


Fig. 78. Expression Pattern of non-targeted metabolites in khejri leaves under different months

Calligonum polygonoides L. as Novel Source of Bioactive Compounds in Hot Arid Regions

Calligonum polygonoides L. (Phog) is an endemic perennial herb that is highly resistant to all type of abiotic stresses and dominant biomass as well as phytochemicals producer in its natural habitat of the "Thar Desert" of Rajasthan, India. The present study was conducted to evaluate the effect of extreme environmental conditions on the phenolic, flavonoids, tannin content, and total antioxidant activities of *C. polygonoides* foliage harvested during different months. It exhibited a significant variation in the content of phenolics, flavonoids, tannins, and antioxidant activity with harvesting time and all parameters are positively correlated to each other. The highest phenolic compounds and antioxidant activity was observed during severe winter and summer months, when monthly average environmental temperature was lowest and highest of the year, respectively.

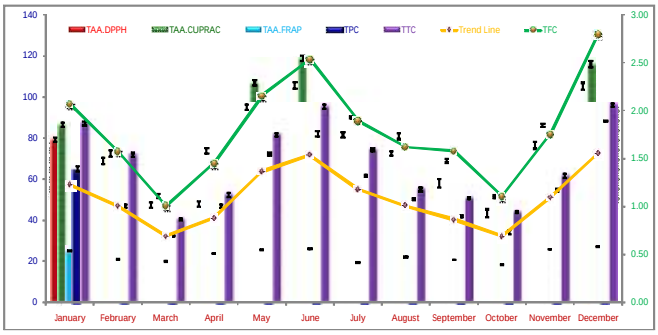


Fig. 79. Changes in total phenolics, flavonoids, tannin, and total antioxidant activity of Calligonum polygonoides L. Foliage during different seasons under extreme climatic condition. Data are presented as mean ± SD, n = 3 experiments, p <0.05.

The PCA was carried out with the assayed parameters like TAAs, phenolic, flavonoids, and tannin content along with harvesting months, it explained 93.7% of variability in axis one and two. The PC1 explained 68.4% of the combined variance and the second component (PC2) explained 25.3% (Figure 4). This clearly demonstrated that there is variability in the parameters assayed in relation to the sampling months or environmental temperature. The level of all parameters (TAA, phenolics, flavonoids, and tannin contents) was strongly related to axle one. The biplot graph from this analysis confirmed the occurrence of seasonality in antioxidant responses in *C. polygonoides* foliage, marked by all the assayed parameters like TAA, phenolic, flavonoids, and tannin contents (Figure 4). The sampling units of summer months (May and June) and winter months (Deceber and January) were grouped on the positive side of axle one and characterized by the highest values for TAA, phenolics, flavonoids, and tannin content. On the other hand, the sampling units of the remaining months were generally grouped at the opposite side of this axle. Plants generally produce more antioxidants under oxidative stress conditions and in the hot arid region; the environmental conditions are highly toward extreme sides. During summer months the environmental temperature remains as high as 48 ?C with very high radiations and winter with extremely low temperature reaching to subzero ?C.

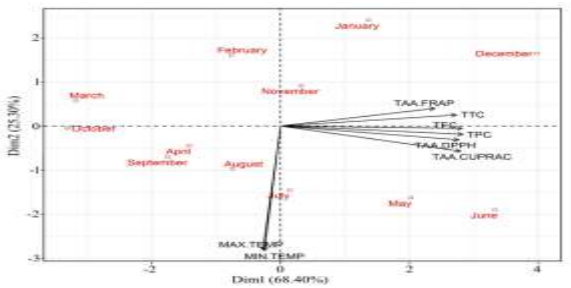


Fig. 80. Principal component analysis (PCA) of TAA, phenolics, flavonoids, and tanning content in C. Polygonoides foli- age during different mon

On the basis of the results, two harvests of *C. polygonoides* foliage during June and December are advised to maximize the phenolic compound production with highest antioxidant activity. These results demonstrate C. polygonoides, which is a dominant biomass producer under the harsh climatic conditions, can be an important source for the development of the functional foods rich in antioxidants in hot arid regions.

Physico-biochemical characteristics and fatty acid profile of tumba seed oil grown in hot arid environment

Tumba or bitter apple (*Citrullus colocynthis* L.) is a highly tolerant against multiple abiotic stresses like drought, heat, soil salinity, and can easily grow on very marginal soil even on sand dunes. Tumba fruits were harvested from ICAR-CIAH research farm. The seeds were separated, and oil was extracted with a soxhlet apparatus using petroleum ether as solvent. The tumba fruits contain 2-3% (in weight) of brown colored seeds, which contains 23-25% golden-yellow colored oil. The extracted oil (0.92 g/ml specific gravity) was assayed for physico-biochemical properties and fatty acid profile. It contains phytochemical (bioactive) compounds like phenolics (5.39 mg GAE/100g) flavonoides (938 mg catechin Eq./100g), carotenoids (79.5 mg/kg), oryzanol (0.066%), lignans (0.012%) along with 70 to 122 mgAAE/100 g total antioxidant activity at different scales. The results of GC-MS/MS based fatty acid profile demonstrated that tumba seed oil contains about 70% unsaturated fatty acids with more than 51% PUFAs (Figure 5 B). It mainly contains linoleic acid C18:2n6 (50.30%), followed by oleic acid C18:1n9 (18.02%), stearic acid C18:0 (15.15%) and palmitic acid C16:0 (12.41%). It is considered as an excellent source of essential fatty acids like omega-6 fatty acid (e.g., Linoleic acid) while omega-3 (α-Linolenic acid) fatty acids and hydroxy polyunsaturated fatty acids are present at lower level. It also contains some odd chain fatty acids (OCFAs) like pentadecanoic acid (C15:0) and heptadecanoic acid (C17:0) which has been demonstrated as an essential fatty acid recently with their bioactivities as reduced cardiometabolic diseases risks. In conclusion, tumba seed oils can be an excellent dietary source of essential fatty acids with several medicinal properties.

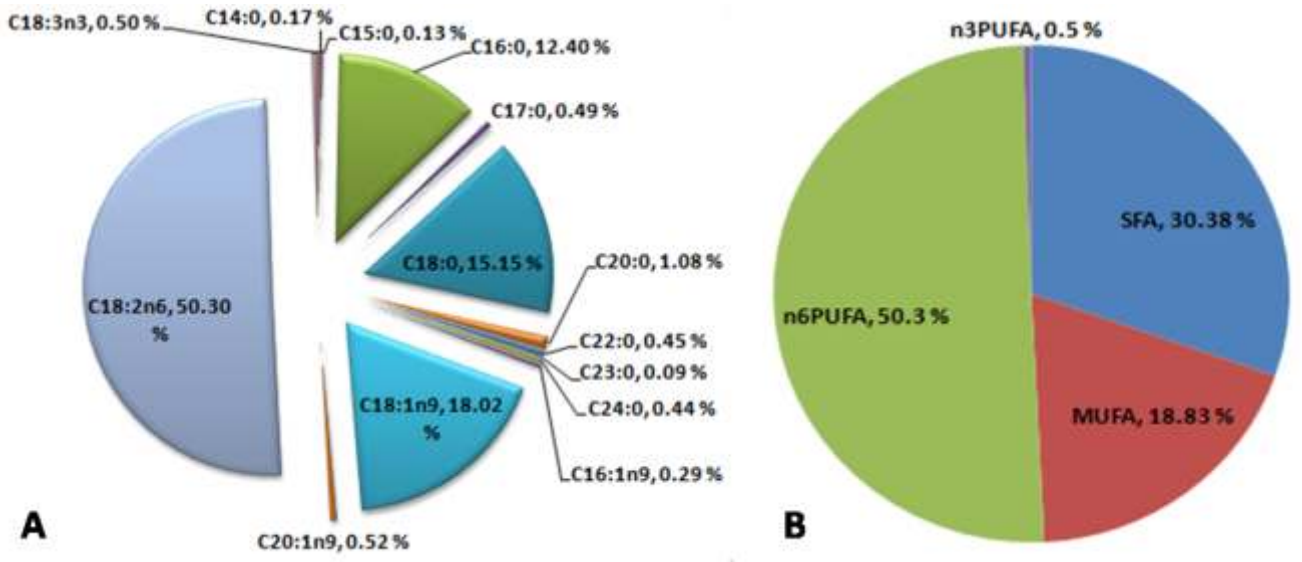


Fig . 81. (A) The fatty acid distribution of Tumba (*C. colocynthis*) seeds oil grown at hot arid region of Rajasthan (India) and (B) fatty acid subclasses distribution in the Tumba seed oil. SFA: Saturated fatty acids; MUFA: monounsaturated fatty acids; n6-PUFA: omega-6 polyunsaturated fatty acids(n3-PUFA): omega-3 polyunsaturated fatty acids. The values are presented as weight % for individual fatty acids.

Plant Protection

To survey pomegranate growing areas for occurrence of nematode

A survey programme of pomegranate orchards was conducted in the second week of September, 2021 at Palana, Ambasar and Sujasar villages of Bikaner district for occurrence of nematode infestation. The information was collected about plantation, plant age and fruit yield during interaction with farmers. Plants of pomegranate variety 'Bhagwa' were established in the orchards by farmers. Root knot nematode infestation was found up to average 6.33% in pomegranate orchards. At initial stages of infestation, no flowering and little leaf symptom was observed on infected plants with stunted growth while on later stage of infestation (after 2-3 year), leaf yellowing and wilting of plants with knots on the roots were observed. Nematode produces galls or knots on the roots. Root system is manifested by retarded growth, leaf yellowing and falling of mature plants. With the increase in nematode population, feeder roots are invaded and destroyed as fast as they are formed. The resulting setback in the uptake of plant nutrients leads to debility of the plants and production of smaller fruits. No root knot nematode infestation was recorded in case of tissue culture plants of variety 'Bhagwa' at this Institute and also farmer's orchards.

Fig. 82. Little leaf, root nodes/galls and nematode infected plant in pomegranate

Screening of date palm germplasm for resistance against *Alternaria* leaf spot

Date palm (*Phoenix dactylifera* L.) is infected by *Alternaria* leaf spot caused by *Alternaria alternata* (Fr.) Keissler. Tolerant cultivars is one of the best options to minimize the losses due to diseases. This disease is mild to moderate form at date palm germplasm block of the Institute. This disease was appeared during rainy season of the year 2021 under field conditions. Forty two date palm germplasm were screened for resistance against *Alternaria* leaf spot under natural conditions. Symptoms were observed as small light, dark gray to black circular spots. Later on, these spots increased in size and become irregular and black to straw colored and coalesced. Disease incidence (PDI) was found from 0.0 to 28.62% in different date palm germplasm of the Institute. It is preliminary study for resistance.

Date palm

Spider mite (*Oligonychus afrasiaticus*)

The mite infection was observed during growth and development as well as ripening stages of date palm fruits. Its adults and nymphs suck the sap of immature green date fruit causing severe fruit scarring, distorting, turn date to brown with scabbed appearance. This pest is sucking fruit juice, crease spotting leading to stop fruit growth and destroying natural appearance & causes their size to shrink and reduce market value of fruits. The serious infection of dust mites build up the webs on fruits bunches around strands and date fruits. The insect's population are blocking the physiological activities of the fruits owing to delays in natural fruit colouring and ripening. The web of mite adheres to dust and sand particle accumulate on infested bunch and turn fruits to dusty appearance that's why the mitesare known as dust mite. Eventually, the fruits become unfit for human consumption.

Red palm mite: It is a minor pest of date palm and emerging two times (October and February) in year. Mite populations are build-up mostly on the underside of the leaflets and visible with the naked eye and feeding chlorophyll content due to yellow patches on plant leaves.

Shape deformity and stone splitting in Thai ber fruits

A field trial was conducted and treatments, namely sucrose (2.5, 5.0& 7.5%), boric acid (0.1, 0.2 & 0.3%), zinc sulphate (0.3, 0.4 & 0.5%), GA_3 (15, 45 & 60 ppm) were imposed on Thai ber. The result revealed that all the treated plants observed less off shape fruits compared to control. Among the agrochemicals, boron and GA_3 treatments not only reduced the splitting of fruits, but also enhanced the TSS content (18.9 ^{0}B) and mean fruit weight (42.52 g) compare to control(18.2 ^{0}B&37.25 g), respectively.

Fig. 83. Thai Ber-Shape deormity and stone splitting fruits

Post-Harvest Management

Standardization of packaging to extend post-harvest life of mulberry fruits

Mulberry fruits are rich in nutrition, but perishable in nature and prone to damage during post-harvest handling due to climacteric ripening behavior, thin skin and soft texture. Here, proper packaging in safe material may enhance the post-harvest life and can check spoilage during transport. Therefore, an experiment was conducted for evaluation of shelf in different packaging material at ambient conditions (Temperature: 40±2 °C and RH: 50-60%). The packaging treatments were CFB box with 0.3% ventilation (T_1), CFB box with 0.5% ventilation (T_2), CFB box covered with cling film (T_3), muslin cloth bag (T_4), brown paper bag (T_5) and open plate as control (T_6). Results revealed that slow progression in TSS and anthocyanin content were noticed in T_3 and T_1 throughout the storage period. Moreover, minimum cumulative physiological loss in weight (7.63%) after 2 days (48 hrs) was observed in T_3 followed by T_1 (12.87%) and maximum in control (23.72%). Thus, CFB box covered with cling film (T_3) and CFB box with 0.3% ventilation (T_1) enhanced shelf life for 2 days and found suitable packaging for mulberry fruits.

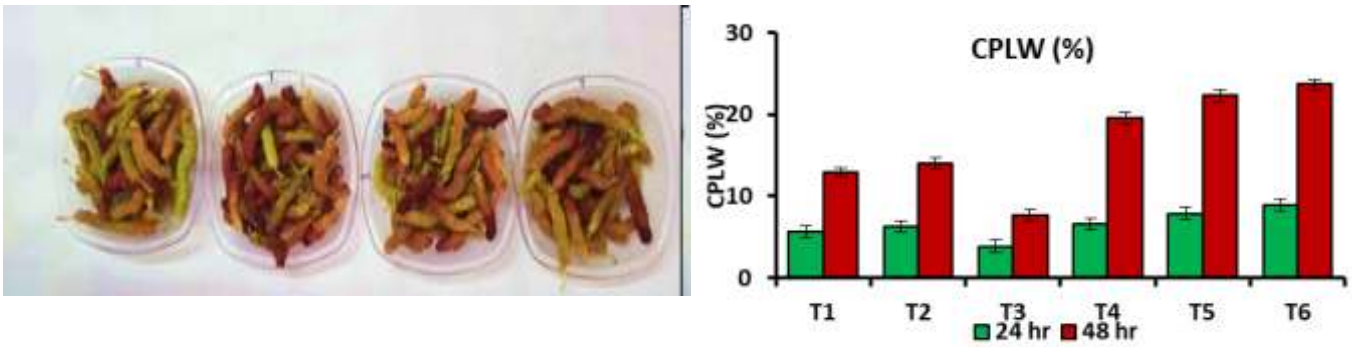


Fig. 84, CPLW of mulberry fruits in different packaging material at ambient conditions

Standardization of packaging for safe transport and marketing of fresh dates

An experiment was carried to standardize suitable packaging material for safe transport and marketing of date palm fresh fruits. Date palm cv. Halawi fruits were harvested at doka stage, packed in different packaging materials and stored at ambient conditions (Avg. temperature: 42±2°C and RH: 55-60%) for 4 days period. The packaging treatments were plastic box with 0.5% ventilation (T_1), plastic box with 1.0% ventilation (T_2), CFB box with 0.5% ventilation (T_3), CFB box with 1.0% ventilation (T_4), woven cloth bags (T_5) and without packaging (T_6). Each packaging treatment was replicated into three and observations were recorded at alternate days. After 2 days of storage, significantly high physiological loss in weight (PLW) was observed in T_6 (16.74%) followed by T_5 (9.92%) and minimum PLW was recorded in T_1 (6.34%) followed by T_2 (6.75%). Fruit shrinkage was observed minimum in T_1 (5.05%) followed by T_3 (5.98%), whereas maximum fruit shrinkage was observed in T_6 (21.53%) followed by T_5 (16.45%).

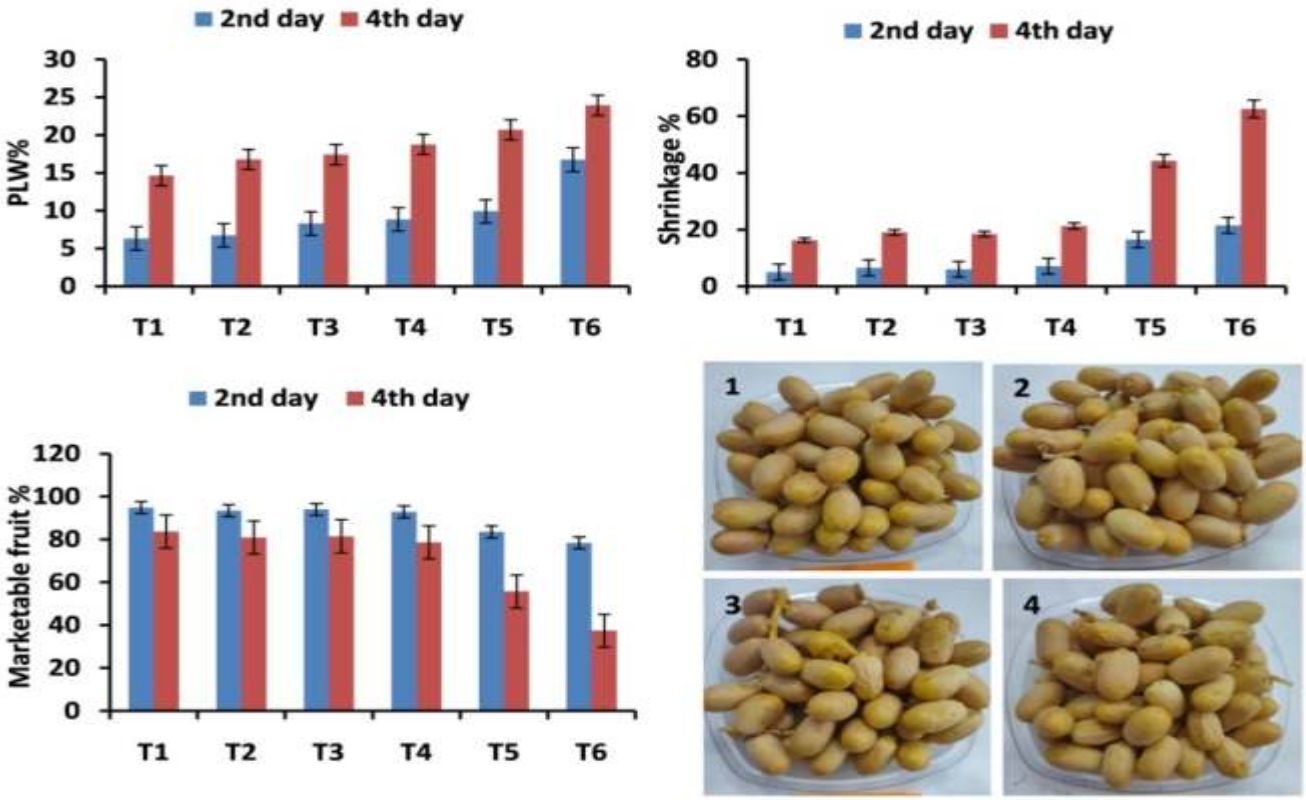


Fig. 85. Physiological loss in weight (%), shrinkage (%) and marketable fruit (%) in different packaging material in date palm fruits cv. Halawi during 4 days storage at ambient conditions

At 4th day of storage, minimum PLW (14.64%), fruit shrinkage (16.28%) and maximum marketable fruits (83.72%) were observed in T_1 followed by T_3 whereas maximum PLW (23.95%), fruit shrinkage (62.54%) and minimum marketable fruits (37.46%) was recorded in fruits stored without packaging material. It is concluded that packaging of fruits considerably extend shelf life and retain freshness for 4 days period. Food grade plastic boxes and CFB boxes with 0.5% ventilation found suitable packaging for retail marketing of doka stage fresh date fruits.

Application of anti-browning agents for reducing browning in dry dates

Surface browning in dry dates during storage and marketing is seriously affects consumer acceptability. In order to improve color in dry dates, anti-browning agents were applied through dip treatment. The treatments were citric acid 1.0% (T_1), ascorbic acid 0.3% (T_2), potassium metabisulphite 1.0% (T_3), Cystene 0.3% (T_4) and water dip (T_5). After treatment date berries were dried in sun, packed in food grade plastic containers and stored at room temperature. Observations for surface color were recorded after two months of storage. Citric acid 1.0% and potassium metabisulphite 1.0% significantly reduced browning as compared to control (Fig. 1). No significant difference was observed in non enzymatic browning (NEB) value among ascorbic acid, cystene treated dates and control. Though citric acid and potassium metabisulphite treatment reduce browning to some extent but still it is not acceptable in market. Therefore, this experiment will be repeated with new anti-browning agents.

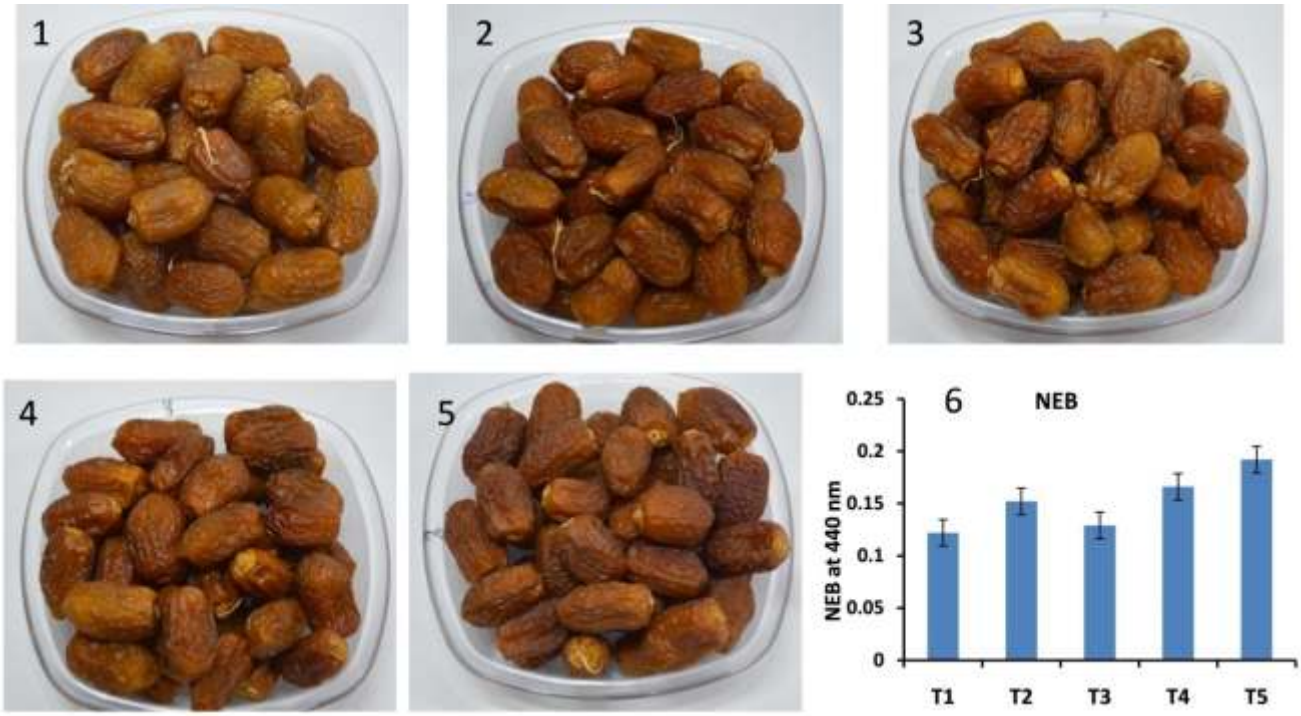


Fig. 86. 1. citric acid 1.0%; 2. ascorbic acid 0.3% 3. potassium metabisulphite 1.0%; 4. cystene 0.3% and 5. distill water treated dry dates color and non-enzymatic browning value in different treatments.

Pre-harvest fruit growth pattern and standardization of maturity indices in sponge gourd

Sponge gourd (*Luffa cylindrica)* is an important cucurbit vegetable of north-western parts of India. To promote its cultivation in the hot arid climate, the variety Thar Tapish is developed through hybridization breeding (parentage AHSG-4 x AHSG-16) at ICAR-CIAH, Bikaner. It is trait-specific and high quality fruit yielding variety and suitable for summer and rainy season crop cultivation under hot arid environment. In market, consumers prefer tender, smooth and straight-long fruits for vegetable culinary. However, it is observed that some tender fruits got curved and converted to abnormal shape due to the extremes of high temperature and fruit-fly damages. Abnormal and damaged fruits fetches poor price in the market which result into economic loss to the growers. However, such kind of fruits can be dehydrated and stored for off-season uses.

The present study was carried out with cultivar *Thar Tapish* sown during February and July month crop of summer and rainy season, respectively. At the peak of flowering (second week

of April and September), opened female flowers were tagged periodically and fruit set observed. Fruit morphological characters such as length, diameter, weight, firmness, texture and colour were recorded post pollination at one-day interval from tagged fruits for marketable quality study. Five fruits were harvested for morphological observation at each stage study. It is revealed from the data that fruit length continued to increase up to 10 days after pollination, and then it slow-down and no significant difference was noticed in fruit length after 10 days of pollination. Exponential enhancement in fruit length was observed between 2 to 7 days after pollination and then the growth slow-down. Fruit diameter was increased gradually during initial 4 days of pollination, however, rapid growth was observed between 4 to 10 days from fruit-set. After 10 days, no considerable variation was observed in diameter. Similarly, fruit weight was also increased with slow rate during initial 4 days after pollination and faster increase in weight was observed during 4 to 11 days of pollination.

Dynamic changes in fruit firmness were noticed during development stages. During first 6 days of pollination, firmness was observed less than 4 kg/cm^2 which indicate presence of less fiber and high moisture content in the tender fruits. After 6 days, firmness was continuously enhanced up to 12 days of fruit growth however rapid increase was observed between 8 to 12 days from pollination (fig 2). High increase in firmness after 8 days may be due to tissue hardening and thickening of fruit peel. With respect to fruit surface texture, tiny hairs was observed during first 3 days of pollination after that they were disappeared and surface remain smooth up to 8 days of pollination. After 8 days, fruit surface become rough, comparatively hard and small ridges appeared.

On the basis of morphological and sensory observations, maturity indices standardized for harvesting of sponge gourd fruits for fresh vegetable purpose and it should be harvested after 6-8 days of fruit set, and at this stages firmness range is 3.5 5.0 kg/cm^2, fruit weight 70-150 g, fruit length 16-22 cm, diameter 2.77-4.27 cm with smooth surface.

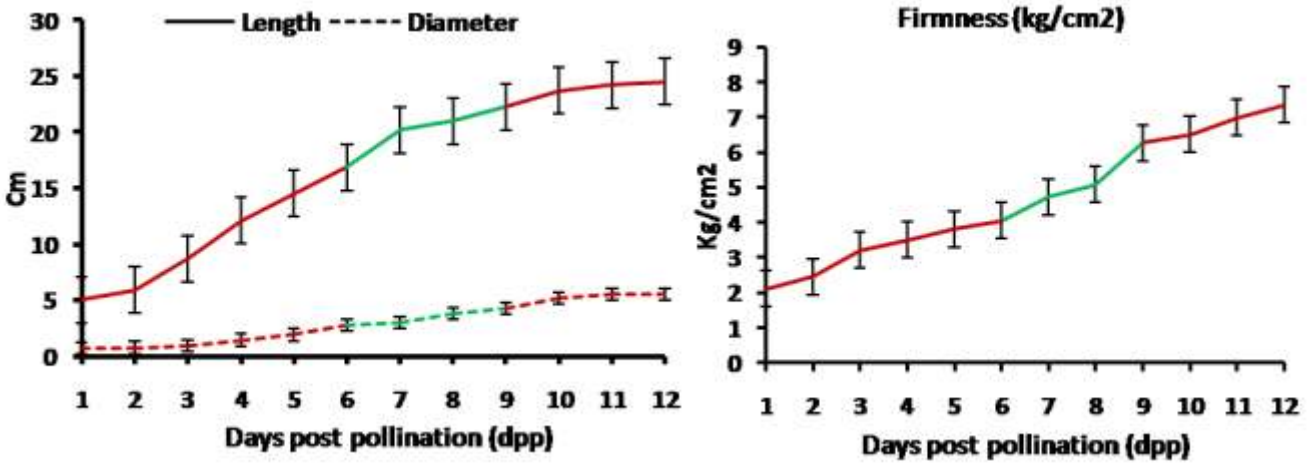


Fig. 87. Dynamic changes in fruit length, diameter and firmness from fruit set to 12 days. Each value is the mean ±SE of 5 fruits.

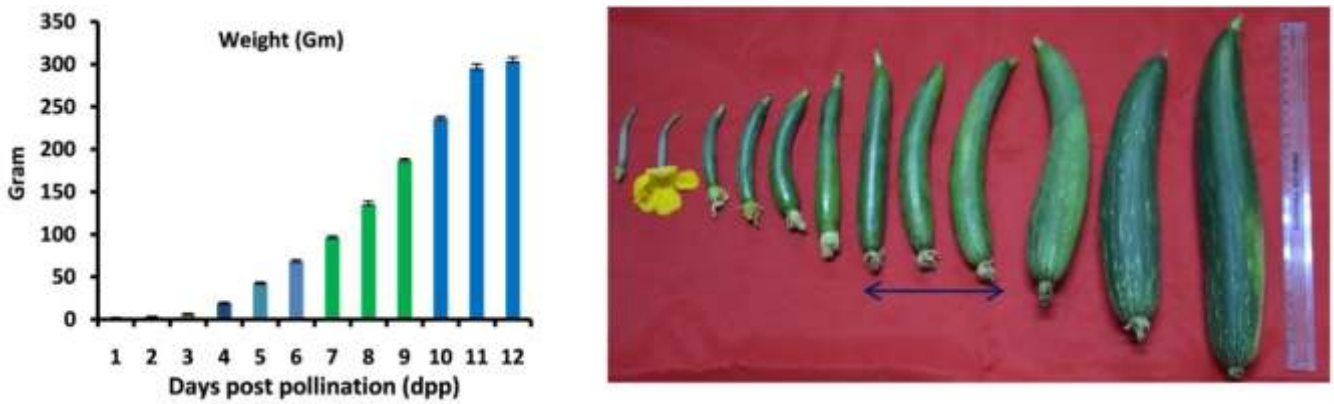


Fig. 88. Changes in fruit weight from fruit set to 12 days; photograph of fruit developmental stages

EXTENSION

Impact assessment of adoption of pomegranate and date palm crops in hot arid regions of Rajasthan.

During the year 2021, the targeted data/information (related impact of adoption of date palm and pomegranate) were collected from arid district of like Bikaner, Jaisalmer, Shri Ganganagar, Hanimangarh, Barmer, Nagaur, Jodhpur, Jalore, Churu, Pali, Jhunjhunu, and Sikar with the help of primary sources (farmers/stakeholders and field workers/extension agencies) and using electronic media like mobile, email, Whatsapp, etc and secondary sources also. The some occasional visits were also made in district like Bikaner, Barmer, Jodhpur and collected desirable, data/information.

Initial data/information of the study revealed that the total area under date palm in different districts of hot arid region like Bikaner, Jaisalmer, Shri Ganganagar, Hanimangarh, Barmer, Nagaur, Jodhpur, Jalore, Churu, Pali, Jhunjhunu, and Sikar was 422, 224, 202, 148, 158, 49, 46, 126, 91, 78, 22, 18 ha. With 4865, 3176, 3154, 1341, 1437, 498, 427, 1174, 732, 640, 161, 81metric ton production/year, respectively during the reported period of time.

In case of pomegranate, it was found that the total area under pomegranate crop production in different districts of hot arid region like Barmer, Jalore. Jodhpur, Jaisalmer, Bikaner, Pali, Nagaur, Sikar, Churu, Shri Ganganagar, Hanumangarh, and Jhunjhunu was 8544, 3928, 404, 380, 1705, 358, 226, 388, 99, 233, 181, 378 ha. with14798, 4499, 565, 564, 2525, 538, 298, 569, 128, 388, 366 and 578 metric tons/year, respectively.

The other information/data related to socio-economic impact of adoption of improved production technologies of pomegranate and date palm in study areas and factors responsible for adoption and non adoption/ discontinuance of the production of the crops under the project were also collected and documented.

The data/information collected during reported period of time were Coded, decoded, compiled, analysed to prepare the report of official use.

A study on impact of adoption and cultivation of vegetables under "Low Tunnel Technology" during off season

An intensive survey was conducted during 02.02.2021 to 04.02.2021 in local areas of Bikaner district like Jaipur bypass, Pemasar village, Jaipur road, Narangdesar, Sagar, Raysar, Ridmalsar, Napasar, Gardwala, Kilchu, Kalyansar, Gigasar, Ambasar, Sujasar, Palana, Swarupsar, Kolsar, Bachhasar, Meghasar, Naiyo ki Bast, Jaisalmer bypass, Ganganagr Hiway, Khara, Sarahkunjiya villages and surrounding areas of Bikaner city and collected basic data/information about the impact of adoption of "Low Tunnel Technologies" for cultivation of vegetables during off season (winter). The wonderful results and outcomes of the study were recorded/ observed. The study revealed that the local farmers grow various vegetables (specially, cucurbits) under "Low Tunnel Technologies (LTT)" during the winter season for advance production with the aim to fetch the high rates/price and high earning from the vegetable market/*Mandies*. "Low Tunnel Technologies (LTT)" vegetable production spread over 1200 ha in Bikaner district and farmers get/ earn Rs. 2.0 - 3.0 lacs net profit from one hectare of land per season depending on type of vegetable, seed quality, climatic conditions, marketing demand and natural hazards. It is cleaning, gainful and employment generating technology.

4. EXTERNALLY FUNDED PROJECTS

1. Production & demonstration of tissue culture raised plants under three locations & collection & maintenance of elite germplasm of date palm.

Funding: ICAR, New Delhi

Tissue culture derived date palm plants of Anand Local were procured at secondary hardening stage from Gujarat Agriculture University, Anand, Gujarat (India). Twenty five plants were transplanted in the field with good success establishment rate and recorded average height of plants reached up to 3.25 m. Number of leaves per plant were 37-46. Average canopy size (north-south x east-west) of the plants was recorded 3.79 x 3.67 m. Good results were obtained with respect to vegetative growth and development of the plants. Canopy size of the plants was also increased and reached up to 3.79 x 3.67 m. During 2021, attack of dust mites on leaves and fruits was noticed in some of the plants and also on fruit bunches. New plantation of sixty plants of Barhee variety also planted.

Emergence of spathe pollination, fruiting and yield attributes

Spathes were emerged in 84 plants with 5-14 spathes/plant during 2021, while in 2020, spathes aroused in 44 plants having 3-13 spathes/plant. Hand pollination was done using male pollen in these plants. Pollination was done manually from first week of March to first week of April 2021.

Heavy flowering and fruiting was observed in date palm 'Anand Local' plants. Good flowering was commenced in 84 plants during March -April, 2021. Heavy fruiting was recorded in these plants. Fruit was attractive shiny red coloured but medium in size. Fruits were matured and ready for harvest in the last week of June and harvested during first fortnight of July . The average fruit yield was recorded 20.13 (17.50-23.00) kg per plant. Average number of fruits per rachis, rachis per bunch, bunch weight, bunches per plant and fruits per bunch were found 16.80, 48.80, 2.69 kg, 8.40 and 965.20, respectively.

2. Enhancing food and water security in arid region through improved understanding of quantity, quality and management of blue, green and grey water (DST)

Funding agency: Department of Science and Technology, New Delh

As per the assigned activity, an experiment on" conjunctive use of surface (canal) and ground water (tubewell) in pomegranate (*Punica granatum* L.) fruit crop in sandy soils of western Rajasthan" was executed. During the period under report observations were recorded on plant vegetative, flowering, fruit yield and quality attributes.

Chemical composition of different irrigation waters

The water used for irrigation purposes are being made through the mixture of canal water (ECw 0.75 dSm^{-1}) and bore-well water (EC_w 4.85 dSm^{-1}). Accordingly in T_1 treatment of irrigation of water was 100% canal water and the pH, SAR were estimated as 7.90 and 4.56 meq/L, respectively. The cation contents (meq/L) of canal water i.e. Ca (1.20), Mg (0.52), Na (2.10) and K (0.02) while anion contents (meq/L) were recorded as HCo3 (1.02), Cl (4.20) and SO_4 (0.21). In T_2 treatment, ratio of canal water and borewell was 75:25 % and the chemical composition was estimated as pH (7.84), SAR (5.65 meq/L), cations (meq/L) Ca (4.00), Mg (3.76), Na (10.21), K (0.10) and anoins (meq/L) HCO_3 (3.90), Cl (6.50) and SO_4 (1.25). In T_3 irrigation water treatment, 50: 50 ratio of canal water and borewell water was used. The pH and SAR of this water was recorded as 7.94 and 7.20 meq/L. The anions and cations (meq/L) were recorded as Ca (6.23), Mg (4.85), Na (11.20), K (0.12), HCO_3 (3.10), Cl (8.50) and SO_4 (2.10). In T_4 treatment ratio of canal and borewell water was 25:75 and chemical composition was recorded as pH (7.90), SAR (8.50 meq/L), cations and anions (meq/L) as Ca (8.50), Mg (5.23), Na (12.50), K (0.16), HCO_3 (3.00), Cl (10.26) and SO_4 (2.50). In T_5 treatment 100% borewell water was used and composition of different ions (meq/L) and other parameters were estimated as pH (7.90), SAR (10.02), Ca (10.25), Mg (6.25), Na (14.20), K (0.20), HCO_3 (3.00), Cl (13.25) and SO_4 (3.50). In T_6 treatment required salts were added in borewell water to attain desired EC level i.e. 6.00 and composition of different ions (meq/L) and other parameters were estimated as pH (7.95), SAR (11.26), Ca (12.40), Mg (7.85), Na (15.85), K (0.26), HCO_3 (2.90), Cl (16.23) and SO_4 (5.20) .

Chemical composition of soil after application of saline irrigation water treatments

The soil sample were taken in different

saline irrigation water treatments and analyzed for soil chemical attributes. Among all the treatments, maximum soil ECe and pH were recorded in T_6 treatment (0.90 dSm^{-1} and 8.10) followed by T_5 treatment (0.85 dSm^{-1} and 8.05) while minimum soil ECe and pH were recorded in T_1 treatment (0.40 dSm^{-1} and 7.90), respectively. Similarly anions and cations (meq/L) were also increased in soil with increase in water salinity levels. The maximum anions and cations (meq/L) were recorded in T_6 treatment Ca (8.65), Mg (30.00), Na (5.18), K (0.42), HCO_3 (4.66), Cl (8.80) and SO_4 (12.36) followed by in T_5 treatment Ca (8.60), Mg (28.50), Na (5.06), K (0.40), HCO_3 (4.65), Cl (8.75) and SO_4 (12.00) whereas minimum anions and cations (meq/L) were recorded in T_1 treatment Ca (8.52), Mg (25.50), Na (4.80), K (0.35), HCO_3 (4.55), Cl (8.55) and SO_4 (11.50).

Effect of saline irrigation waters on growth parameters of the pomegranate

Different growth parameters like plant height, number of shoots, leaf area, plant spread, total number of flowers and perfect flowers were recorded in pomegranate plant irrigated with different salinity levels of water. The maximum plant height (175 cm) was recorded in T_1 treatment (100% canal water) and statistically at par with T_2 (172 cm) while in T_3, T_4, T_5 and T_6 significant reduction in plant height was recorded and minimum plant height (140 cm) was recorded in T_6 (maximum saline irrigation level) treatment. In all treatment 3 to 4 stems as per standard practice were maintained in all plants, hence no effect saline irrigation was recorded. Maximum leaf area (6.10 cm^2) of a leaf was recorded in T_1 treatment and significantly at par with treatment T_2 (6.00 cm^2) and in remaining treatment significant reduction in leaf area was recorded and minimum (4.25 cm^2) was recorded in T_6 treatment. Plant spread was recorded in two directions. The maximum plant spread N-S (155 cm) was recorded in T_1 treatment and at significantly at par with T_2 and T_3 treatments. Thereafter significant reduction was recorded and in similar trend was also observed E-W direction plant spread. The plants were flowered in the month of August 2021 and total numbers of flowers in each plant were recorded. The higher numbers of flowers were recorded in T_1 and T_2, while in T_3, T_4, T_5 and T_6 significantly reduced the total number of flowers were observed. In pomegranate, three types of flower like male, intermediate and perfect (hermaphrodite) flower were observed but fruit sets only in perfect (hermaphrodite) flowers, therefore observation on perfect flowers were also recorded and presented in the form of per cent flowers of total number of flowers. The salinity levels affected the percentage of perfect flowers and observed the maximum perfect flowers (32%) in T_1 treatment and statistically at par with T_2 treatment (28%), thereafter in T_3 to T_6 treatments reduction in perfect flowers were recorded with increase in salinity level.

Effect of saline irrigation water on fruit and fruit quality attributes of the pomegranate cv. Bhagwa

The different treatment of saline irrigation water significantly affected the fruit set, fruit retention and fruit quality like fruit weight, aril and peel content per fruit and fruit cracking incidence. Among all the treatments, maximum fruit set and retention (35.20 and 84.75%) were observed in T_1 treatment (100% canal water) followed by T_2 treatment (30.15 and 81.75%) and T_3 treatment (30.02 and 80.00%) as compared to minimum recorded in T_6 treatment (20.20 and 75.00%), respectively. The number of fruits per plant was varied significantly among different treatments and recorded maximum (22.50) in T_1 treatment (100% canal water) followed by T_2 treatment (20.00) and T_3 treatment (18.50) as compared to minimum recorded in T_6 treatment (10.50). The maximum fruit weight and yield per plant (185.50g and 4.17 kg) were observed in T_1 treatment (100% canal water) followed by T_2 treatment (180.20g and 3.60 kg) and T_3 treatment (160.50g and 2.97 kg) as compared to minimum recorded in T_6 treatment (125.00g and 1.31 kg), respectively. The maximum aril and peel weight per fruit (120.00 and 65.50g) were observed in T_1 treatment (100% canal water) followed by T_2 treatment (115.50 and 64.70g) and T_3 treatment (102.50 and 58.00g) as against minimum recorded in T_6 treatment (90.25 and 34.70g), respectively. The different treatment of saline irrigation water significantly affected fruit cracking incidence in pomegranate. The lowest fruit cracking (12.00%) was observed in T_1 treatment which was at par with T_2 treatment (12.00%) while highest fruit cracking was observed in T_5 treatment (18.50%) which was which was at par and followed by T_6 treatment (18.00%).

Effect of saline irrigation water on physico-chemical attributes of pomegranate fruit juice cv. Bhagwa

The different treatment of saline irrigation

water significantly affected on physico-chemical attributes of pomegranate fruit juice cv. Bhagwa. Among all the treatments, maximum juice content was recorded in T_1 treatment (32.20%) which was statistically at par with T_2 treatment (32.20%), T_3 treatment (31.50%) and T_4 treatment (29.50%) while minimum juice content was recorded in T_6 treatment (28.00%). There were no significant difference were observed in juice pH, juice EC, TSS, acidity and total sugar content of pomegranate fruit juice. However, the maximum juice pH was recorded in T_1 treatment (3.22) followed by T_6 treatment (3.21) as compared to minimum in T_2 treatment (3.18) and T_3 treatment (3.18). The highest fruit juice TSS and total sugar was recorded in T_6 treatment (17.00 °Brix and 12.05%) followed by T_5 treatment (16.80°Brix and 11.90%) as against lowest fruit juice TSS and total sugar recorded in T_2 treatment (15.20 °Brix and 11.40%), respectively. The fruit juice acidity was recorded maximum in T_5 treatment (0.45%) and T_1 treatment (0.45%) in comparison to minimum (0.40 %) recorded in T_2 treatment (Table 34).

Effect of OMF -K fertilizer on performance of pomegranate cv. Bhagwa

This is the engineered pelletized-mineral fertilizer from poultry manure and contains nearly 9.5% potassium content. This material was used as basal treatment in two year old plants of pomegranate cv. Bhagwa which were irrigated with different saline waters. Accordingly 500g OMF-K was given to each plant of pomegranate in the of August 2021. After five month period, the observation on growth and production attributes revealed that OMF-K had no effect on plant height, flowering pattern and yield and quality parameters. However, second dose has also been given to plants and observations on different parameters of plant parameters and production potential will be given in next reports.

Fig. 89. Experimental field view pomegranate cv. Bhagwa

3. DUS centre on bael

Funding agency : PPV & FRA, New Delhi

Reference varieties, *viz.*, Goma Yashi, Thar Divya, Thar Neelkanth, Thar Srishti, NB-5, NB-7, NB-9, NB-16, NB-17, Pant Aparna, Pant Sujata, Pant Shivani, Pant Urvashi, CISH-B-1 and CISH-B-2 are being maintained at the Station to characterize the farmer's varieties. Farmers varieties of Chhatishgarh, West Bengal and Bihar are being studied for DUS characters.

4. DUS centre on aonla

Funding agency : PPV & FRA, New Delhi

Reference varieties, viz., NA-7, NA-6, Banarasi, Chakaiya, Francis, Anand-1, Anand-2, NA-4, Goma Aishwarya, NA-10 and NA-5 are being maintained at the Station to characterize the farmer's varieties.

5. DUS in Ber

Funding agency : PPV & FRA, New Delhi

Twenty five reference and 85 example varieties of ber were maintained in field gene bank. During the year-2021, BC series (14) and Jodhpur series (7) described as per DUS descriptor.

6. DUS in date palm

Funding agency : PPV & FRA, New Delhi

Under DUS centre on date palm, data on morphological and fruit characters in reference varieties were recorded as per DUS guidelines. The thirty eight genotypes of date palm were evaluated for morphological, yield, fruiting, and quality attributing characters. The observation of plant morphological characters, yield attributing characters, fruiting characters, quality characters and yield, respectively were recorded & exhibited large variation in among the parameters. The reference varieties were maintained at the centre.

7. DUS Centre on Watermelon and Muskmelon

Funding agency : PPV & FRA, New Delhi

During the summer season of 2021, maintained the seed of reference varieties of watermelon and muskmelon to utilize in DUS testing.

8. DUS centre on jamun

Funding agency : PPV & FRA, New Delhi

As per morphological descriptors and DUS test guidelines for jamun all varieties were described and maintaining as reference block.

9. DUS on tamarind and chironji

Funding agency : PPV & FRA, New Delhi

Morphological descriptors and DUS test guide lines for tamarind and chironji have been developed and submitted to the Authority. Varieties are being maintained at the station.

10. Development of Hi-Tech Horticultural Nursery with water harvesting structure (4 ha area under nursery with water harvesting structure.

Funding agency: RKVY Rastra Krishi Vikas Yojana

5. TRANSFER OF TECHNOLOGY

Trainings organized

- Conducted one day farmers training programme on "Women empowerment through self-sufficient attitude and value addition" dated 15.02.2021.
- Organized/conducted Two Days Farmers' Training Programme on "Improved production technologies of arid horticultural crops" during 24.02.2021 to 25.02.2021 Sponsored by ATMA, Bikaner.
- Conducted two days off campus training programme at Kolasar village of Bikaner district on 23.03.2021 to 24.03.2021 under SCSP Scheme in which > 100 farmers participated.
- Conducted one day on campus training and input distribution programme for SC women under SCSP on "Empowerment of farm women through value addition" in Video- Conferencing Hall of the Institute on 15.05.2021.
- Conducted one day women training programme on "Nutrient management for fruits and vegetable production in arid region" under SCSP Scheme in Udasar village of Bikaner district dated - 25.03.2021.
- Conducted one day training programme and distribution of horticultural tool kits among > 100 SC farmers under SCSP Scheme at Budiwara village of Barmer district (Rajasthan) on 05.03.2021.
- Conducted one day farmers' training programme at the field (FLDs site of arid vegetables) of Sh. Idan Ram S/o Akuda Ram Meghwal, village- Khara (4JMD, Teh.- Bikaner, district -Bikaner, Rajasthan on 09.08.2021.
- Conducted one day farmers' training programme at the field (FLDs site of arid vegetables) of Sh. Mukesh Pareek S/o Sh. Satya Narayan Pareek, village- Khichiya (5 KHM), Teh.- Bikaner, district -Bikaner, Rajasthan on 10.08.2021.
- Conducted one day farmers' training programme at the field (FLDs site of arid vegetables) of at the field of Sh. Virendra Meghwal S/o Sh. Ishar Ram Meghwal, Village-Belasar, Teh.- Bikaner, district - Bikaner, Rajasthan on 11.08.202.
- Conducted farmers' training on "Entrepreneurship development through Propagation of Khejri organized during 16.08.2021 to 18.08.2021 at the Institute.
- Conducted Five days Collaborative Training Programme with MANAGE Hyderabad on “Extension of Horticultural Technologies in Arid and Semi-arid Regions for Nutritional and Livelihood Security” in virtual /online mode at ICAR-CIH, Bikaner during from 18.10.2021 to 22.10.2021.
- Organized training programme for 20 SC women farmers and distribution of kitchen item among at the Institute on 18.12. 2021 under SCSP scheme of the Institute.
- Organized one day farmers' training programme entitled as "Waste water recycling and its role in Swachchhata" during the Swachchhata campaign held in Sarahkunjiya village of Bikaner district (Rajasthan) on 22.12.2021.

FLDs conducted

- Conducted FLD on improved variety of Kachri (AHK-119) in Birtdhwal villages (Suratgarh) of Shri Ganganagar district (Raj.) at field of Ramswaroop Meghwal on 20.02.2021.
- Conducted FLD on improved variety of Kachri (AHK-119), Snapmelon (AHS-82), Long melon (Thar Sheetal), ridgegourd (Thar Karni) and clusterbean (Thar Bhadvi) in Gigasar villages of Bikaner district (Raj.) at field of Sh. Kalu Ram Jat on 23.02.2021.
- Conducted FLD on improved variety of Snapmelon (AHS-82), in Napasar villages of Bikaner district (Raj.) at field of Sh. Bhanwar Lal Meghwal on 25.02.2021.
- Conducted 02 FLDs of improved varieties of arid vegetables like cluster bean vegetable type (Thar Bhadvi) and ridge gourd (Thar Karani) at the field of sh. Prahalad Ram S/o Gordhan Ram Jat , village-Inana, Teh.- Mundwa, district - Nagaur, Rajasthan on 06.08.202.
- Conducted 02 FLDs of improved varieties of arid vegetables like Kachri (AHK-119), snapmelon (AHS-82), at the field of Sh. Champa Lal S/o Mangla Ram Rathor,

village- Raven, Teh.- Mundwa, district - Nagaur, Rajasthan on 06.08.2021.

- Conducted 02 FLDs of improved varieties of arid vegetables like snapmelon (AHS-82) and cluster bean vegetable type (Thar Bhadvi) at the field of S. Idan Ram S/o Akuda Ram Meghwal, village- Khara (4JMD, Teh.- Bikaner, district -Bikaner, Rajasthan on 09.08.2021.
- Conducted 01 FLDs of improved varieties of ridge gourd (Thar Karani) at the field of Sh. Mukesh Pareek S/o Sh. Satya Narayan Pareek, village- Khichiya (5 KHM), Teh.- Bikaner, district -Bikaner, Rajasthan on 09.08.202
- Conducted 04 FLDs of improved varieties of arid vegetables like Kachri (AHK-119), snapmelon (AHS-82), cluster bean vegetable type (Thar Bhadvi), ridge gourd (Thar Karani) and Khejri (Thar Shobha) at the field of Sh. Virendra Meghwal S/o Sh. Ishar Ram Meghwal, Village-Belasar, Teh.- Bikaner, district -Bikaner, Rajasthan on 11.08.202.
- Conducted FLDs of improved variety of kachri (AHK-119) and snapmelon (AHS-82), ridge gourd (Thar Karani), long melon (Thar Sheetal) at the field of Sh. Bhanwar Lal (Pappu) Meghwal (Kadela) of Ambasar village of Bikianer district on 09.03.2021.
- Conducted FLDs of improved variety of kachri (AHK-119) and snapmelon (AHS-82) at KVK, Chandkothi, Churu on 14.03.2021 through Dr. Aditi Gupta, SMS, Home Science (seed sent through Bhawani Shankar, Driver, KVK, Churu on 14.03.2021).
- In addition to FLDs, > 40 method demonstration of the production technologies of arid horticulture were also performed at the Institute to the visiting farmers or while visiting to the farmers' fields during the reported period of time.

Participation in farmers' fair and Technological Exhibitions displayed.

- Participated and arranged an exhibition stall of improved arid horticultural technologies during the Kisan *Mela* organized by KVK Gudamanali, Barmer-II under AU, Jodhpur on 06.03.2021 and we got Best Technological Exhibition Award in this Mela. This award was given by Hon'ble State Agriculture and Farmers' Welfare Minister, Sh. Kailash Chaudhary Ji.

Days/ weeks/ fortnights/ programmes/ campaigns organized/ celebrated.

- Celebrated the International Women' Day on 08.03.2021 in the Institute at Library-cum- Vidieo Conferencing Hall of the Institute
- Celebrated "*World Environmental Day*" on 05.06.2021 in the Institute during which the plantation work was done by the all staff of the Institute in front of library building and Children Park of the Institute.
- Carried out farmers' awareness campaign on "Balanced use of fertilizers" during which, I played leading role in organizing this campaign in villages like Gigasar village of Bikaner district on 18.06.2021 in which more than 90 farmers/farm women and children participated.
- Celebrated "The "93th ICAR- Foundation Day" in the Institute on 16.07.2021 in the Institute in which more than 100 farmers/stakeholders, students, scientists, to participate in above programme.
- Organized the programme/campaign to create "Awareness and knowledge about importance of food and nutrition among school going children/students and teachers" at Bal Bharati Secondary School, Bichwal Bikaner on 06.09.2021 under observance of " National Nutritional Week and *Bharat Ka Amrut Mahotsav*" programme of the country.
- Organized programme/campaign to create "Awareness and knowledge about importance of food and nutrition among farmers/villagers" at Meghasar, Kolasar and others village of Bikaner district 07.09.2021 under observance of "National Nutritional Week" and *Bharat Ka Amrut Mahotsav*" programme of the country.
- Organized programme/campaign on *Posan Vatika Maha Abhiyan and Tree Plantation and curtain Raiser of " International Year of Millet - 2023* on 17.09.2021 during which more than 100 farmers, 72 school students, > 100 scientists, experts, staff of the Institute, technical, SRF, YPs, ext participated. I Played the leading role in this programme.
- Celebrated the "Thar Shobha (Khejri Distribution/Selling Day" in the Institute to

the farmers on 21.09.2021.

- Contributed during the celebration of 28th Foundation Day of the Institute on 27.09.2021 during which 5 progressive were called and honoured with certificates.
- Organized programme/campaign on "Farmers- Scientists interface meeting and Telecast of Hon'ble Prime Minister's Programme" in Auditorium of the Institute on 28.09.2021 in which 98 farmers and > 100 scientists, experts, SRFs, and other dignitaries participated.
- Celebrated "Khejri- Thar Shobha Sale Day" in the Institute on 29.09.202.
- Organized "Special *National Swachaata Campaign* with the theme of *Waste to Wealth*" in adopted villages viz; Dholera, Khinchiya and Sararupayat village of Bikaner district on 12.10.2021 and about 200 farmers/students of different schools participated in above programme.
- Organized the *"Equity and Empowerment-Mahila Kisan Diwas"* in Udasar village of Bikaner District on 15.10.2021 in which more than 50 women/children participated.
- Observed the Communal Harmony Campaign Week from 19.11.2021 to 25.11.2021 and collection of money voluntarily from employee of the Institute (ICAR-CIAH, Bikaner) to raise fund of NFCH (National Foundation for Communal Harmony New Delhi, an autonomous organization under the Ministry of Home Affair, Govt. of India).
- Celebrated " World Pulses Day" at the Institute on 10.02.2022
- Celebrated "National Science Day" 0n 28.02.2021 at Shanskar Bal Bharati Sec. School, Bichwal Bikaner in which more than 100 students/teacher participated and the Scientists/ technical of the Institute delivered the lecture on different relevant topics during the programme.
- Organized "National Campaign on theme "Agriculture and Environment: The Citizen Face" on 26.11.2021 at ICAR-CIAH, Bikaner in which 34 students/children, teachers, scientists, and other officials participated.
- Organization of "*wachh Bharat Abhiyan"* in three adopted villages (Khinchiya, Sarahrupayat and Dholera) of Bikaner district)" under MGMG Scheme to create awareness and interest among the farmers/school going children about during " *Swachhata Pakhwada* on 18.12.2021.
- Organized/ celebrated Kisan Diwas in Meghasar Village of Bikaner district on 23.12.2021. In this programme more than 300 farmers participated and seed storage bins, packets of improved varieties of vegetables, technical folders, etc were also distributed among the SC farmers under the SCSP scheme of the Institute during the programme.
- Organization of "*PM Kisan Samman Nidhi Fund Programme*" in virtual mode at the Institute on 01.01.2022 during which several farmers were called/interacted in virtual mode.

Other extension activities

- More than 30 technical lectures (online /offline) were delivered during the different farmers' trainings and other programmes organized at the Institute or outside of the Institute during the reported period of time.
- Delivered more than 40 lectures related arid horticultural technologies to visiting farmers, students, stakeholders at the Institute or while visiting to the farmers fields during the reported period of time.
- Three "Farmers' Advisory" were prepared sent to farmers, *Arid-Hort.-Farmers' WhatsApp Group* and sent of I/c AKMU to upload the same on Institutes' website for the benefit of farmers/stakeholder/ Viewers, etc.
- More than 500 farmers, students, field workers, supervisors, SMS, dignitaries/ NGO, etc. were visited to Institute during the reported of time.
- More than 30 on/off campus Research-Extension - Farmers- Interface- Meetings to inculcate the knowledge and awareness among the farmers about improved production technologies of arid horticultural crops. The activities like visit, meetings/group discussion training, interaction, etc., were also organized for empowerment of farm women, particularly in the field of arid horticulture.
- Various farmers' programmes and activities like visit, meetings/group discussion training, interaction, Research- Extension - Farmers- Interface- Meetings (REFIM), diagnostic and problem solving visits, etc., were conducted in adopted villages under MGMG Scheme of the ICAR/Institute.
- More than 2000 technical folders/literature

were distributed among the farmers/ clients during different extension programmes/ activities/ occasions.

- There were made 20 diagnostic and advisory visits to farmer's fields to solve their problems and provide technical help/suggestions for their better crop production/farming system.
- Various programmes/activities like farmers' visits, meeting/ *Sangosthi*, discussions, training, kisan Diwas, FLDs, method demonstrations, mobile advisory, creating linkages, creating knowledge and awareness, distribution of seeds and planting materials, technical literature, etc., were organized under Mera Gaon Mera Gaurav MGMG) Scheme in adopted villages of the Institute during the year 2021.
- In addition to above, various technological advisory work (One line / telephonic/off line discussions/ guidance/Qns. Ans.) with farmers were also performed.

Organized a National Webinar on 'Indian jujube (14 June, 2021)

National webinar on Indian jujube was organized at ICAR-CIAH, Bikaner with the objective to exchange the information for the benefits of the researchers, farmers, entrepreneurs and other stakeholders in India. The webinar was graced with the virtual presence of Dr. Vikramaditya Pandey, ADG (Hort-I), ICAR, New Delhi and Dr. Kuldeep Singh, Director, ICAR-CIAH, Bikaner was chief guest. This programme attended 200 participants from different parts of India.

Chief Guest, President and Chairman of Webinar on 'Indian jujube'

Organized a National Webinar on 'Low Tunnel Vegetable Production'

As a part of "*Azadi Ka Amrit Mahotsav*", ICAR-CIAH, Bikaner has organized a National Webinar on 'Low Tunnel Vegetable Production' virtually to exchange the generated information of R&D among researchers/ students/ farmers/ stakeholders on 25th June, 2021. The webinar was graced with the virtual presence of Padam Shree Dr. Brahma Singh, Former Director, DRDO & Founder Chairman, BSHF, New Delhi as Chief Guest and Dr. Bijendra Singh, Hon'ble Vice Chancellor, ANDUAT, Ayodhya (UP) & DG, UPCAR as President. A total of 382 participants from different parts of India joined the webinar virtually.

Glimpse of National Webinar on 'Low Tunnel Vegetable Production'

Chief Guest, President and Chairman of Webinar

ICAR-KVK Panchmahal, Vejalpur, Gujarat

On farm trials (OFTs)

Eight on farm trials were conducted on farmer's field during 2021, involving 79 farmers. On farm trials were conducted on integrated nutrient management in castor, evaluation of sesamum varieties for yield, impact of RDF, NAA and mulching on yield attributes of mango cv. Kesar under semi arid ecosystem, nutrient management in mango cv. Kesar, evaluation of variety of okra during summer, management of fall armyworm infesting maize, termite management in wheat, use of curd as probiotic supplementation for growing goats and nutrition management of cattle calves with commercial probiotics and traditional curd

Front line demonstrations (FLDs): During reporting period total 16 front line demonstrations (FLDs) were laid out in 150.5 ha area at 410 farmer's field. Results are shown in table below.

Glimpse of work carried out under FLDs Program conducted by KVK, Panchmahal

Summary of training programs organized: During the reporting period KVK Panchmahal organized 45 training programmes on different aspects of agriculture and animal husbandry and 967 farmers were benefited.

Clientele	No. of courses		No. of Participants		
	On Campus	Off Campus	Male	Female	Total
Practicing farmers	17	20	560	218	788
Rural Youth	4	-	83	2	85
Vocational Trainings	4	-	88	6	94
Total	25	20	731	226	967

Certificate course on “Insecticides Management for Insecticide Dealers/Distributors

Date	Training Program	Venue	Duration	Trainees	Beneficiaries
19.06.2021 to 09.09.2021	CCIMID Batch-1	KVK	72 hrs	Insecticide Dealers	42
15.10.2021 to 27.12.2021	CCIMID Batch-2	KVK	72 hrs	Insecticide Dealers	41

Workshop cum training program on Prakritik Kheti at KVK collaboration with ATMA, Godhra:

Sr. No	Date	Programme	Place	Participants
01	21.10.2021	Prakritik Kheti Workshop	KVK-PMS	Godhra Taluka Farmers
02	22.10.2021	Prakritik Kheti Workshop	KVK-PMS	Morva (H.) Taluka Farmers
03	23.10.2021	Prakritik Kheti Workshop	KVK-PMS	Shahera Taluka Farmers
04	26.10.2021	Prakritik Kheti Workshop	KVK-PMS	Halol Taluka Farmers
05	27.10.2021	Prakritik Kheti Workshop	KVK-PMS	Kalol Taluka farmers
06	28.10.2021	Prakritik Kheti Workshop	KVK-PMS	Ghoghamba Taluka farmers
07	03.11.2021	Jivamrut Application	KVK-PMS	Farmers
08	08.11.2021	Prakritik Kheti Workshop	KVK-PMS	Jambughoda Taluka farmers
09	10.11.2021	Prakritik Kheti Workshop	KVK-PMS	Lunavada Taluka farmers
10	11.11.2021	Prakritik Kheti Workshop	KVK-PMS	Santrampur & Khanpur Taluka farmers
11	12.11.2021	Prakritik Kheti Workshop	KVK-PMS	Virpur Taluka farmers
12	16.12.2021	PM Live programme on Prakritik Kheti	KVK-PMS	Farmers

Azadi Ka Amrit Mahotsav

Celebrating 79 Years of India's Independence

S. No.	Date	Programme	Place	Participants
1	17.09.2021	National Comparing on Poshan Abhiyan (Nutri Cereals) & Tree Plantation	KVK	Female Villagers & Farmers
2	04.06.2021	Awareness campaign on Animal health & Productivity	Kharsaliya	Farmers
3	26.08.2021	Awareness campaign on Food & Nutrition	KVK-PMS	Farmers
4	28.09.2021	Farmers Scientist Interface for awareness on food and nutrition	KVK-PMS	Farmers & Farm Women
5	24.12.2021	t; toku t; fdlku ^mRre [krh& mUur fdlku* okrkyke@ in'kuh	KVK-PMS	Farmers & Farm Women
6	23.07.2021	Conference on Agro-metrology services	KVK-PMS	Officers of Line Department

RAWE program for B. Sc. Ag. Students Organized and BRS students at ICARKVK,Panchmahal.

S. No	Date	Programme	Place	Institute/ University	Participants
1	15.03.2021 to 15.04.2021	BRS Student Kendra Niwas for One Month	KVK -PMS	Mangal Bharti Lok Shikshan and Agriculture college, Golagamdi, Ta Sankheda, Chhotaudaipur	Male - 10 Female - 06 Total - 16
2	20.12.2021 to 18.01.2022				Male - 06 Female - 05 Total – 11
4	13.12.2021 to 12.01.2022			Shri I.K.Chavda Gram Vidhyapith Kahanvadi, Anklav, Anand	Male -01
5	01.08.2021 to 15.09.2021	RAWE Students B. Sc. (Hons) Agriculture for One & Half Month		G.D. Goenka University, Gurugram, Haryana, India.	Male – 04 Female – 05 Total – 09

Glimpse of Training Program conducted by KVK, Panchmahal in different aspects of agriculture and animal husbandry

Live webcast programme of Hon'ble Prime Minister of India and farmers scientists interface on climate resilient varieties, technologies and practices on dated 28.09.2021at ICAR-KVK-Panchmahal.

Live telecast of Natural farming program by Hon'ble Prime Minister of India at ICAR-KVK-Panchmahal on dated 16.12.2021, in which farmers of district were participated.

Exhibition

S. No.	Date	Venue	No. of. Participants	Organizing agency
1	24.12.2021	KVK, Panchmahal	600	KVK, Panchmahal, FTC and ATMA, Panchmahal

Organization of field days/ Abhiyaan /campaign, etc.				
S. No.	Title	Date	Place	Beneficiaries
1	Groundnut production technology	18.05.2021	Nayasda village, Kalol Taluka	41
2	Green gram production technology	25.05.2021	Ratanpur Reliya Godhra Taluka	28
3	Maize production technology	20.01.2022	Chachpur village Godhra Taluka.	24
4	Pigeonpea production technology	28.02.2022	Pandyapura village Godhra Taluka	27
5	Chilli cultivation	22.10.2021	Vill.- Athmna , taluka-Kalol	23

Any other extension activities/farmers' programmes

S.No.	Title	Date	Place	Beneficiaries
1	Republic Day	26.01.2021	KVK	27
2	International women day	08.03.2021	KVK	32
3	World Water Day	22.03.2021	KVK	24
4	World Meteorology Day	23.03.2021	KVK	21
5	World Health Day	07.04.2021	KVK	20
6	World No Tobacco Day	31.05.2021	KVK	28
7	Yoga day	21.6.2021	KVK	50
8	Independence day	15.08.2021	KVK	19
9	*Hindi Divas*	14.09.2021	KVK	22
10	Kisan divas	23.12.2021	KVK	45
11	Swachchta Abhiyan	16.12.21- 31.12.21	KVK, Vejalpur, Bediya, Nesda and Dudhva	517
12	Advisory services	Advisory services were imported to farmers in relation to their problems pertaining to agriculture and animal husbandry matters which benefited 1250 farmers.		
13	Telephone helpline	Total 1352 cases of helpline were dealt with, this included matters concerned with agriculture and allied sectors.		
14	Diagnostic visit	Diagnostic visits (72) Were carried out at farmer’s field to solve his/her problem related to agriculture and animal husbandry.		
15	Method demonstration	Method demonstrations (3 2) were carried out at farmer’s field/ KVK to solve his/her problem related		

6. TRAINING AND CAPACITY BUILDING

Training and Capacity Building of ICAR-CIAHEmployee

S.No.	Name & Designation	Training attended	Duration	Place/Vanue
A	Scientists			
1.	Dr. Pawan Kumar (Scientist)	Bio Diversity and Environment Law for Agricultural Resources	07-09June, 2021	ICAR-NAARM
2.	Dr. S.R.Meena (Pri. Scientist)	Data analysis in Social Science research (Virtual mode)	04-08 Oct.,2021	ICAR-NAARM
3.	Dr. Dhurendra Singh Head-Crop Improvement	MDP on PME in Agricultural Research Project (Online Mode)	25-30 Oct., 2021	ICAR-NAARM
4.	Dr. Pawan Kumar (Scientist)	Workshop on Analysis of Multi location experiment (Online mode)	28-30 Oct., 2021	ICAR-NAARM
5.	Dr. Lalu Prasad Yadav (Scientist)	Natural Resource Management for Sustainable Dry land Horticulture	09-11 Feb., 2022	ICAR-CRIDA Hyderabad
6.	Dr. R.C. Balai (Scientist & HRD-Nodal Officer)	HRD Nodal Officers Training Programme on "Competency Enhancement Programme for Effective Implementation of Training Functions HRD Nodal Officers of ICAR.	21-23 Feb., 2022	ICAR-NAARM-Hyderabad
7.	Dr. B. R. Choudhary (Pri. Scientist)	Managerial /Supervisory Skill (MSS-7)	18-21 Apr., 2022	ISTM, New Delhi
8.	Dr. Gangadhara (Scientist)	International Webinar on " Role of Legume & Pulses in Sustainable Cropping System of Hot Arid Zone	17.07.2021	SKRAU Bikaner
9.	Dr. D.S. Mishra (Pri. Scientist)	Training on "Monitoring and Evaluation of Government Scheme"	07 Feb., 2022	ISTM New Delhi
10.	Dr. Anita Meena (Scientist)	Attended 21 days on line Certificate Course training titled on "Soil Management for Climate Smart Agriculture organized by Centre for Advanced Agricultural Science and Technology for Climate Smart Agriculture and Water Management (CAAST-SAWM)	June 14th to July 04th, 2021 .	MPKV, Rahuri (MS)
B	Technical			
1	Sh. K.V. Parmar (T.O.)	Workshop on Communication Skills" By ISTM, GOI New Delhi	17-18 Feb., 2022	ISTM, New Delhi
2	Sh. B.V. Rathwa (T.O.)	Workshop on Communication Skills" By ISTM, GOI New Delhi	17-18 Feb., 2022	ISTM, New Delhi
C	Administrative			
1.	Sh. Ramesh (A.O.)	Training on e-Office & implementation of PFMS	05.04.2021	CSWRI-ARC Bikaner
2.	Sh. Kuldeep Pandey (A.A.O.)	Training on e-Office & implementation of PFMS	05.04.2021	CSWRI-ARC Bikaner
3.	Sh. Rakesh Swami (Assistant)	Training on e-Office & implementation of PFMS	05.04.2021	CSWRI-ARC Bikaner
4.	Sh. H.S. Patel (Assistant)	Training on e-Office & implementation of PFMS	05.04.2021	CSWRI-ARC Bikaner
5.	Sh. RaheshDaiya (UDC)	Training on e-Office & implementation of PFMS	05.04.2021	CSWRI-ARC Bikaner
6.	Rawat Singh (UDC)	Training on e-Office & implementation of PFMS	05.04.2021	CSWRI-ARC Bikaner
7.	Sh. Swaroop Chand (LDC)	Training on e-Office & implementation of PFMS	05.04.2021	CSWRI-ARC Bikaner
8.	Sh. Gulla Ram (LDC)	Training on e-Office & implementation of PFMS	05.04.2021	CSWRI-ARC Bikaner
9.	Smt. Pooja Joshi (Jr. Steno)	Training on e-Office & implementation of PFMS	05.04.2021	CSWRI-ARC Bikaner
10.	Sh. S.C. Rathore (LDC)	Training on "Accrual Accounting" for Amdin.	26-30 July, 2021	ICAR-NRRI Cuttack
11.	Sh. B. K. Panchal (L.D.C.))	Dealing in Public Procurement for Govt. Offices	Aug., 2021	AJNIFI- Faridabad
12.	Sh. B. K. Panchal (L.D.C.))	Dealing in Public Procurement for Govt. Offices	Aug., 2021	AJNIFM- Faridabad
13.	Sh. Kuldeep Pandey	Repair & Maintenance of Office, Residential Building.	10-12 Aug., 2021	ICAR-CIAE Bhopal
14.	Sh. Kuldeep Pandey	Online Training on " Making a Secure & resilient workplace"	1-3 Sept., 2021	ICAR-CPRI Shimla
15.	Sh. Rajesh Daiya	Training on Accrual Accounting for Admin.	20-24Sept., 2021	ICAR-CRRI Cuttack Batch-IV
16.	Sh. B. K. Panchal (L.D.C.))	Online Training Programme on "Establish ment Matters LDC& UDC of ICAR	17-22 Jan., 2022	IISR Lucknow
D	Supporting Staff			
1	Skill Support Staff	Skill Improvement on good horticultural practices (06 persons)	05-08 Oct., 2021	ICAR-CIAH CHES Vejalpur

Lecture Delivered

Dr. L. P. Yadav

Delivered lecture on "Scientific cultivation of drumstick under dryland semi-arid conditions" to the 40 farmers of Kheda district under ATMA at CHES, Vejalpur on 02.01.2021

Field visit and lectured on "Nutritional importance of vegetable crops and scientific cultivation of drumstick in dryland semi-arid conditions" to the 42 students of Collage of Agriculture, Parul University, Vadodara at CHES, Vejalpur on 27.01.2021.

Field visit and lectured on "New advances in integrated insect pest management of vegetable crops under semi-arid conditions" to the 40 students of Collage of Agriculture, Parul University, Vadodara at CHES, Vejalpur on 28.01.2021.

Delivered lecture on "Importance of nutria-garden for health and nutritional security" to the 25 farmers of Dahod district under ATMA at CHES, Vejalpur on 06 September, 2021.

Delivered lecture on "Technologies of vegetable crops developed from CHES" to the 25 farmers of Dahod district under ATMA at CHES, Vejalpur on 07 September, 2021.

Field visit and delivered lecture on "Recent advances in vegetable crops" to the 60 Students of B.A. Agriculture collage, AAU, Anand at CHES, Vejalpur on 08 September, 2021.

Field visit and delivered lecture on "Recent advances in underutilized horticulture crops" to the 59 Students of Anand Agriculture University, Anand at CHES, Vejalpur on 09 September, 2021.

Delivered lecture on "Scientific cultivation of drumstick under semi-arid condition" to the 33 farmers of Fatehpura district under ATMA at CHES, Vejalpur on 13 September, 2021.

Delivered lecture on "Scientific cultivation of cucurbits under semi-arid condition" to the 30 farmers of Limkheda district under ATMA at CHES, Vejalpur on 14 September, 2021.

Delivered lecture on "Scientific cultivation of drumstick under semi-arid condition" to the 50 farmers of Kheda district under ATMA at CHES, Vejalpur on 15 September, 2021.

Delivered lecture on "Scientific cultivation of spine gourd and ivy gourd under semi-arid condition" to the 30 farmers of Dahod district under ATMA at CHES, Vejalpur on 15 September, 2021.

Delivered lecture on "Nursery management techniques in vegetable crops" to the 50 farmers of Kheda district under ATMA at CHES, Vejalpur on 16.09.2021.

Delivered lecture on "Scope and importance of vegetable crops under semi-arid condition" to the 30 farmers of Dahod district under ATMA at CHES, Vejalpur on 16.09. 2021.

Delivered lecture on "Scientific cultivation of cucurbits under semi-arid condition" to the 30 farmers of Kheda district under ATMA at CHES, Vejalpur on 17.09. 2021.

Delivered lecture on "Nutritional security and women empowerment through vegetables" to the 30 women farmers of Dahod district under ATMA at CHES, Vejalpur on 17.09.2021.

Delivered lecture on "Socio-economic up-liftment and women empowerment through vegetable crops under semi-arid conditions" to the 15 women and 15 man farmers of Dahod district under ATMA at CHES, Vejalpur on 18.09.2021.

Delivered lecture on "Potential of semi-arid vegetable crops for nutritional and Socio-economic security of rural livelihood" to the 51 women farmers of Kheda district under ATMA at CHES, Vejalpur on 18.09.2021.

Delivered lecture on "Nutritional potential and production technology of drumstick under rainfed semi-arid condition" to the 50 farmers of Kheda district under ATMA at CHES, Vejalpur on 20.09.2021.

Delivered lecture on "Income generation and Nutritional security through vegetable crops under rainfed semi-arid condition" to the 50 farmers of Kheda district under ATMA at CHES, Vejalpur on 21.09.2021.

Delivered lecture on "Diversification through vegetable crops under rainfed semi-arid condition" to the 50 farmers of Kheda district under ATMA at CHES, Vejalpur on 22.09.2021.

Delivered lecture on "Vegetables as intercrop: A profitable venture in semi-arid condition" to the 55 farmers of Kheda district under ATMA at CHES, Vejalpur on 24.09.2021.

Delivered lecture on "Cultivation technology of cucurbits under rainfed semi-arid condition" to the 50 farmers of Kheda district under ATMA at CHES, Vejalpur on 25.09.2021.

Field visit and lectured on "Nursery management

and propagation techniques of fruits and vegetables" to the 38 students of Collage of Agriculture, Jabugam, AAU, Anand at CHES, Vejalpur on 27.09.2021.

Stations experiment block visit and lectured on "Production technology of horticultural crops under semi-arid conditions" to the farmers Rajsamand District of Rajasthan under N.M. Sadguru foundation Dahod at CHES, Vejalpur on 19.10.2021.

Field visit and lectured on "Nursery management and propagation techniques of fruits and vegetables" to the 38 students of Collage of Agriculture, Jabugam, AAU, Anand at CHES, Vejalpur on 27.09.2021.

Delivered lecture on "Nursery raising of vegetable crops" in four days In-house training on skill improvement in good horticultural practices after COVID- organized by CHES (ICAR-CIAH), vejalpur on 06.10.2021.

Field visit and lectured on "Recent advances in production technology of underutilized perennial vegetable crops under rainfed semi-arid conditions" to the students of Collage of Agriculture Engineering and Technology, NAU, Dediapada, Narmada at CHES, Vejalpur on 18.12.2021.

Dr. B. D. Sharma

Sharma, B D (2020) Approaches of Integrated Nutrient managemernt for Enhanced production and Productivity of Arid Fruit Crops in Technical Session I of Training programme on Extension of Horticultural Technologies in Arid and Semi-Arid Regions for Nutritional and Livelihood Security at ICAR-CIAH, Bikaner 18-22 October 2022.

Sharma, B. D. (2020) Organic Horticulture Production System in Hot Arid and Semi-Arid Region for Quality and Nutritional Value products in Technical Session III of Training programme on Extension of Horticultural Technologies in Arid and Semi-Arid Regions for Nutritional and Livelihood Security at ICAR-CIAH, Bikaner 18-22 October 2022.

Sharma, B. D. (2021) Fertilizer Management in Vegetable Grown under Low Tunnel. In: Training on Low Tunnel Technology for Vegetable Cultivation in Arid Zone on 16-19th February 2022. PFDC, ARS, SKRAU, Bikaner.

B. D. Sharma (2022) Status of Micro-irrigation in India and Abroad IN: Winter School on Advances in Irrigation Technology and Nutrient Management in Arid Horticultural Crops at SKRAU, Bikaner (8-28 March 2022). pp: 1-32.

B. D. Sharma (2022)Advances in Integrated Nutrient management in Horticultural Crops of India. IN: Winter School on Advances in Irrigation Technology and Nutrient Management in Arid Horticultural Crops at SKRAU, Bikaner (8-28 March 2022). pp: 191-209.

B. D. Sharma (2022)Integrated Nutrient Management for Better Production of Underutilized horticultural crops IN: Winter School on Advance Production Technologies of Underutilized Vegetable Crops under Arid and Semi-Arid Conditions at SKNAU, Jobner during 8-28 February 2022.

Dr. A.K. Singh

Delivered 37 lectures on different aspects of semi-arid fruit to 1110 farmers (ATMA) visited to the Station from various districts of Gujarat during the year 2021.

Delivered lecture on cultivation of semi-arid fruits to RAWE students (60) of AAU, Anand on 08/09/2021.

Delivered lecture oncultivation of semi-arid fruits to RAWE students (69) of AAU, Anand on 09/09/2021.

Delivered lecture on the topic entitled improved production system of fruit crops in semi-arid ecosystem of the country for economic security and living standard of the farmers and stakeholders during collaborative virtual training programme by ICAR-CIAH and MANAGE, Hyderabad on Extension of Horticultural Technologies in Arid and Semi-Arid Regions for Nutritional and Livelihood Security on 21.10.2021

Delivered lecture on the topic entitled post harvest management and value addition of semi-arid fruits for better nourishment and income generation during collaborative virtual training programme organized by ICAR-CIAH and MANAGE, Hyderabad on Extension of Horticultural Technologies in Arid and Semi-Arid Regions for Nutritional and Livelihood Security on 22.10.2021.

Dr. Gangadhara K.

Delivered lecture on "Scientific cultivation of Indian bean in rainfed conditions" to the farmers of Thasara under ATMA at CHES,

Vejalpur on 01/01/2021.

Delivered lecture on "Major pest and disease management in beans" to the farmers of Vaso, Kheda district under ATMA at CHES, Vejalpur on 02/01/2021.

Delivered lecture on "Scientic cultivation of yardlong bean and Indian bean in rainfed conditions" to the 42 students of college of agriculture, Parul university, vadodara at CHES, Vejalpur on 27/01/2021.

Delivered lecture on "production technology and pest and disease management in yardlong bean and Indian bean in rainfed conditions" to the 40 students of college of agriculture, Parul university, vadodara at CHES, Vejalpur on 28/01/2021.

Acted as a resource person and delivered a talk on "Nutraceutical properties of vegetable crops in human diet" on the eve of 75th year of India's independence with the theme "jai javan jai kisan- uttamkheti- unnathkisan'in farmer's day celebration and Exhibition programme organized by KVK, Panchmahal, Vejalpur, Godhra, Gujarat on 24/12/2021

Dr. Ajay Kumar Verma

Delivered key note lecture on 'Microclimate modulations vis-à-vis covering material for early and off-season production of cucurbits' in National Webinar on 'Low tunnel vegetable production' at ICAR-CIAH, Bikaner on 25th June, 2021.

Dr. B. R. Choudhary

Delivered a lecture on 'Low tunnel technology: A farmer friendly approach' on 25th June, 2021 in a National webinar on 'Low tunnel vegetable production' organized at ICAR-CIAH, Bikaner on 25th June, 2021.

Delivered a lecture on 'Hybrid and improved seed production technologies of arid and semi-arid vegetables for high production and income generation' in a training programme on 'Extension of horticultural technologies in arid and semi-arid regions for nutritional and livelihood security' organized by ICAR-CIAH, Bikaner in collaboration to MANAGE, Hyderabad from 18-22 October, 2021.

Delivered a lecture on 'Entrepreneurship opportunities in arid vegetable cultivation' in Regional campaign on creating entrepreneurship in the field of horticulture among small and marginal farmers under *Bharat ki Azadi ka Amrut Mahotsav* organized by ICAR-CIAH, Bikaner from 24-31 December, 2021.

Dr. D. K. Sarolia

Oral presentation a lecture on Canopy Management in Arid Fruit Crops in webinar theme "Challenges and Opportunities in Arid Horticultural Crops" organized NAHEP, SKNAU,Jobner(Raj.) during 13 /5/ 2021.

Oral presentation a talk on Improved production technologies of arid fruit crop's socio-economic and nutritional security in hot arid regions in five days training programme on "Extension of horticultural technologies in arid and semi-arid regions for nutritional and livelihood security" organized jointly ICAR-CIAH andMANAGE, Hyderabad during 18/10/2021

Resource person for solving zone wise problems of fruit crops (ber) in IIHR national horticulture fair during 9-11 Feb., 21 at different zones.

Delivered a lecture on propagation of quality planting material of horticultural crops on 10-03-21 at Central State Farm, Suratgarh, Rajasthan

Delivered a talk on basic requirement and procurement of material for nutria, garden in training on " Nutrigarden for nutritional and income security in arid region from 5-11 March, 2021 (10.30-11.30 am on 7/3/21) at ICAR-CIAH, Bikaner.

Delivered lecture on "Canopy management infruit crops (online)" in national webinar on Future prospectus and challenges of underutilized fruit crops in India for nutritional security under COVID-19 pandemic, SKN AU, Jobner, Jaipur. (24/5/21).

Delivered a talk on entrepreneurship opportunities in vegetable nursery (online) under Ajadikaaamrutmohatsav regional campaign programme (29/12/21).

Delivered lecture on Techniques of nursery development and budding in khejri under training programme "Entrepreneurship development through khejri propagation" (16/8/2021 at 11.30-1.0 PM).

Delivered a lecture on Entrepreneurship opportunity in vegetable nursery under programme Regional campaign on creating entrepreneurship in field of horticulture

among small and marginal farmers organized at ICAR-CIAH, Bikaner (29/12/21)

Dr. Hanuman Ram

Delivered lecture on 'Preparation of vegetables seedlings for nutri-garden' in a seven days training programme on "Nutri-garden for nutritional and income security in arid region" from 5th to 11th March 2021 at ICAR-CIAH, Bikaner under scheduled caste-sub plan "SCSP"

Delivered lecture on 'Vegetable cultivation in arid region' in two days off campus training under scheduled caste-sub plan "SCSP" at Kolasar village on 23.03.2021.

Delivered lecture on 'Nutrition management in arid vegetables' in one day off campus training program on "Nutrient management for fruit and vegetables production in arid region" under scheduled caste-sub plan "SCSP" at Udasar village on 25.03.2021.

Delivered lecture on 'Nursery raising, field preparation and transplanting of onion' in seven days training program on "Advances in Onion Cultivation under Hot Arid Conditions" 09.07.2021 through virtual mode.

Delivered lecture on 'Seed production of important vegetable crops in arid region' in one day training at ICAR-CIAH, Bikaner under scheduled caste-sub plan "SCSP" on 06.12.2021.

Delivered lecture on 'Raising vegetable seedlings in Pro-trays' in one day training at ICAR-CIAH, Bikaner under scheduled caste-sub plan "SCSP" on 08.12.2021.

Delivered lecture on 'Nursery development of vegetables' in one day training at ICAR-CIAH, Bikaner under scheduled caste-sub plan "SCSP" on 14.12.2021.

Delivered lecture on 'Sustainability through vegetable cultivation' in one day training at ICAR-CIAH, Bikaner under scheduled caste-sub plan "SCSP" on 16.12.2021.

Delivered lecture on 'Livelihood and nutritional security through vegetable cultivation' in one day training at ICAR-CIAH, Bikaner under scheduled caste-sub plan "SCSP" on 18.12.2021.

Dr. K. L. Kumawat

Fatty acid composition of almond genotypes grown under rainfed condition of Kashmir at International Web Conference on Global Research Initiatives for Sustainable Agriculture & Allied Sciences Astha Foundation, Meerut (U.P.) from 13-15th December, 2021.

Delivered oral lecture/presentation on "Canopy management in fruit trees planted in Nutri-garden" during seven days training programme on "Nutri-garden for nutritional and income security in arid region" for farm women from Bikaner district from 5th to 11th March, 2021 at ICAR-CIAH, Bikaner.

Delivered oral lecture/presentation on "Training and pruning in arid fruit crops and their nutrient management at pre-bearing stage" during one day training programme on "Nutrient management for fruit and vegetables production in arid region at Udasar village, Bikaner on 25th March, 2021.

Delivered oral lecture/presentation on "Production of aromatic and medicinal plants" at farmer training under ATMA at Swami Keshawanand Rajasthan Agriculture University on 21st March, 2021.

Delivered oral lecture/presentation on "Development of sylleptic shoots in apple nursery trees" at farmer training at ICAR-Central Institute of Temperate Horticulture, Srinagar on 16th December, 2021.

Dr. Pawan Kumar

Delivered a lecture virtually on "Entrepreneurship opportunities in value addition of fruits and vegetables" in ABI centre at JNKVV, Jabalpur on 06 April, 2021.

Delivered a lecture virtually on "Post harvest management of aonla and ber fruit" in Horticulture Training Centre, Uchani, Karnal on 30 July, 2021.

Delivered a lecture on 'Grading, packing and value addition of arid fruits and vegetables for economic an{nutritional surety' in five days training programme on 'Extension of horticuhural technologies in ariclond semi-arid regions for nutritional and livelihood security' held at ICAR-CIAH, Bikaner during 18-22 October, 2021.

Dr. Ramesh Kumar

Delivered lecture on "Scope of floriculture and landscaping in agriculture system" and "Date palm production technology" on 13th March, 2021 in 15 days training course on 'Integrated farming system' organized by

KVK, Lunkaransar sponsored by NABARD.

Delivered lecture on "Integrated management practices for better production of pomegranate in arid and semi-arid regions of the country" in the training programme on "Extension of horticultural technologies in arid and semi-arid regions for nutritional and livelihood security" held at ICAR-CIAH, Bikaner during 18-22 October, 2021 in collaboration with MANAGE, Hyderabad.

Delivered lecture and demonstrated practical on "Khejri propagation through budding techniques" in the three days training programme entitled "Entrepreneurship development through khejri multiplication" organized by ICAR-CIAH, Bikaner during 16-18 August, 2021.

Delivered lecture and conducted field visit on "Pomegranate cultivation" in training programme entitled "Nutri-garden for nutritional and income security in arid region" held during 5th March to 11th March, 2021 at ICAR-CIAH, Bikaner.

Dr. D. K. Samadia

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Delivered lead speaker "Cultivation and seed production of *Cucumis* crops" In: Workshop on doubling farm women's income : developing customized farm plants of community content from farmer's for technology integration &post harvest processing, CAZRI, Jodhpur dated 23.10.2021.

Delivered lecture as resource person Production systems of perennial arid vegetables for nutritional, economic and environmental security. In: Five days collaborative online training programme between ICAR-CIAH, Bikaner (Rajasthan) and MANAGE, Hyderabad (Telangana) on 20.10.2021.

Delivered lecture as resource person Low cost improved production technologies of cucurbitaceous vegetable production for betterment of livelihood in hot arid regions. In: Five days collaborative online training programme between ICAR-CIAH, Bikaner (Rajasthan) and MANAGE, Hyderabad (Telangana) on 18.10.2021.

Delivered lecture as resource person Khejri improvement and horticultural based crop production concept under rainfed conditions. In: National Webinar on Khejri: A versatile tree for horticultural exploitation. Organized by ICAR-CIAH, Bikaner dated 07.07.2021.

Delivered lecture as resource person Cultivation of cucurbitaceous crop under low tunnel technology. In: NAHER Training on low tunnel technology for vegetable cultivation in arid zone. Organized from 16-19 February 2021 at SKRAU, Bikaner dated 18.02.2021.

Dr. Jagan Singh Gora

Lecture delivered on "Advancement in citrus production in hot arid climatic conditions" in five days entitled "extension of horticultural technologies in arid and semi-arid regions for nutritional and livelihood security" a collaborative online training programme between ICAR- CIAH, Bikaner (Rajasthan) and MANAGE Hydrabad (Telangana) dated 25.10.2021.

Dr. Kamlesh Kumar

Delivered a lecture on 'New orchard establishment for improved varieties of arid fruit crops' in an off-campus training programme "Nutrient management for fruits and vegetables production in arid region" at Udasar village, Bikaner on 25 March, 2021.

Delivered a lecture on 'Selection of site and layout of nutri-garden' in 7-day training program "*Nutri-garden for nutritional and income security in arid region*" on 7 March, 2021.

Delivered a lecture on Nursery bed preparation, filling of polybags, care and maintenance in a training programme" Entrepreneurship development through khejri multiplication" held at ICAR-CIAH, Bikaner during 16-18 August, 2021.

Dr. M. K. Berwal

Presented an oral talk on "Bottom-up Mechanism of Tolerance against Concurrent Abiotic Stresses in Khejri (*Prosopis cineraria*) under Hot Arid Region" in the International Web Conference on Innovative and Current Advances in Agriculture & Allied Sciences-2021 held during July 19-21, 2021.

Delivered a lecture on "Plant tissue culture:

Potential Source for Production of Industrially Important Bioactive compounds" during a training "Advances in Plant Tissue culture and its Applications in Agriculture" organized by Plant Biotechnology Centre, SK RAHU, Biknaer During 24.02.2021.

Delivered a lecture in hindi during a training programme on "Nutri-garden for nutritional and income security in arid region" for rural woman at ICAR-CIAH, Bikaner during March 5-11, 2021.

Dr. M. K. Jatav

Regional seminar on Importance of Water in arid region "Valuing water" was organized on ther occasion of World Water Day on 22.03.2021 at ICAR-CIAH Bikaner and a lead lecture on "efficient utilization of irrigation water in agriculture was delivered.

Dr. M. K. Choudhary

Delivered a lecture on Establishment of Nutri-Garden in training on "Nutri-garden for nutritional and income security in arid region from 5-11 March, 2021 at ICAR-CIAH, Bikaner.

Delivered lecture on "Floral Biology and Crop Improvement in Ber Species" during 27 May 2021 at ICAR-CIAH, Bikaner.

Dr. Anita Meena

Oral presentation on "Production of kachri *(Cucumis callosus)* (AHK-119) with saline water irrigation in hot arid region. In International web conference titled: International Conference on Innovatives and current advances in agriculture and allied Science, 19-21. July, 2021.

Oral presentation on **"**Use of saline water with amendments for higher production of Snapmelon (*Cucumis melo* var. *momordica)* under hot arid region", International web Conference on Global Research Initiatives for Sustainable Agriculture & Allied Sciences (GRISAAS-2021) during 13-15 December, 2021.

Delivered lecture in 5 days training programme on "Farmer training programme titled "Vegetable crop production with saline water irrigation under hot arid region" during 21st to 25th March, 2022, under ATMA scheme at ICAR-Central Institute for Arid Horticulture, Bikaner.

Delivered lecture on the occasion of World soil health day on importance of soil sampling, testing and fertilizer recommendation on 05.12.2021 at farmer's field of Gigasar village and soil health card were distributed to farmers

Delivered lecture in One day Farmer training program and input distribution during 06.12.21 under SCSP scheme at ICAR-CIAH, Bikaner.

Delivered lecture in One day Farmer training program and input distribution titled "Importance of value added products in arid region" during 07.12.21 under SCSP scheme at ICAR- CIAH, Bikaner.

Delivered lecture in One day Farmer training program on promotion of kitchen garden and input distribution during 13.12.21 under SCSP scheme at ICAR- CIAH, Bikaner.

Delivered lecture in one day Farmer training program and input distribution under SCSP scheme during 17.12.21.

Delivered lecture in one day on campus "Women farmer training on poshan vatika/ nutrigarden for livelihood security by horticulture in the arid region and input distribution like utensils, vegetables seed kit and pamphlets during 18.12.2021 under SCSP scheme at ICAR- CIAH, Bikaner.

Delivered lecture one day on campus training programme on "Contribution of women farmers in upliftment of Agriculture during International Women's day celebration, 08.03.2022 at ICAR-CIAH, Bikaner.

Delivered lecture in one day on campus "Women farmer training for horticulture crop production in the arid region, promotion of kitchen gardening and input distribution like utensils, vegetables seed kit and pamphlets during 23.12.2021 under SCSP scheme at ICAR- CIAH, Bikaner.

Seminar/ symposia/ conference/ workshop/ Meetings/ others

Dr. B. D. Sharma

Attended Rajasthan mein Garm Shusk Chetron mein Krishi Evam Pashupaln Uddamita. 15th June 2021 at ICAR-NRCC, Bikaner.

Attended Workshop on Yoga Day on 21.06.2021 at ICAR-CIAH, Bikaner through online

Attended meeting with Nodal Agency of Krishi Shiksha AurAnusandhan on 27.08.2021at

ICAR-CIAH, Bikaner.

Attended Institute Foundation Programme on 29.09.2021 at ICAR-CIAH, Bikaner.

Attended International Webinar on Soil Spectroscopy: An Emerging Technique for Rapid Soil Health Assessment on 01.10.2021 organized by ICAR-IISS, Bhopal.

Attended Webinar: Recent Advancement in Seed Health Management on 05.10.2021. (Online)

Attended Virtual Workshop on NABL Assessor Training Programme on 25.10. 2021.

Attended KisanDiwas and Experience sharing on Swachhata Initiatives by Farmers and Civil Society Officials held on 23.07.2021 at Meghasar Village of Bikaner district.

Attended Third Party Evaluation Meeting held on 28.08.2021 through online.

Attended Regional Committee VII meeting of ICAR held on 25.08.2021 through online.

Attended Regional Committee VIII meeting of ICAR held on 14.09.2021 through online.

Attended Collaborative training programme on Extension of horticultural technologies in Arid and Semi-Arid Regions for nutritional and Livelihood Security during 18-22 October 2021 through virtual mode.

Variety identification committee meeting on 23.09.2021 through online mode

Attended Foundation Day Function of ICAR-IIPR, Kanpur on 05.09.2021

Attended Hindi Divas and Opening of Hindi pakhwada on 14.09.2021

Attended Abiotic Stresses in Agriculture on 18.08.2021 through online organized by ICAR-NIASM, Baramati.

Attended Farmers Awareness Compaign on Balanced use of fertilizers on 18.06.2021 organized at ICAR-CIAH, Bikaner.

Attended meeting on suitability of Fig and Dragon fruit in dry climate on 28.06.2021 at Collect orate office, Bikaner.

Attended virtual interface meeting on engancing preparedness for agriculture contingencies during kharif 2021 on 02.08.2021.

Attended ITMC meeting on 12.08.2021 at ICAR-CIAH, Bikaner

Attended ITMC meeting on 21.06.2021 and 03.09.2021 at NRCC, Bikaner

Attended Rajbhasha Implementation Committee meetings held on 14.06.2021 and 01.09.2021 at ICAR-CIAH, Bikaner through online.

Attended Hindi workshops held on 30.06.2021 and 27.09.2021 at ICAR-CIAH, Bikaner.

Attended the programme on "Nutri-Smart Village: An innovative mode for strengthening Poshan Abhiyn" launched on 10 November, 20201 by Honble Union Cabinet Minister of Agriculture and Farmer's Welfare, Govt. of India in presence of State Agriculture Ministers and Secretary DARE & DG, ICAR, New Delhi on 10.11.2021 through virtual mode.

Attended Lecture #35 of Dr. C. D. Mayee, Former Chairman ASRB, New Delhi on "Talent search manning agriculture tree (Teaching Research and Extension Education) in presence of Secretary DARE & DG ICAR, New Delhi through virtual mode.

Attended the Meeting of Institute Technology Committee on 11.11.2021 at ICAR-CIAH, Bikaner through off-line and online mode.

Attended Lecture #37 on "Protection of plant varieties, the key to improved agricultural commerce & growth" by Dr. K. V. Prabhu, Chairperson, PPV&FRA, GOI, New Delhi through virtual mode (Zoom) on 01.12.2021.

Attended First Global "FinTech event "InFinity Forum" on 3-4 December, 2021, inaugurated by Hon'ble Prime Minster of India, organized by IFSCA (International Financial Services Centres Authority) through virtual mode.

Attended Foundation Day of Directorate of Floriculture Research Pune on 10-12-2021 through virtual mode.

Attended Review the progress in matters of Horticultural Planting Material including its import and creation of PEQ facilities on 17-12-2021 organized by MIDH Division, DA&FW, New Delhi through virtual mode.

Attended credit seminar of Mr. Suresh Kumawat, Ph.D. Student of Department of Soil Science and Agricultural Chemistry, COA, SKRAU, Bikaner on 21.12.2021 through virtual mode as Member of Advisory Committee.

Attended Lecture #38 by Dr. A. K. Singh, DDG (Ag. Extn.) ICAR, New Delhi on Gender and Nutri-Sensitive Agriculture through virtual mode on dated 23.12.2021.

Attended as Special Guest on the occasion of SwachhataPakhwada" at NRC on Camel and also deliver lecture on "Utilization of horticultural waste & its safe disposal to make the environment clean" on 31.12.2021 at NRC on Camel.

Acted a Chief Guest in Workshop on Advances in Post Graduation Agricultural Research in Arid Zone on 15-16, March 2022.

Invited as special Guest on workshop on Role of Nano Technology in Agriculture SKRAU, Bikaner 18.02. 2022.

Attended the online live telecast and arranged the live telecast of PM KisanSamman Nidhi Fund Release programme on 01.01.2021 alongwith farmers and staff of the Institute. 188 farmers and staff at CIAH, Bikaner and 156 were attended at CHES, Vejalpur, & KVK, Panchmahal, Gujarat.

Participated in Kissan Mela as Special Guest and Exhibited of stall at ICAR-CSWRI, Avaikanagar, Tonak and got 2nd prize for exhibition.

Attended the meeting on 04.01.2022 with DG, ICAR, New Delhi through virtual mode.

Attended Kisa Mela as Special Guest at ICAR-CSWRI, Avikanagar, chaired by Sh. Kailash Choudhary, Hon'ble State Agriculture Ministry, MoA&FW, GOI, New Delhi on 04.01.2022.

Attended the Lecture#39 "Indian Crop Improvement Programme: New Viastas by Deputy Director General (Crop Science), ICAR, New Delhi on 07.01.2022 through virtual mode.

Attended the meeting on Natural Farming at ICAR-CIAH, Bikaner on 10.01.2022, all principal scientists and Incharge were participated in the meeting.

Attended Monthly Meeting of Horticultural Science Division Director's on Merger of Schemes and EFC related on 20.01.2022 chaired by DDG (Hort. Sci.), ICAR, New Delhi through virtual mode (Zoom).

Attended Meeting of Directors/PCs of Horticultural Science Division on SFC/EFC and Merger of Schemes on 22.02.2022, Chaired by DDG (Hort. Sci.), Horticultural Science Division, ICAR, New Delhi through virtual mode (Zoom).

Organized Regional Awareness Comparing on Natural and Organic Farming in Arid Horticulture Crops undr Bharat Ki Ajadi Ka Amrit Mahotsva during 01-07 Feb., 2022.

Deliver lecture on General Awareness about difference between Natural Farming and Organic Farming on 01.02.2022 through virtual mode. (60 Participants were participated, 20 Farmers and 40 scientists and stakeholders)

Organized Assessment Committee for Technical Group-II for Cat.II to Cat.III (Lab. Tech.) on 02.02.2022.

Attended the ICRISAT Event by Hon'ble PM on 05.02.2022 through virtual (webex) mode.

Attended the ARMS meeting held on 08.02.2022 chaired by Sec. DARE & DG ICAR, New Delhi through virtual mode.

Attended the 14th Foundation Day on 21st February 2022 of ICAR-NIASM, Baramati (MS) through virtual mode.

Attended the National Science Day on 28th February, 2022 organized by NAAS, New Delhi on the topic "The Role of Science in the Development of Indian Agriculture: Challenges and the Future".

Attended Mallinath Pasu Mela at Tilwara, Barmer and carry the live samples for exhibition in the Mela during 01-03 April, 2022.

Attended the SOC Meeting of ICAR on 07.03.2022 Chaired by Sec. DARE and DG ICAR, New Delhi with Administrative Officer, Audit and Account Section and I/c PME Cell.

Attended and delivered lecture on Status of micro-irrigation in India and abroad during winter school on "Advances in Irrigation Technology and Nutrient Management in Arid Horticultural Crops" by SKRAU, Bikaner during 02 January 2022 to 09 February, 2022.

Participation in one day Farmers' Fair as Guest of Honor at ICAR-NRC on Seed Spices, Tabiji, Ajmer.

Attended delivered lecture on INM in Horticultural crops workshop on NAHEP at SKRAU, Bikaner on 13.03.2022.

Attended delivered lecture in Training programme of Farmer Training from 21-25 March, 2022 from ATMA, Jhunjhunu where 35 farmers were participated.

Chaired the IJSC meeting held on 24.03.2022 through virtual mode.

Attended SAC meeting of KVK, Panchmahal as Chairman of the Committee on 25.03.2022, through virtual mode.

Attended 93rd Annual General Meeting of ICAR Society on 26.03.2022 through virtual mode (zoom) vide council letter No. 9(1)/2021-Gov. Cell Dated 24th March, 2022.

Dr. S. R. Meena

Participated /attended online 05 days training on "Data Analysis in Social Sciences Research" organized by ICAR-NAARM,

Hyderabad- 500 030 (Telangana).

Attended and contributed during the organization of the National Webinar on "Indian JuJube" held in the Institute on 14.06.2021.

Attended and contributed during the organization of the webinar on "Importance of YOGA and its advantages" at the Institute on 21.06.2021 on the occasion of International Yoga Diwas on 21.06.2021.

Attended and contributed during the organization of the webinar on "Low tunnel vegetable production" held at the Institute on 25.06.2021.

Attended and contributed during the organization of the National Webinar on " Khejri: Versatile tree for horticultural exploitation" virtually held at the Institute on 25.06.2021.

Attended a DPC of some technical at ICAR-CAZRI, Jodhpur on 20.08.2021 as a ASRB Nominee Member of the Committee.

Attended the PMEC meeting held to evaluate the new project proposal submitted by Dr. Hanuman Ram related to research work on "Tomato &Chilli" for developing heat tolerant varieties of the same.

Attended the meeting held at the Institute to discuss about different programmes (monthly/ weekly programmes/ campaign) to be conducted by the Institute in compliance of ICAR letter/ email 03.06.2021 and Commemoration of 75th year of India's Independence.

Attended the meeting held by Director of the Institute with Divisions' Heads/ section In charges on 16.06.2021 to discuss and take decisions about programmes/ activities to be carried out during the year-2021 for commemoration of 75th year of India's Independence as "Bharat Ka Amrut Mahotsav" per guidelines of DARE/ICAR, New Delhi.

Attended the meeting and visit held at the Institute in respect of Dr. SumitGodara, MLA Lunkarnsar, Bikaner held in the Institute on 22.06.2021. He visited the whole farm/ experimental block of the Institute, interacted with Director, scientists and he highly appreciated the work progress and technologies developed by the Institute as a whole.

Attended and contributed as per need during the RAC meeting held at the Institute on 22.07.2021.

Various meetings like monthly meetings and other meetings held in the Institute time to time were also attended.

Attended and contributed as per need during the IRC Meeting held at the Institute from 03.09.2021 to 04.09.2021.

Attended all the programmes and activities carried out during the celebration of "Hindi PakhawadaProgramme" in the Institute from 14.09.2021 to 30.09.2021 .

Attended and contributed as per need during the virtual National Interaction Meeting of all ICAR scientists with Secretary, DARE and DG, ICAR, New Delhi on 28.10.2021 held at ICAR-CIAH, Bikaner.

Participated in "Workshop of new KVKs and review of the existing KVKs" organized by ATARI, Jodhpur on 31.01.2022 in virtual mode (online).

Participated in a summit titled as Natural Farming Pre Vibrant Gujarat Summit-2021 and held at Anand (Gujarat) in virtual mode on 16.12.2021.

Dr. S. K. Maheshwari

Attended VI International Conference on Global Research Initiatives for Sustainable Agriculture & Allied Science (GRISAAS-2021) in online mode during 13-15 December, 2021.

Dr. D. K. Samadia

Attended, PM' programme of International Years of Millets-2023 “Campaign on Nutri-Garden and Tree Plantation” at ICAR-CIAH, Bikaner, dated 17.09.2021.

MA&FW national conference “International year of fruits and vegetables 2021” dated 29.10.2021.

Attended Webinar “National consultation on plant based local foods for health and nutrition” NBPGR, New Delhi, dated 22.10.2021.

Attended Programme of PM's presentation “Climate change varieties and technologies” dated 28.09.2021.

Attended, Virtual “39th group meeting of AICRP on vegetable crops of IIVR” dated 07-09 Sep., 2021.

Attended, Virtual “ICAR-NBPGR foundation day” dated 02.08.2021.

Attended, Virtual “Biological Diversity Act NBA-2002” webinar of NDRI on 17.07.2021.

Attended, Virtual “93th ICAR foundation day” dated 16/07/2021.

Attended, Virtual lecture of ICAR series “Nature & Environment by Dr. A.P. Joshi” dated

26.05.2021.

Attended,Virtual "Vishav Jal Divas Samaroh" at ICAR-CIAH, Bikaner dated 22.03.2021.

Attended,Virtual "Brainstorming on digital sequence information and germplasm sharing" of ISPGR & NBPGR, New Delhi, dated 01.03.2021.

Attended,Virtual "25th AICRP on AZF group meeting of ICAR-CIAH, Bikaner dated 26-27.02.2021.

Attended,Virtual national meeting convergence for popularization for biofortified varieties of ICAR, New Delhi, dated 26.02.2021.

Attended,Virtual "National webinar on bael" organized by ICAR-CIAH, Bikaner dated 19.02.2021.

Attended,Virtual "National webinar on khejri" organized by ICAR-CIAH, Bikaner dated 07.07.2021.

Attended,Meeting of NABARD officials at ICAR-CIAH, Bikaner and given presentation on production technology of Khejri, Kachri and Kaakdia, dated 12.03.2021.

Dr. L. P. Yadav

Participated 10 days national level online training programme on "Emerging trends in seed production technology and quality control framework for effective seed supply chain of horticulture crops" organized by (UHS, Bagalkot), Karnataka from 28.12.2020-06.01.2021.

Participated in Regional Seminar on Importance of Water in Arid Region "valuing water" organized by ICAR-CIAH, Bikaner on world water day 22.03.2021.

Participated in webinar "Nutritional Security: Challenges and Opportunities on Gender Sensitive Agriculture" organized by ICAR-CIWA, Bhubaneshwar on 25.03.2021.

Participated in national webinar on "Indian jujube" organized by ICAR-CIAH, Bikaner on 14.06.2021.

Participated in national webinar on "Khejri- A versatile tree for horticultural exploitation" organized by ICAR-CIAH, Bikaner on 07.07.2021.

Participated in national webinar on "Low tunnel vegetable production" organized by ICAR-CIAH, Bikaner on 25.06.2021.

Participated in two days training on "Enterpreneurship development through hi-tech horticulture' organized by DEE, BCKV, Mohanpur, West Bengal on 06-07.08.2021.

Participated in Pradhan Manri Kisan Jan-DhanYojna (PM-KMY) virtually on 13.07.2021.

Participated in International Webinar Conference on "Alternate Cropping Systems for Climate Change and Resource Conservation" organized by ICAR-Indian Institute of Farming Systems Research, Modipuram, Meerut-250110 from 29 September to 01 October, 2021.

Participated in 3rd International webinar on stingless Bee organized by Regional apiculture center (virtually) on 22.09.2021.

Dr. Gangadhara K.

Participated 10 days national level online training programme on "Emerging trends in seed production technology and quality control framework for effective seed supply chain of horticulture crops" **o**rganized by dept. of biotechnology and crop improvement, COH-Bidar (UHS, Bagalkot), Karnataka from 28**.**12**.**2020- 06**.**01**.**2021.

Participated in regional seminar on importance of water in arid region "valuing water" organized by ICAR-CIAH, Bikaner on world water day 22.03.2021.

Participated in national webinar on "Indian jujube" organized by ICAR-CIAH, Bikaner on 14.06.2021.

Participated in national webinar on "Khejri- A versatile tree for horticultural exploitation" organized by ICAR-CIAH, Bikaner on 07.07.2021.

Participated in national webinar on "Low tunnel vegetable production" organized by ICAR-CIAH, Bikaner on 25.06.2021.

Participated in International Webinar on "Role of legumes and pulses in sustainable cropping system of hot arid zone" organized by SKRU, Bikaner on 17.07.2021.

Participated in farmer's day celebration and Exhibition programme on the eve of 75th year of India's independence with the theme "jai javan jai kisan- uttamkheti-unnathkisan' organized by KVK-Panchmahal, Vejalpur, Godhra, Gujarat on 24/12/2021

Dr. Ajay Kumar Verma

Participated in International Conference on 'Vegetable Research and Innovations for Nutrition, Entrepreneurship and Environment (ICVEG-21)' organized by ISVS and ICAR-IIVR, Varanasi during 14-

16 December, 2021.

Participated in 5th International Conference on 'Advances in Agriculture, Environmental and Biosciences for Sustainable Development (AAEBSD-2021)' organized by CoHF, Pasighat, NABARD, RVSKVV, Gwalior and AEDS, Rampur' during 05-07 August, 2021.

Attended 2nd International Agrobiodiversity Congress from November 15 to 18, 2021 convened by Ministry of Foreign Affairs and International Cooperation.

Participated in National Webinar on 'Low tunnel vegetable production' organized by ICAR-CIAH, Bikaner on 25th June, 2021.

Participated in National Webinar on 'Khejri-A versatile tree for horticultural exploitation' organized by ICAR-CIAH, Bikaner on 07th July, 2021.

Participated in International Webinar on 'Role of legumes and pulses in sustainable cropping system of hot arid zone' organized by SKRAU, Bikaner on 17th July, 2021.

Participated in Regional Seminar on 'Importance of water arid region-Valuing water' organized by ICAR-CIAH, Bikaner on 22nd March, 2021.

Participated in 6th National Youth Convention on 'Innovations and agricultural reforms towards farmers prosperity' organized by ICAR, AIASA, New Delhi and PJTSAU, Hyderabad in virtual mode from 20-21 February, 2021.

Participated in 39th Annual Group Meeting of AICRP (VC) held online during 7-9 September, 2021.

Presented an oral presentation on 'Microclimate modulations vis-à-vis covering material for early and off-season production of cucurbits' in International Conference on 'Advances in Agriculture, Environmental and Biosciences for Sustainable Development (AAEBSD-2021)' organized by CoHF, Pasighat, NABARD, RVSKVV, Gwalior and AEDS, Rampur during 05-07 August, 2021.

Dr. B. R. Choudhary

Participated in Farmer-Scientist Interaction on entrepreneurship opportunities in the field of horticulture organized by ICAR-CIAH, Bikaner on 28-12-2021 during Regional campaign on creating entrepreneurship in the field of horticulture among small and marginal farmers under Bharat ki Azadi ka Amrut Mahotsav from 24-31 December, 2021.

Attended 10 days national level online training on "Emerging Trends in Seed Production Technology and Quality Control Framework for Effective Seed Supply Chain of Horticulture Crops" organized by College of Horticulture, Bidar (UHS, Bagalkot) Karnataka from 28-12-2020 to 06-01-2021.

Attended 'International round table on achieving global food security through instrumentalities of plant variety and other related disciplines' organized virtually by Department of Promotion and Industry and Internal Trade (Ministry of Commerce & Industry) from 05-06 March, 2021.

Attended one day Regional Seminar on Importance of Water in Arid Region: Valuing Water on the occasion of "International Water Day" on 22nd March, 2021 organized at ICAR-CIAH, Bikaner.

Attended an International Webinar "Exchange of post PVP Control Measures" on 08th April, 2021 organized by PPV&FRA, New Delhi.

Participated in webinar "Prospects of under-utilized fruits in India for nutritional security and entrepreneurship" on 24th May, 2021 organized by SKN Agriculture University, Jobner.

Attended online DUS review meeting presented the progress of DUS Centre (Watermelon and Muskmelon) organized by PPV&FRA, New Delhi from 24-06-2021 to 25-06-2021.

Attended 39th Annual Group Meeting of AICRP (VC) held virtually from 07-09th September, 2021.

Attended ZREAC *Rabi* Meeting of 2021-22 held on 14-15 September, 2021 at ARS, Bikaner.

Attended International Webinar on "Fighting the hunger using smart technology" on 26 October, 2021 organized by ICAR-IIOPR, Pedavegi, Andhra Pradesh.

Attended International Conference on "Vegetable research and innovation for nutrition, entrepreneurship and environment (ICVEG-21)" through virtual mode organized by ICAR-IIVR, Varanasi from December 14-16, 2021.

Attended International webinar on "Exchange on Biochemical and Molecular Techniques (BMT) guidelines and implementation of BMT in DUS" on 16th & 17th December,

2021 organized by PPV&FRA, New Delhi.

Dr. Chet Ram

Attended IRC meeting held on 3-4 September, 2021 at ICAR-Central Institute for Arid Horticulture, Bikaner

Attended one day workshop (online mode) on Gene editing research in agriculture: Key Initiatives in India organized by Tata Institute for Genetics and Society (TIGS), Bengaluru, Karnataka.

Attended 42nd Annual Meeting of Plant Tissue Culture Association (India) & International Symposium on Advances in Plant Biotechnology and Genome Editing-2021 (APBGE-2021) organized by ICAR-Indian Institute of Agricultural Biotechnology (IIAB), Ranchi-834010, Jharkhand on 8-10 April, 2021.

Attended webinar on Medicinal Plants: Leads for Drug Discovery organized by ICAR-Directorate of Medicinal and Aromatic Plants Research (ICAR-DMAPR), Anand on 31 August, 2021.

Attended 2nd International Agrobiodiversity Congress-2021 (IAC-2021) organized by Indian Society of Plant Genetic Resources and Bioversity International, Rome, Italy on 15-18 November 2021.

Dr. D. K. Sarolia

Attended International webinar (Indo-German) on "Exchange of Post PVP Control Measures" organized by PPV&FRA,New Delhi on 8.4.2021.

Attended an international webinar on DUS testing data management/ automation/ image analysis on 6-7 October, 2020.

Attended webinar on "Prospects of Under-utilized Fruits in India for Nutritional Security and Entrepre-neurship" organized by Department of Horticulture, SKN Agriculture University, Jobner (Raj.) on 24.5. 2021.

Attended International webinar (Indo-German) on "Exchange on Biochemical and Molecular Techniques (BMT) guidelines and implementation of BMT in DUS" organized by PPV&FRA,New Delhi on 16-17, Dec., 2021.

Attended Institute technology management committee meeting at ICAR-CIAH, Bikaner (11.11.21).

Attended Review meeting regarding olive farmers, ROCL, Krishi Pant Bhawan Jaipur (6.10.21).

Attended meeting on line mode for discussion on design and development of Training Modules for Technical Staff of ICAR headed by Dr. A.K. Vyas, ADG (HRM), ICAR on 20.10.2021 at 02:30 pm.

Dr. Hanuman Ram

Participated in "VI International Conference on Global Research Initiatives for Sustainable Agriculture and Allied Sciences-GRISAAS 2021" (An International Event) during 13-15 Dec, 2021 through virtual mode.

Attended 39th AICRP (Vegetable Crops) group meeting held Online from 7-9 September 2020 (through virtual mode).

Participated in the International Webinar Conference on "Alternate Cropping Systems for Climate Change and Resource Conservation" from 29 September to 01 October 2021 (through virtual mode).

Participated & exhibited ICAR-CIAH technologies in Kisan and Pashupalak Mela on 24.12.2021 at RAJUVAS, Bikaner.

Dr. K. L. Kumawat

Participated in National Webinar on "Bael" organized by ICAR-CIAH, Bikaner (Rajasthan) on 19 Feb., 2021.

Participated in the Regional seminar on Importance of water in arid region "Valuing Water" organized by ICAR-CIAH, Bikaner on World Water Day, 22nd March, 2021.

Participated in the National Webinar on "Indian Jujube" organized by ICAR-CIAH, Bikaner (Rajasthan) on 14 June, 2021.

Participated in the International webinar on "Pomegranate: Ancient Fruit in Modern Horticulture" jointly organized by ICAR-National Research Centre on Pomegranate, Solapur in collaboration with ICAR-CIAH, Bikaner from 25-27 August 2021.

Participated in the International Webinar on "Alternate Cropping Systems for Climate Change and Resource Conservation" organized by ICAR-Indian IIFSR, Modipuram, Meerut from 29 September to 01 October 2021.

Participated in the International Web Conference on Global Research Initiatives for Sustainable Agriculture & Allied Sciences organized by Astha Foundation, Meerut (U.P.) from 13-15th December, 2021.

Pawan Singh Gurjar

Participated and delivered oral Paper presentation on "Ripening and fungicide treatment improves post cold storage life and quality of Dashehari mango. In International e-conference on Post Harvest Disease Management and Value Addition of Horticultural Crops held at ICAR-IARI, New Delhi during August 18-20, 2021.

Participated and presented poster on 'Arid vegetables dehydration to foster rural entrepreneurship and reducing post-harvest losses' In: Vegetable Research and Innovations for Nutrition, Entrepreneurship and Environment. International Conference at ICAR-IIVR, Varanasi from December 14 to 16, 2021.

Participated and presented poster on 'Standardization of packaging material for enhancing post harvest life of mulberry fruits'. In 9th Indian Horticulture Congress, Horticulture for Health, Livelihoods and Economy, held at CSUAT, Kanpur, Uttar Pradesh, India from 18-21, November, 2021

Participated and presented poster on 'Biochemical profiling of pomegranate cultivars grown under arid region'. In International Webinar on Pomegranate : Ancient Fruit in Modern Horticulture, August 25-27, 2021, held at ICAR-NRCP, Solapur, Maharashtra.

Participated virtually on National Webinar on "Secondary Agriculture for Agricultural Income Enhancement" held on 09th April 2021 and organized by the Department of Horticulture, Rajasthan College of Agriculture, MPUAT, Udaipur.

Participated virtually in International Webinar On "Food Security through Innovative Post harvest Technologies in Horticulture" held on 4th May, 2021 at College of Agriculture (SKNAU Lalsot (Dausa).

Participated virtually in National webinar on 'Prospects of Under-utilized fruits in India for nutritional security and entrepreneurship' held on 24 May, 2021, organized by NAHEP SKNAU, Jobner.

Dr. Ramesh Kumar

Attended and delivered oral presentation entitled "Crop regulation in pomegranate for higher quality yield under hot arid climate" inthe International Conference on Agriculture, Horticulture and Botany (AHB-2021) organized by IRDCP from 22nd - 23rd January, 2021.

Attended and delivered invited lecture entitled "Flower regulation in pomegranate with special reference to hot arid region" in the International Webinar on "Pomegranate: Ancient fruit in modern horticulture" organized by ICAR-NRC on Pomegranate, ICAR-CIAH, Bikaner and SARP, Solapur during 25-27, August 2021.

Attended and delivered oral presentation on "Effect of flower regulation on biotic and abiotic stress management in pomegranate (*Punic agra-natum* L.) under hot arid climate" in the Indian Horticulture Congress-2021 organized by IAHS, New Delhi and CSAUA&T, Kanpur from18-21 November, 2021.

Participated in International Conference on Agriculture, Horticulture and Botany (AHB-2021) held during January 22-23, 2021, organized by International Research and Development Center for Publication (IRDCP), Jaipur.

Attended International Webinar on "Pomegranate: Ancient fruit in modern horticulture" organized by ICAR-NRC on Pomegranate, ICAR-CIAH, Bikaner and SARP, Solapur during August 25-27, 2021.

Attended 9th Indian Horticulture Congress- 2021, held at CSAUA&T, Kanpur from 18-21, November, 2021, organized by the IAHS, New Delhi.

Attended National Webinar on "Low tunnel vegetable production" held on 25 June, 2021, organized by ICAR-Central Institute for Arid Horticulture, Bikaner-334006 (Rajasthan) through virtual mode.

Attended National Webinar on "Bael" held on 19 February, 2021, organized by ICAR-Central Institute for Arid Horticulture, Bikaner-334 006 (Rajasthan) through virtual mode.

Attended Regional Seminar on "Importance of water in arid region" organized by ICAR-CIAH, Bikaner on World Water Day, 22nd March 2021.

Participated in Kisan Mela organized by the Krishi Vigyan Kendra, Gudamalani (AU, Jodhpur) on 6th March, 2021 and exhibited institution technologies.

Attended ICAR-All India Coordinated Research Project on Arid Zone Fruits Annual Group Meeting 2021, held virtually from 26-28 Feb., 2021 at ICAR-CIAH, Bikaner.

Participated in Meeting held with NABARD and discussed on "Pomegranate production

technology" with NABARD Officials from different distracts of Rajasthan on 12.02.2021 at ICAR-CIAH, Bikaner.

Sh. Jagan Singh Gora

Attended and delivered oral presentation on "Introduction and performance evaluation of citrus germplasm under hot arid ecosystem of Rajasthan" in VI International Conference in Hybrid Mode on Global Research Initiatives for Sustainable Agriculture & Allied Sciences (GRISAAS-2021) being organized by SKRAU, Bikaner, Rajasthan, during 13-15 th December 2021.

Attended and poster presentation on "Phylogeny and population structure analysis of citrus cultivars using neutral and functional molecular markers" in 2nd International Agro-biodiversity Congress using Agro-biodiversity to Transform Food System dated 15-18 November 2021.

Participated in the IDP-NAHEP sponsored National Webinar on "Nematodes A Continuing Bottleneck in Crop Production: Available Technologies and Recent Advances" on 06th April 2021 organized by Department of Nematology, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan.

Participated in webinar on "Prospects of Under-utilized Fruits in India for Nutritional Security and Entrepreneurship" to held on 24th May, 2021 under the aegis of World Bank-ICAR funded National Agricultural Higher Education Project (NAHEP)-IDP organized by Department of Horticulture, SKNAU, Jobner (Raj.).

Participated in National Webinar on "Emerging Trends in Plant Physiology" on June 28, 2021 under the aegis of World Bank-ICAR Funded National Agricultural Higher Education Project (NAHEP) organized by Department of Plant Physiology, SKNAU, Jobner, Rajasthan.

Participated in the International Webinar-Pomegranate: Ancient Fruit in Modern Horticulture organized by ICAR- National Research Centre on Pomegranate, Solapur in collaboration with ICAR- CIAH, Bikaner from 25-27th Aug, 2021.

Participated in National Webinar on "Khejri - A Versatile Tree for Horticultural Exploitation" held on 07 July, 2021, organized by ICAR-CIAH, 334006, Rajasthan through virtual mode.

Participated in National Webinar on "Low Tunnel Vegetable Production" held on 25 June, 2021, organized by ICAR- Central Institute for Arid Horticulture, Bikaner, 334006, Rajasthan through virtual mode.

Participated in National Webinar on "Indian jujube" held on 14 June, 2021, organized by ICAR-Central Institute for Arid Horticulture, Bikaner, 334006, Rajasthan through virtual mode.

Dr. Kamlesh Kumar

Attended and presented oral lecture on 'Development of seed, rootstock and clonal plant standards of *lasoda* (*Cordia myxa* L.) for conservation of elite type and mass multiplication of quality planting materials' in 'International Web Conference on Global Research Initiatives for Sustainable Agriculture & Allied Sciences (GRISAAS-2021)' during 13-15 December 2021.

Attended and delivered oral lecture in monthly seminar on the topic 'Speed breeding: An innovative technique of crop improvement held at ICAR-CIAH, Bikaner on 25 February, 2021.

Attended 'International Webinar on Pomegranate: Ancient Fruit in Modern Horticulture' held during 25-27 August, 2021.

Attended webinar on "Prospects of Under-utilized Fruits in India for Nutritional Security and Entrepreneurship" held at Department of Horticulture, SKNAU, Jobner (Rajasthan) on 24 May, 2021.

Participated in 2nd International Agrobiodiversity Congress-Using Agrobiodiversity to Transform Food Systems' held virtually during 15-18 November, 2021.

Attended 'National Webinar on Bael' at ICAR-CIAH, Bikaner on 19 February, 2021.

Participated in 'National Webinar on Indian Jujube' held at ICAR- CIAH, Bikaner on 14 June, 2021.

Attended Regional Seminar on Importance of water in Arid region' "Valuing Water" held on 22 March, 2021 at ICAR-CIAH, Bikaner.

Attended online Hindi Workshop on 'Rajbhasha Hindi- Saralevam Sugam' at ICAR-CIAH, Bikaner on 27 March, 2021.

Attended Webinar on 'Medicinal Plants: Lead for Drug Discovery' held on 31 August, 2021.

Attended Webinar on 'Sensor based technology in horticulture' held at ICAR-CIAH, Bikaner on 7 September, 2021.

Attended all the online meetings on 'Horticulture

Planting Material and Creation of PEQ Facility' held at MIDH Division, Krishi Bhawan, DA&FW, MA&FW, New Delhi during 2021.

Participated 25th All India Coordinated Research Project on Arid Fruits (AICRP-AZF) meeting held at ICAR-CIAH, Bikaner during 26-28 February, 2021.

Attended online interaction meeting on 'International Year of Millets 2023' (Nutr-garden campaign and plantation programme) at ICRA-CIAH, Bikaner on 17 September, 2021.

Participated in virtual meeting of ICAR-AICRP on AZF at ICAR-CIAH, Bikaner on 26-28 February, 2021.

Attended Farmer-Scientist Interaction Meeting held at ICAR-CIAH, Bikaner on 28.09.2021.

Sh. M. K. Choudhary

Attended Annual Group Meeting of ICAR-All India Coordinated Research Project on Arid Zone Fruits held from February 28-29 2021 on virtual mode.

Attended Regional seminar on importance of water in arid region 'Valuing water' at ICAR-CIAH, Bikaner on 22.03.2021.

Attended monthly seminar of institute scientists, Dr. Dhurendra Singh, Dr. M.K. Berwal, Dr. P.S.Gurjar, Dr. Kamlesh Kumar, Rajeshwar Sanodiya at ICAR-CIAH, Bikaner.

Attended IRC meeting on 03-04 Sept, 2021 at ICAR-CIAH, Bikaner.Attended an interaction meeting of ICAR scientists with Secretary DARE &DG ICAR on October 28, 2021 on virtual mode.

Participated in National webinar on bealorganised by ICAR-CIAH, Bikaner on 19.02.2021

Participated in webinar on "Challenges & Opportunities in Arid Horticultural Crops" to held on 13.05.2021 under the aegis of World Bank-ICAR funded NAHEP-IDP organized by SKNAU, Jobner (Raj.)on virtual platform.

Participated in webinar on "Prospects of under-utilized fruits in India for nutritional security and entrepreneurship" to held on 24.05.2021 under the aegis of World Bank-ICAR funded NAHEP-IDP organized by Department of Horticulture, SKNAU, Jobner (Raj.) on virtual platform.

Participated in National Webinar on "Indian Jujube" held on 14.06.2021, organized by ICAR-CIAH, Bikaner (Rajasthan) through virtual mode.

Participated in National Webinar on Low Tunnel Vegetable Production on 25.06.2021 seminar.

Participated in National Webinar on "Khejri-A versatile tree for horticultural exploitation" held on 07.07.2021,organized by ICAR-CIAH, Bikaner (Rajasthan)on virtual platform.

Participated in International Conference on Global Research Initiatives for Sustainable Agriculture & Allied Sciences during 13-15, December 2021 through virtual mode.

Dr. S. K. Maheshwari

Attended VI International Conference on Global Research Initiatives for Sustainable Agriculture & Allied Science (GRISAAS-2021) in online mode during 13-15th December, 2021.

Dr. Anita Meena

Attended the National webinar on "Indian Jujube"at ICAR-CIAH, Bikaner-334006 (Rajasthan) through virtual mode ICAR-CIAH during 14.06.2021

Attended the National webinar on "Prospects of Under-utilized Fruits in India for Nutritional Security and Entrepreneurship" held on under the aegis of World Bank-ICAR funded NAHEP organized by Department of Horticulture, SKNAU, Jobner (Raj.) 24.05.2021

Attended one day Seminar on "Importance of water in arid region-valuing water organized by ICAR-CIAH during 22.03.2021

Attended the International webinar on "Translating Physiological Tools to Augment Crop Breeding" organized by ICAR-CIAH during 17-19 March, 2021.

One day training programme organized by CHES,Vejalpur

Sr. No	Date	Addresse for Organizetion	Total Farmers
1.	01/01/2021	ATMA Project, Thasara, Distt. Kheda, Gujarat	40
2.	02/01/2021	ATMA Project, VAso, , Gujarat	40
3.	06/01/2021	N.M Sadguru foundation ,Chosala, Dahod	62 female
4.	10/01/2021	N.M Sadguru foundation ,Chosala, Dahod	70 female
5.	12/01/2021	N.M Sadguru foundation ,Chosala, Dahod	60 female
6.	19/01/2021	College of Agriculture, Parul University Vadodara	42 students
7.	27/01/2021	College of Agriculture, Parul University Vadodara	40 students
8.	28/01/2021	N.M Sadguru foundation ,Chosala, Dahod	25
9.	08/03/2021	ATMA , Project Dhar M.P	45
10.	08/03/2021	ATMA , Project Dhar M.P	28+28=56
11.	09/03/2021	ATMA , Projec t Dhar M.P	28+17=45
12.	10/03/2021	ATMA , Project Dhar M.P	39
13.	24/03/2021	N.M Sadguru foundation ,Chosala, Dahod	37
14.	03/07/2021	N.M Sadguru foundation ,Chosala, Dahod	51
15.	07/07/2021	N.M Sadguru foundation ,Chosala, Dahod	45
16.	13/07/2021	N.M Sadguru foundation ,Chosala, Dahod	52
17.	16/07/2021	Sadguru water and development, Dahod	45
18.	06/02/2021	ATMA Staff tour.	17 Officers
19.	06/09/2021	ATMA Project, Distt.Dahod, Gujarat	25
20.	07/09/2021	ATMA Project, Distt.Dahod, Gujarat	M15+F11=26
21.	08/09/2021	Anand Agricultural University, B.A College of Agri.	Students 60
22.	08/09/2021	ATMA Project, Distt.Zal od, Gujarat	M15+F15=30
23.	09/09/2021	RAWE Students A.A.U Anand	Students 59
24.	09/09/2021	ATMA Project, Fatepura, Gujarat	33
25.	14/09/2021	ATMA Project, D istt. Dahod, Limheda, Gujarat	30F
26.	15/09/2021	ATMA Project, Distt. Kheda, Gadteshwar Gujarat	50
27.	15/09/2021	ATMA Project, Distt.Dahod, Dhanpur, Gujarat	30
28.	16/09/2021	ATMA Project, Keda, Distt. Kheda, Gujarat	50
29.	16/09/2021	ATMA Project, Dev Garh Baria Distt. Dahod , Gujarat	30
30.	17/09/2021	ATMA Project, Distt. Kheda, Gujarat	52
31.	17/09/2021	ATMA Project, Ta. Sanjeli, Distt.Zal od, Gujarat	30F
32.	18/09/2021	ATMA Project, Singhwad Distt. Dahod , Gujarat	M15+F15=30
33.	18/09/2021	ATMA Project, Kapadvanj , Gujarat	51
34.	20/09/2021	ATMA Project, VAso, , Gujarat	50
35.	21/09/2021	ATMA Project, Nadiyad, Distt. Kheda, , Gujarat	50
36.	22/09/2021	ATMA Project, Mahemdabad , Distt. Kheda, , Gujarat	50
37.	23/092021	ATMA Project, Distt. Kheda, Gujarat	50
38.	24/092021	ATMA Project, Matar, Distt. Kheda, Gujarat	55
39.	25/092021	ATMA Project, Mahudha, Distt. Kheda, Gujarat	50
40.	27/09/2021	CoA,Jabugam,BSc. Agri Students final years	38 students
41.	18/10/2021	N.M Sadguru foundation ,Chosala, Dahod	30
42.	18/12/2021	Navsari Agriculture Agricultural University, Uni.	26 student

7. WOMEN EMPOWERMENT

Training programmes on women empowerment

In arid region, the main aim of the training programme is to enhance the quality of life of women through increased knowledge and skills. The women need vocational training or skills also to uplift their status. The empowerment of women is the way for economic independence of rural women and hopefully the future will bring more opportunities for them. So, the training programmes were organized with the objective of entrepreneurial empowerment of rural women farmers through nutrigarden in arid region, processing of arid horticultural crops and through nursery management in arid region. For women awareness so many training programmes and skill based training programmes were conducted under SCSP scheme during March, 2021. A total of 750 SC farm women were benefitted through the different training programmes in 2021 and all necessary precautionary measures like social distance, compulsory use of face mask and hand sanitizing were followed as per guideline by ICAR during training. The International Women's Day was organized on 8th March, 2021 at the ICAR-Central Institute for Arid Horticulture, Beechwal, Bikaner. Women farmers were participated from Sagar, Hussangsar, Udaar and Pemasar villages on this occasion. Smt Santosh Devi Khedar, a progressive farmer of organic farming of Beri village in Sikar district, was invited as the chief guest on the occasion of International Women's Day 2021. She addressed the occasion and said that women should not consider themselves weak in any form. Rural women can establish herself in the society by working hard and diligently. The hard work of women in farming is always excellent. On this occasion, she told the farmer women that the use of chemicals should be minimized in farming. The land should be protected from the ill effects by using organic pesticide. Dr. Anita Meena, Scientist and Nodal officer of International women's day 2021 of the institute's program, told the women present on the occasion that you are not lagging behind men in any way, women labor more than men and nurture families.

The training was based on theoretical knowledge and women trainees were also exposed to hands on training practical. The major emphasis was given to small scale home-level processing of arid fruits and vegetables. Hands-on training was provided for preparation of fruit beverages viz. squashes, nectar, RTS *etc*. They were also, trained for preparation of ber pickle, aonla mouth freshener and watermelon rind candy. Under the training of "Women empowerment through nutrigarden and income security in arid regions". The women farmers have actively participated in the training programme. Major emphasis of the training was given to establish the nutrigarden with arid fruit crops and vegetables, budding, grafting of CIAH released fruits varieties and kitchen gardening to small scale home nurseries in arid region. Hands-on training was provided for showing the seedling, seed production technologies seed treatment methods, post harvest technologies, filling of pot mixture, transfer of plant from portray to polybags *etc*. During training the inputs like seeds of improved verities of vegetables, spices, kitchen gardening kit and some literatures of CIAH technologies were distributed to trainee of farm women. Under SCSP scheme some the sewing machines, milk cane, grain storage tank, utensils like pan (5litre), three fold rack, big size spoon, sieve were distributed among women farmers and they will be benefited by distribution of utensils for making valued added products at their home. The over look of CIAH, Farm by all women trainee participants and they were briefed about CIAH production technologies and quality standards, packing, storage and marketing of products were also covered during the training programmes. The CIAH technologies literatures were also distributed to SC women (BPL) under the SCSP scheme during different training programmes.

The institute honored Smriti Kiran Meghwal as front line worker, Mrs. Mamta Meghwal and Mrs. Sunita Shekhawat as Corona worrier by giving them shawls, certificates and institute memento. Song and Rangoli competitions were also organized during the program. Soil health cards were distributed to SC women farmers under SCSP scheme. During soil health day celebration a training programme was organized at Kolasar village and inputs like kitchen gardening kit, vermicompost and some literatures of CIAH

technologies were distributed to SC women farmers. In this training different lecture like importance of soil testing, collection of soil samples and factor affecting fertilizer requirement by the different arid vegetables were delivered. Farmers were also got trained in preparation of good quality FYM, compost and vermi-compost.

Specific training modules formulated and conducted for women

Specific training modules formulated and conducted for Entrepreneurial empowerment of women through processing of arid horticultural crops. Women empowerment through nursery management of arid horticulrural crops Post harvest management and value addition of arid fruits and vegetables.

Organized seven days training programme on "'Nutri-garden for nutritional and income security in arid region" from 05-11 March, 2022 under Scheduled Caste-Sub Plan (SCSP) scheme at ICAR-CIAH, Bikaner.

Organized the one day on campus "Women farmer training on poshan vatika/ nutrigarden for livelihood security by horticulture in the arid region and input distribution like utensils, vegetables seed kit and pamphlets during 18.12.2021 under SCSP scheme at ICAR-CIAH, Bikaner.

Organized the one day on campus "Women farmer training to farmers for horticulture crop production in the arid region, promotion of kitchen gardening and input distribution like utensils, vegetables seed kit and pamphlets during 23.12.2021 under SCSP scheme at ICAR-CIAH, Bikaner.

Organized one days training program entitled "Women empowerment for self reliance and distribution of utensils under Covid-19 pandemic." during August, 2021, under SCSP scheme at ICAR-CIAH, Bikaner.

Organized and celebrated one day training program for women farmer on occasion the National women day during October 16, 2021 at Udasar, Village, Bikaner.

8. ACCESSIBILITY TO THE PERSON WITH DISABILITIES (DIVYANGIAN)

The Institute has constructed ramp and washrooms in all office buildings/guest house for person with disabilities (divyangian).The scientists also interacted with them and conducted their visit to museum, experimental fields etc.

9. AWARD AND RECOGNITION

Awards

ICAR-CIAH got Best Technological Exhibition Award during Kisan *Mela* organized by KVK Gudamanali, Barmer-II under AU, Jodhpur on 06.03.2021. This award was given by Hon'ble State Agriculture and Farmers' Welfare Minister, Sh. Kailash Chaudhary Ji.

Dr. D. S. Mishra

1. Received Excellence in Research Award conferred by Society for Scientific Development in Agriculture & Technology (SSDAT), Meerut (U.P.) for outstanding contribution in the field of fruit science on the occasion of International Web Conference on "Global Research Initiatives for Agriculture and Allied Sciences (GRISAAS-2021)" held at SKRAU, Bikaner, Rajasthan, India during December, 13-15, 2021.
2. Received best oral presentation award for the paper presented on "Evaluation of guava germplasm based on physico-chemical traits and their use in breeding program". In: VIth International Conference on Global Research Initiatives for Agriculture and Allied Sciences (GRISAAS-2021) held at SKRAU, Bikaner, Rajasthan, India during Dec., 13-15, 2021.

Dr. Hanuman Ram

1. Awarded by "Emerging Scientist Award-2020" for the outstanding contribution in the field of Vegetable Science in 4th International conference on "Global approaches in natural resource management for climate smart agriculture during pandemic era of COVID-19" from 26-28th Feb 2021 (through virtual mode).

Dr. Kamlesh Kumar

1. Received 'best oral presentation award' on "development of seed, rootstock and clonal plant standards of lasoda (*Cordia myxa* L.) for conservation of elite type and mass multiplication of quality planting materials" in international web conference (GRISAAS-2021) held during 13-15 December, 2021.

Sh. M. K. Choudhary

1. Received best oral presentation award for 'Inheritance of branching habit in Cluster bean (*Cyamopsis tetragonoloba* (L.) Taub.) in International web Conference on Global Research Initiatives for Sustainable Agriculture and Allied sciences during 13-15th December 2021.

Dr. Mukesh Berwal

1. Received Best oral presentation award for "Bottom-up Mechanism of Tolerance against Concurrent Abiotic Stresses in Khejri (*Prosopis cineraria*) under Hot Arid Region" in the International Web Conference on Innovative and Current Advances in Agriculture & Allied Sciences-2021 held during July 19-21, 2021.

Dr. Anita Meena

1. Received Research Excellence awards form Institute of scholar, Bangalore An ISO 9001: 2015 certified Institute by International Accurate Certification , Accredited by UASL during , 2020.
3. Received the third oral presentation award in National conference titled: Agriculture Resource management for Atmnirbhar Bharat at Central Agriculture University, Imphal, and Manipur during 17-18 July, 2020.

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5. Awarded the Best poster presentation and Titled "Kachri (*Cuumus callous*) (AHK-119): Novel and Potential source of antioxidant in arid region" in International web conference titled: International Conference on Innovative and Current advances in Agriculture and allied Science, 19-21 July, 2021.

Recognitions

Dr. D. S. Mishra

1. Worked as Rapporteur in one day National Webinar on Bael (*Aegle marmelos* Correa) held at ICAR-CIAH, Bikaner on February 19, 2021.
2. Worked as Chairman in the Technical Session II: Impact of climate change on Biodiversity, food security and IPR issues in In: VIth International Conference on Global Research Initiatives for Agriculture and Allied Sciences (GRISAAS-2021) held at SKRAU, Bikaner, Rajasthan, India during Dec., 13-15, 2021.
3. Acted as Editor (National) of the Hort Flora

Research Spectrum (Biosciences & Agriculture Advancement Society), Meerut.
4. Acted as Editor (PHT) for ISAH Indian Journal of Arid Horticulture (Indian Society for Arid Horticulture), Bikaner.
5. Recognized as member of Scientific Advisory Committee of KVK, Dahod (AAU, Anand) on August 10, 2021.
6. Worked as Chairman of Expert Committee for evaluation of debate on "Azadi ka Amrut Mahotasava aur Rajbhasha Hindi" held at ICAR-CIAH regional station CHES, Godhra on September 17, 2021.
7. Acted as expert and evaluated M.Sc. (Ag.) Horticulture (Fruit science) thesis of Sri Shankar Lal (Id.No. 55542) on Effect of drip irrigation and mulching on plant growth, flowering and fruiting in litchi cv. Rose Scented, GBPUAT, Pantnagar.
8. Evaluated Ph. D. (Horticulture) thesis of Sri Rajkumar Jat (Id.No. 54148) on Scheduling of deficit irrigation with mulching for improving water productivity, yield and fruit quality in guava cv. VNR Bihi on 20.10.2021, GBPUAT, Pantnagar.
9. Acted as expert and evaluated Ph. D. (Horticulture) thesis of Sri Gurbir Singh on Morphological characterization of mango germplasm in North West India, GNDU, Amritsar.
10. Worked as reviewer of many journals of repute viz., India Journal of Agricultural Sciences, Agricultural Science Digest, International Journal of Agriculture Sciences and Brazilian Archives of Biology and Technology during the year 2021.

Dr. B. R. Choudhary

1. Acted as rapporteur of 25th Research Workers Group Meeting-2021 of AICRP-AZF (Virtual) organized by ICAR-CIAH, Bikaner from 26-28th February, 2021 for the session Interaction with farmers and developmental agencies on 28th February and presented the recommendations.
2. Acted as Panellist in regional seminar on importance of water in arid region: valuing water on the occasion of "International Water Day" on 22nd March, 2021 in technical session IV: Efficient use of water in agriculture organized at ICAR-CIAH, Bikaner.
3. Inducted as Fellow of Indian Society of Arid Horticulture (ISAH), ICAR-CIAH, Bikaner, Rajasthan for the year 2020-21.
4. Inducted as Fellow of Indian Society of Vegetable Science (ISVS), ICAR-IIVR, Varanasi, UP for the year 2020.

Dr. Hanuman Ram

1. Acted as a Co-convener in a seven days training programme on "Nutri-garden in arid regions for nutritional and income security" from 5-11 March, 2021 at ICAR-CIAH, Bikaner under scheduled caste-sub plan "SSP".
2. Acted as a training coordinator in a seven days training programme on "Advances in onion cultivation under hot arid conditions" from 8-14th July 2021 through virtual mode at ICAR-CIAH, Bikaner

Dr. Ajay Kumar Verma

1. Appointed as External Examiner to evaluate M.Sc. (Ag.) thesis of Divesh Kurre and Nidhi Mishra of CoA, Tikamgarh by JNKVV, Jabalpur.
2. Appointed as paper setter for M.Sc. and Ph.D. courses *viz*. VSC-501, VSC-507, VSC-508, VSC-602, FSC-501, FSC-502 and FSC-504 by JNKVV, Jabalpur.
3. Invigilator for conducting JET 2021 examination on 08.08.2021 at IABM, SKRAU, Bikaner.
4. Reviewed the manuscript for *Indian Journal of Horticulture, Indian Journal of Agricultural Sciences*, *Indian Journal of Arid Horticulture*, *Vegetable Science*, *Electronic Journal of Plant Breeding* during 2021-22.
5. Member of organizing committee for 6th National Youth Convention on 'Innovation and Agricultural Reforms for Farmers' Prosperity' jointly organized by ICAR, PJTSAU and AIASA through virtual mode from February 20-21, 2021 at PJTSAU, Hyderabad.

Dr. L. P. Yadav

1. Received certificate of excellence in reviewing from International Journal of Environment and Climate Change, Asian Plant Research Journal, International Journal of Plant and Soil, European Journal of Medicinal Plants, Current Journal of Applied Science and Technology, 2021.
2. Acted as editorial board members, International Journal of Environment, Agriculture and Biotechnology, Mexico.
4. Acting as organising committee member in Webinar on Nutritional Health and Food

Science during February 3-4, 2022.
5. Acted as paper setter and examiner for "Potato and Tuber Crops" (VEG-311) of B.Sc. (Hons.) Agriculture, Agriculture University, Kota, Rajasthan.
6. Acted as paper setter for "Spices and Condiments (VS-212) for Maharana Pratap University of Horticulture, Karnal Haryana.

Dr. Chet Ram

1. Recognized for outstanding contribution to the quality of Plant Cell Biotechnology and Molecular Biology Journal and awarded a certificate for excellence in peer-reviewing by the Journal.
2. Recognized as member of editorial board of Journal of Plant Sciences, Science Publishing Group, USA.

Dr. D. K. Sarolia

1. Served as panellist for technical session-III (Traditional water harvesting system in Rajasthan) in regional seminar on importance of water in arid region "valuing water" on eve of world water day on 22.03.2021 at ICAR-CIAH, Bikaner.
2. Worked as rapporteur in session of Plant Genetic Resource Management (Session-II), All India Coordinated Research Project on Arid Fruits (AICRP-AZF) on 27th Feb., 2021
3. Expert team member for consultancy services to Mr. Adarsh Banthia for orchard establishment near Palana village, Bikaner.
4. Reviewer for Indian Journal of Arid Horticulture and reviewed two papers (1) effect of IBA concentration on semi hard wood cuttings of phalsa cv. Thar Pragati (2) Quality of pomegranate fruits as influenced by preharvest bagging under hot arid climate.
5. Served as organizing secretary in National webinar on Indian jujube held at ICAR-CIAH, Bikaner on 14.06.2021.
6. Served as session coordinator in International webinar on "Pomegranate: Ancient fruit in modern horticulture for the session-I organized by SARP, ICAR-NRC on Pomegranate, Solapur on 25.08.2021.
7. Co-Chairperson for poster session (VI a soil health management: current and future strategies) in 2nd International Web-Conference on Smart Agriculture for Resource Conservation and Ecological Stability (29-31, October 2021) organized by Academy of Natural Resource Conservation and Management, Lucknow (UP), India on 30.10.2021.

Dr. Ramesh Kumar

1. In AICRP on AZF Annual Group Meeting 2021, acted as Rapporteur in the session "Action Taken on Recommendations on XXIV Research Worker Group Meeting" and in "Plenary Session-Finalization of Recommendations" held virtually during 26-28 Feb., 2021 at ICAR-CIAH, Bikaner and documented its proceedings.
2. Acted as Associate Editor of Indian Journal of Arid Horticulture published by Indian Society for Arid Horticulture, Bikaner.
3. Acted as Academic Editor for International Journal of Agriculture Sciences published by Bioinfo Publication, Pune, Maharashtra.
4. Acted as "Editorial Board Members" for Krishi Kiran Hindi Magazine published by Society for Agriculture and Arid Ecology Research, Bikaner.
5. Acted as Co-Organizing Secretary in International Webinar on "Pomegranate: Ancient Fruit in Modern Horticulture" organized by ICAR-NRC on Pomegranate, ICAR-CIAH, Bikaner and SARP, Solapur during August 25-27, 2021.
6. Acted as Expert Team member for consultancy services for establishment of orchard of different fruit crop and value chain under MoA to Mr. Adrash Banthia M/s Posthik Dairy Farm, Palana, Bikaner.
7. Acted as Crop Specific Sub Committee (Pomegranate) Member of Restructured Weather Based Crop Insurance Scheme (RWBCIS) of Govt. of India for pomegranate crop for standardization of Term-sheets under RWBCIS.

Dr. Kamlesh Kumar

1. Received 'certificate of excellence in reviewing' from International Journal of Plant & Soil Science, Journal of Advances in Microbiology, Plant Cell Biotechnology and Molecular Biology, 2021 and reviewed a article of Indian Journal of Arid Horticulture during 2021.
2. Acted as rapporteur in session of Plant Genetic Resource Management (Session-II), All India Coordinated Research Project on Arid Fruits (AICRP-AZF) on 27th February, 2021.

Dr. Mukesh Berwal

1. Acted as Co-organizing Secretary in "National webinar on Bael" organized at ICAR-CIAH, Bikaner on virtual platform on February 19, 2021.
2. Acted as Convener in National webinar on "Khejri-A versatile tree for Horticultural Exploitation" organized at ICAR-CIAH, Bikaner on virtual platform on July 07, 2021.
3. Acted as Course coordinator in five days training on "Extension of Horticultural Technologies in Arid & Semi-arid Region for Nutritional and Livelihood Security" in collaboration with MANAGE, Hyderabad during October 18-22, 2021 in virtual mode.
4. Worked as an Expert in five days meeting of "Commission for Scientific and Technological Terminology, MHRD, Govt. of India" for preparation of Agri. Science Definitions Dictionary at SKRAU, Bikaner during September 20-24, 2021.
5. Editorial Panel Member of "Rivista Medicine journal".

Sh. M. K. Choudhary

1. Worked as rapporteur in session of Plant Propagation, Planting system, Plant densities, Training, Pruning and Post Harvest management (Session- V, VI & VII), All India Coordinated Research Project on Arid Fruits (AICRP-AZF) on 27th Feb., 2021.
2. Appointed to work as Flying Squad for JET 2021 examination held on 8th August, 2021.

Dr. S. K. Maheshwari

1. Acted as Rapporteur in Technical Session-IX: "Disease Management in Arid Zone Fruits during AICRP meeting on AZF (virtually)" during 26-28th Feb., 2021.
2. Acted as Panellist for Technical Session-IV in Regional Seminar on "Importance of Water in Arid Region: Valuing Water" during occasion of World Water Day on 18.03.2021.
3. Nominated as Member for the post of UDC under the DPC case on 14th July, 2021.
4. Acted as Member Secretary, RAC Meeting held on 22nd July, 2021 online/offline under Chairmanship of Dr. V. S. Thakur (Former V.C.) at ICAR-CIAH, Bikaner.
5. Nominated as 'Chairman' for 'Swachhta Week' (02-07th August, 2021) in the campus of Institute.
6. Nominated as 'Chairman' for celebrating 'Swachhta Pakhwada' held during 16-31st December, 2021.

10. PUBLICATIONS

Research Papers

Appa Rao V.V, Singh Sanjay, A. K. Singh, Vikas Yadav, B.D. Sharma, Anita Meena and P. L. Saroj (2020) Diagnosis and Recommendation Integrated System (DRIS) norms in custard apple (*Annona squamosa* L). *Indian Journal of Arid Horticulture*, 1(2):-21-24.

Apparao V. V., Singh Sanjay, Singh A. K., Yadav Vikas, Sharma B. D., Meena Anita and Saroj P. L. (2020) Diagnosis and Recommendation Integrated System Norms in Custard apple. *Ind. J. Arid Hort.* 2(1&2):19-21.

Apparao V. V., Singh Sanjay, Singh A. K., Yadav Vikas, Sharma B. D., Anita Meena and P. L. Saroj (2020) Diagnosis and Recommendation Integrated System Norms in Custard apple. *Ind. J. Arid Hort*. 2(1&2):19-21.

Berwal M.K., Haldhar S.M., Chet Ram, Gora J.S., Singh D. and Samadia D.K. (2021) GC-MS/MS Based Phytochemical Screening of Therapeutic Potential of *Calligonum polygonoides* L. Flower Bud Against Chronic Diseases. *Pharmacognosy Magazine*, 17(5): S68-S76.

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Radio/Hello KisanProgramme

Dr. A. K. Singh

Delivered radio talk on "Scientific Production Technology of Bael and Aonla " at All India Radio Godhra in Kissan Vaani Programme in October, 2021

Dr. D. S. Mishra

Delivered a TV talk in Hello Kisanon "successful cultivation of guava (Amrud ki safal baghwani)" at DD Kisan on September 28, 2021

Delivered a radio talk on "seasonal management of acid lime and guava orchards" at All India Radio Godhra on November 15, 2021.

Dr. L. P. Yadav

Radio talk recorded at All India Radio, Godhra on "Advances in cultivation practices of root and tubers crops under rainfed semi-arid condition" in Hindi for 'kishanvani' programme on 24.10.2021 and broadcasted on 01.12.2021.

Recorded TV talk broadcasted on News 18 Rajasthan entitled "? ?? ?? ??? ? ? ??? ? ?? ? ?" in Annadata Programme on 02.08.2021, at 5.30 to 6.00am. (Https://youtu.be/EMFpjXGx3fA).

Dr. D. K. Sarolia

Radio talk on "Improved farmer's practices for arid horticulture" in Kheti Re Baatan programme, AIR Bikaner (11.07.2021)

Doordarshan Kisan talk in Hello Kisan programme on Date palm cultivation (6-7 PM at 06.12.2021)

Dr. Anita Meena

Radio talk on "Importance of Natural Farming" during Radio talk on 19.03.2022 05:30:00 at AIR, Bikaner, Rajasthan.

10. RESEARCH PROJECTS

Code	Title of the projects	Name of PI & Co-PI
S. No.	New Research Project Proposal	
1	Enhancement of genetic potency of tomato and chilli under heat stressed environment	Dr. Hanuman Ram
2	An economic analysis of marketing system and entrepreneurial scope in arid horticulture	Dr. Rekha Rani
3	Breeding for fruit cracking and quality in pomegranate under hot arid region of Rajasthan.	Dr. Pawan Kumar
4	Water footprint and water management	Dr. K. L. Kumawat
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 Dr. Kamlesh Kumar Sh. M. K. Choudhary
(b)	Pomegranate (*Punica granatum* L.)	Dr. Ramesh Kumar Dr. D. S. Mishra Dr. Ramkesh Meena Dr. Chet Ram Dr. Pawan Kumar
c)	Date palm (*Phoenix dactylifera* L.)	Dr. Ramkesh Meena Dr. B. D. Sharma Dr. P.S. Gurjar Sh. M.K. Choudhary
(d)	Aonla (*Emblica officinalis* Gaertn)	Dr. A. K. Singh Dr. D. S. Mishra Dr. Mukesh K. Berwal
(e)	Bael (*Aegle marmelos* Correa.)	Dr. A. K. Singh Dr. Ramkesh Meena Dr. M.K. Berwal
(f)	Wood apple (*Feronia limonia*) and custard apple (*Annona squomosa)*	Dr. Vikas Yadav Dr. A. K. Singh
(g)	Jamun and manila tamarind.	Dr. A. K. Singh Dr. V. V. Appa Rao Dr. D. S. Mishra
(i)	Guava and acid lime.	Dr. D. S. Mishra Dr. Vikas Yadav
(j)	Underexploited fruit crops (lasoda, ker, karonda and pilu).	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. Ajay Kr. 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)	Introduction, collection, characterization, conservation and evaluation of vegetable crops (dolichosbean, clusterbean and cowpea) under rainfed semi-arid conditions of western India	Dr. Gangadhara, K. Dr. V. V. Appa Rao Dr. L. P. Yadav Ms. Ramyashree Devi
(n)	Introduction, collection, characterization, conservation and evaluation of germplasm of drumstick, spine gourd, ivy gourd, tomato, pumpkin and bottle gourd.	Dr. L. P. Yadav Dr. V. V. Appa Rao Dr. Gangadhara, K.

CIAH: 2	Improvement of arid and semi arid fruit and vegetable crops including biotechnological interventions:	
(d)	Biochemical and biotechnological interventions:	
(iii)	Biochemical mechanism of abiotic stress tolerance in arid horticultural crops.	Dr. Mukesh K. Berwal Dr. Chet Ram
iv)	Development, exploitation and validation of genomic resources for enhanced utilization of arid horticultural crops.	Dr. Chet Ram Dr. M. K. Berwal Dr. Ajay K. Verma Dr. Kamlesh Kumar Dr. Ramesh Kumar
CIAH: 3	Standardization of arid and semi-arid fruits and vegetables production technology:	
(c)	Intensification of research on tissue cultured date palm in hot arid region.	Dr. B. D. Sharma Dr. Ramkesh Meena
(d)	Standardization of production technology of *bael* under rainfed semi-arid conditions of western India.	Dr. A. K. Singh Dr. Sanjay Singh Dr. V. V. Appa Rao
(e)	Studies on compatibility and adaptability of citrus rootstock under hot arid environment of Rajasthan.	Sh Jagan Singh Gora Dr. Ramesh Kumar Dr. B. D. Sharma Sh. Roop Chand Balai
(f)	Studies on flowering regulation, cracking management and root stock adaptability in pomegranate under hot arid environment of Rajasthan.	Dr. Ramesh Kumar Dr. M. K. Jatav Dr. Ramkesh Meena Sh Jagan Singh Gora Ms. Ramyashree Devi
(i)	Nutrient management in chironji, custard apple, jamun and tamarind.	Dr. V. V. Appa Rao Dr. Sanjay Singh Dr. A. K. Singh
(j)	Production system management in *ber* under hot arid ecosystem.	Prof. (Dr.) P. L. Saroj Dr. D. K. Sarolia Dr. B. D. Sharma Dr. S.K. Maheshwari
(k)	Standardization of production technology of jamun and custard apple under semi-arid conditions of western India.	Dr. A.K. Singh Dr. D. S. Mishra Dr. V. V. Appa Rao
(l)	Response of date palm cultivar to pollen sources, pollen quality, quantity and suitability under hot arid ecosystem.	Dr. Ramkesh Meena Dr. Chet Ram Dr. K.L. Kumawat
(m)	Nutrients management in vegetables (*mateera*, kachri, snap melon and cluster bean,) of hot arid region of Rajasthan.	Dr. M. K. Jatav Dr. B. D. Sharma Dr. Anita Meena Sh. R. C. Balai
(n)	Protected cultivation of vegetables under hot arid conditions.	Dr. Ajay Kr. Verma Dr. Dhurendra Singh Dr. D. K. Samadia Dr. B. R. Choudhary
(o)	Management practices for saline soil and water for crop production in arid region.	Dr. Anita Meena Sh. Roop Chand Balai
(p)	Tuber crops in the arid region (Potato).	Dr. M. K. Jatav Ms. Ramyashree Devi Shri R. C. Balai
(r)	Exploitation of arid fruits and vegetables for value addition and commercialization.	Dr. Pawan Singh Gurjar Dr. S. R. Meena Dr. Ramkesh Meena Dr. Mukesh K. Berwal

(s)	Development of functional foods and nutraceutical value added products from arid horticultural crops.	Dr. Mukesh K. Berwal Dr. Ramesh Kumar Dr. P.S. Gurjar
(t)	Development of native crop -plant production system using saline water under hot arid environment.	Shri R.C. Balai Dr. Anita Meena Shri R. Sanodia
(u)	Impact assessment of adoption of pomegranate and date palm in hot arid and semi-arid regions of Rajasthan.	Dr. S. R. Meena Shri R. C. Balai Dr. Rekha Rani
CIAH: 4	Plant health management studies in arid and semi-arid fruit and vegetable crops:	
(c)	Development of a bio -fertilizer cum bio -pesticide formulations of native *Rhizobium* sp. for vegetable cultivation.	Ms. Ramyashree Devi Dr. Anita Meena
(d)	Major diseases and their control measures in important arid fruit crops (pomegranate and date palm).	Dr. S. K. Maheshwari Ms. Ramyashree Devi Dr. Ramkesh Meena Dr. Ramesh Kumar
Externally funded projects/Collaborative projects		Name of PI & Co-PI
1.	DUS centre (watermelon and muskmelon).	Dr. B. R. Choudhary
2.	DUS centre for *ber* (*Ziziphus* sp.).	Dr. D. K. Sarolia
3.	DUS centre for date palm horticultural crop.	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. A. K. Singh
7.	DUS nodal centre for chironji and tamarind.	Dr. A.K. Singh
8.	Production and demonstration of tissue culture raised plants under three locations and collection and maintenance of elite germplasm of date palm.	Dr. Dhurendra Singh Dr. Kamlesh Kumar
9.	Enhancing food and water security in arid region through improved understanding of quantity, quality and management of blue, green and grey water.	Dr. B. D. Sharma Dr. Ramesh Kumar
10.	Road map for branding rose products.	Prof (Dr.) P.L. Saroj
11.	Performance and evaluation of onion varieties under hot arid conditions.	Dr. A. K. Verma

12. RAC, IMC and IRC Meeting

Research Advisory Committee

In pursuance of Rule 71(A) of the Rules and Bye-laws of the ICAR Society, the Director General, ICAR, New Delhi has constituted the following Research Advisory Committee to review the progress of the ongoing research programme and suggest the future modalities of the future programme. The RAC meeting was held on 22 July, 2021 under the chairmanship of Dr. V. S. Thakur, Former Hon'ble VC, YSPUHF, Solan, H.P. (2021) at ICAR-CIAH, Bikaner.

Chairman
Dr. V. S. Thakur, Former Hon'ble VC, YSPUHF, Solan, H.P.

Member
Dr. D.P. Wasker, Director of Research VNMKV, Prabhani -431402 (MS)

Dr. Pemanand Mahapatra, Former Head Hort., OUAT and Dean, SOA University, Bhubaneswer

Dr. A.B. Rai, Ex-Head, IIVR, Varanasi

Dr. B.N.S Murthy, OSD, DAC&FW, New Delhi

Dr. Govind Singh, Ex. Director (R), SKRAU, Bikaner

Director, ICAR-CIAH, Bikaner

Asstt. Director General (Hort. II), ICAR-New Delhi

Member Secretary
Dr. S.K. Maheshwari, Principal Scientist (Plant Pathology)

Institute Research Committee

During the reported period, the meeting was held at ICAR-CIAH, Bikaner on 3-4 Sept., 2021 to discuss the progress of the ongoing research programmes and to finalize the new proposals. Dr. Govind Singh, Ex-DoR, SKRAU, Bikaner was the chief guest and meeting was chaired by Director of the Institute. The progress of ongoing research projects were presented in details by the scientist and discussion were also held on new project proposal.

Chairman
Dr. P.L. Saroj, Director, ICAR-CIAH, Bikaner

Member
All Scientists of the Institute

Member Secretary
Dr. M.K. Jatav, Principal Scientist (Soil Science)

Institute Management Committee Meeting
Held on 01.02.2021.

Member

ADG (H-II), ICAR, KAB-II, Pusa, New Delhi	02.02.2018	01.02.2021
Director (Horticulture) Government of Rajasthan, Jaipur (Rajasthan)	04.04.2019	03.04.2022
Director of Horticulture Government of Gujarat, Gandhinagar (Gujarat)	04.04.2019	03.04.2022
Director of Research, Swami Keswanand Rajasthan Agricultural University Bikaner	04.04.2019	03.04.2022
Shri Atma Ram Tard Village + Post - Maniwali, Tehsil -Sadulsahar, Distt. - Sriganganagar, Rajasthan	27.12.2018	26.12.2021
Shri Vijay Acharya Suranno Ka Mohalla, Acharya Chowk, Bada Bazar, Bikaner	27.12.2018	26.12.2021
Finance & Accounts Officer Central Arid Zone Research Institute, Jodhpur	04.04.2019	03.04.2022
Dr. A.K. Singh, Pr. Scientist, CHES, Vejalpur, Godhra	02.02.2018	01.02.2021
Dr. D. Singh, Principal Scientist (Plant Biotechnology) CIAH, Bikaner	02.02.2018	01.02.2021
Dr. R.A. Sharma, Pr. Scientist, Division of Plant Improvement, Propagation and Pest Management, CAZRI, Jodhpur	02.02.2018	01.02.2021
Dr. T.K. Behera, Pr. Scientist, Vegetable Science, IARI, New Delhi	02.02.2018	01.02.2021
Administrative Officer & Member Secretary	Ex-officio whole time	

13. LINKAGE AND COLLABORATION

MoU with Universities/Institutes

Johdpur Agricultural University, Mandore, Jodhpur for student training, study, PG Research etc.

SKN Agriculture University, Jobner for student training, study, PG Research etc.

Swami Keshwanand Rajasthan Agricultural University, Bikaner for teaching & research of students.

ICAR-NRC on Camel: Horti-pasture development and livestock camel production (camel focrsing on feed technology based on the concept 'Best from Waste'.

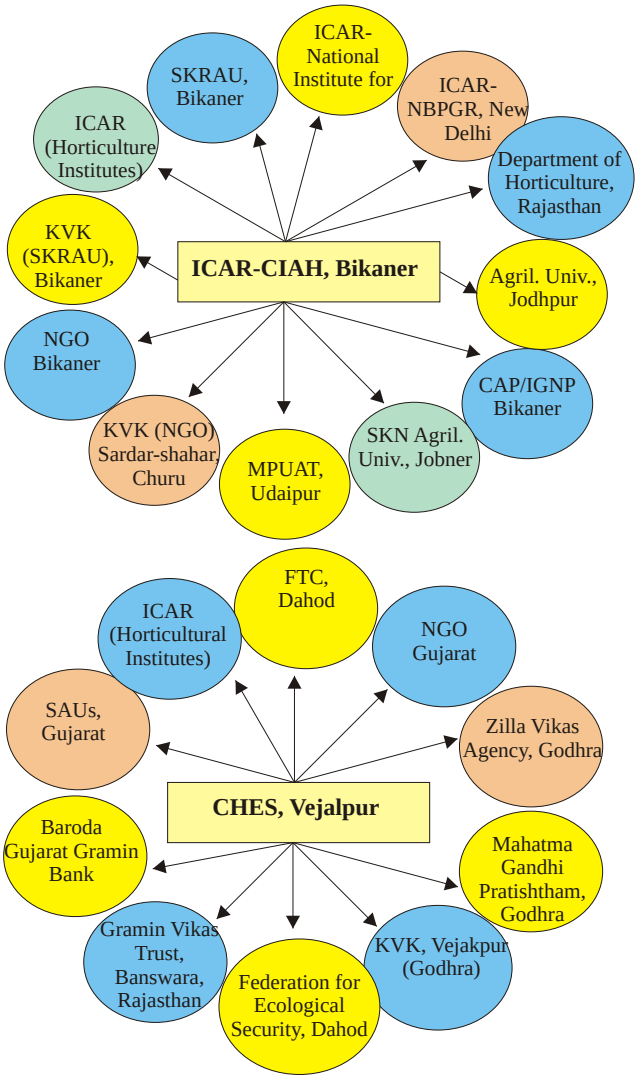
MoA with entrepreneurs

Lucence: Thar Divya Bael- to authorize for multiplication and commercialization of Thar Diva variety of Bael to VNR Nursery, Gujarat (Rs. 50,000/-)

Lucence: Goma Yashi-Bael- to authorize for multiplication and commercialization of Goma Yashi variety of Bael to VNR Nursery, Gujarat (Rs. 1.0 lakh)

Lucence: Goma Priyanka-Jamun- to authorize for multiplication and commercialization of Goma Jamun variety of Jamun to VNR Nursery, Gujarat

Providing consultancy for establishment of orchard of different fruit crops and value chain to Poustik Dairy, Bikaner Rs. 14,000/- (Yearly installment Rs. 3000/-, 5000/- and 6000/- including service tax for 3 years)



14. Rajbhasha

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lLFkku e dk;jr vf/kdkfj;k@depkfj;k dk fgUnh e dk; dju dh çj.kk d fy, jkt Hkk"kk foHkkx d fun'kkulkj pkj =ekfld dk;'kkykvk dk vk;ktu fd;k x;kA o"k 2021 dh igyh dk;'kkyk dk vk;ktu fnukd 27 ekp] 2021 dk fd;k x;k ftle ^^jkt Hkk"kk fgUnh &ljy ,o lxe^ fo"k; ij 0;k[;ku dk vk;ktu fd;k x;kA ble bft- vk'kk 'kek] lgk;d vfHk;Urk ¼fo|r½ ,o fgUnh lkfgR;dkj o dFkkdkj u 0;k[;ku fn;kA o"k dh nljh dk;'kkyk fnukd 30 tu] 2021 dk vk;kftr dh x;h ftle ^^jkt Hkk"kk ic/ku vkj b&vkfQl^^ fo"k; ij Jh /kjt 'kek] mi fun'kd ¼jkt Hkk"kk½] jk"Vh; M;jh vul/kku lLFkku] djuky u 0;k[;ku fn;kA e iFke nk dk;'kkykvk dk vk;ktu vkuykbu :i e fd;k x;k FkkA blh Øe e rhljh dk;'kkyk dk vk;ktu 27 flrEcj] 2021 dk fd;k x;k ftle chdkuj d tku eku gkL; dfo Jh ch-,y-Nxk.kh vkj o;ko) fgUnh lkfgR;dkj Jherh iehyk xxy u viuk 0;k[;ku fn;kA o"k 2021 dh vfre dk;'kkyk dk vk;ktu fnukd 16 fnlEcj] 2021 dk fd;k x;k ftle ^^jkt Hkk"kk fgUnh e vuLokj vkj mudk i;kx^ fo"k; ij Jh rkjkpn jiLoky] i/kkukpk;] jktdh; iof'kdk lLdr fo|ky;] xk<okyk] chdkuj u viuk 0;k[;ku fn;kA

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bl nkjku 14 flrEcj 2021 dk fgUnh fnol dk vk;ktu fd;k x;kA bl volj ij Mk- je'k ijh] lgk;d vkpk; ¼fgnh½] jktdh; egkfo|ky;] Mxjx< e[; vfrfFk FkA Jherh l/kk vkpk;] ofj"B fgUnh lkfgR;dkj fof'k"B vfrfFk FkhA

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fof'k"V vfrfFk M,- ctjru tk'kh] lg vkpk;] Mxj egkfo|ky;] chdkuj u dgk fgnh Hkk"kk d çpkj e ge lQy gk jg gkx] ijUr] bl lQyrk dh lkFkdrk lfnX/k gA fgnh Hkk"kk ftruh oKkfudrk l ifji.k g mruh llkj e vU; dkb Hkk"kk ugh gA fgnh Hkk"kk e vul/kku dk; dh deh dk mYy[k djr g, mUgku dgk fd bld ckj e 'kk/k dk; cgr de gk jg g] tk c<kuk vfuok; gA fgnh e ifj'kk/ku dk; ugh gku l Hkk"kk dk fodkl vo:) gk tk,xkA

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		iFke	f}rh;	rrh;@lkRouk
1	fgnh lkekU;u Kku çfr;kfxrk ¼oKkfud ox½	M,- vt; dekj oek	M,- prjke M,- dey'k dekj	M,- fd'ku yky dekor M, iou flg xtj
	ç'kklfud ox	Jh dynhi ikUM	Jh Lo:i pn jkBkM	Jh jkt'k dekj n;k
	rduhdh ox	Jh lt; ikfVy	--	--
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2	;fudkM fgnh Vd.k çfr;kfxrk	M,- vt; dekj oek	M, jked'k eh.kk	---
3	le lkef;d fo"k; ij y[k çfr;kfxrk	M,- nhid dekj ljkfy;k	Jh :ipn cykb	M,- j[kk jkuh
4	fgnh e vR;k{kjh	ny ^v^	ny ^l^	ny ^n^
5	cPpk dh fp=dyk çfr;kfxrk cMh d{kk leg	d- vofrdk	d- Hkkfodk	d- fjfrdk
	NkVh d{kk leg	d- tkxfr	fp- ;'ko/ku	--
6	fgnh 'kCn y[ku çfr;kfxrk oKkfud ox	M,- gueku jke	M,- vt; dekj oek	M,- iou dekj xtj
	rduhdh ox	Jh Nêu yky eh.kk	Jh lt; ikfVy	--
	ç'kklfud ox	Jh Lo:i pn jkBkM	Jherh itk tk'kh	Jh dynhi ikUM
	vkj-, rFkk okbih ox	M,- iou dekj ikjhd	Jh vkRek jke	--



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jktHkk"kk dk;Uo;u lfefr ,o fgUnh dk;'kkyk%

dUæ dh jktHkk"kk dk;kUo;u lfefr dh frekgh dh cBdk ,o fgUnh dk;'kkyk Øe'k% fnukd 30-06-2021]15-09-2021] 23-12-2021] dk lHkk d{k e vk;kftr fd;k x;k ftle dUæ dh jktHkk"kk dh çxfr dh leh{kk dh xb ,o dk;kUo;u e vk jgh dfBukb;k dk nj dju d fy, fopkj foe'k djd fgUnh dh çxfr dk lfuf'pr dju d fy, dne mBk;A

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dUæh; ckxokuh ijh{k.k dUæ] otyij ¼xk/kjk½ e fnukd 13-09-21 l 18-09-21 rd fgUnh llrkg dk vk;ktu fd;k x;kA fgUnh llrkg nkjku 14-09-21 fgUnh fnol dk;ko;u e e[; vfrFkh Jh }kjk fgnh Hkk"kk dk bfrgkl] 17-09-2021 0;k[;ku Li/kk] 18-09-2021 vkl Hkk"k.k] dk;Øe vk;kftr fd, x;A ;g Hkh fu.k; fy;k x;k dh lHkh depkjh ,o vf/kdfj;k viuk egUke dk; fgnh e gh dju dk ç;kl djA

fdlku çf'k{k.k%

dUæ }kjk le;≤ ij fdlkuk d ,d fnolh; çf'k{k.kk vk;kftr fd, tkr gA bu fdlku çf'k{k.kk e doy fgUnh Hkk"kk dk gh ç;kx fd;k tkrk gA dUæh; ckxokuh ijh{k.k dUæ otyij ij vkRek ikt DV d lg;kx l xtjkr d db xko l i/kkj fdlkuk vkj efgyk fdlkuk dk Þxkeh.k fodkl d fy, ckxokuhß çf'k{k.k dk;Øe dk vk;ktu fd;k x;kA ;g dk;Øe li.k fgUnh e gh vk;kftr fd;k x;kA

bu fdlku çf'k{k.kk e doy fgUnh Hkk"kk dk gh ç;kx fd;k tkrkg dUæh; ckxokuh ijh{k.k dUæ otyij ij vkRek ikt dV d lg;kx l xtjkr d db xko l i/kkj fdlkuk vkj efgyk fdlkuk dk Þxkfe.k fodkl d fy, ckxokuhß çf'k{k.k dk;Øe dk vk;ktu fd;k x;kA ;g dk;Øe li.k fgUnh e gh vk;kftr fd;k x;k Fkk

Mk yky ilkn ;kno fgUnh llrkg d nkjku vk;kftr oKkfud oXk e Lihp dEihfV'ku e iFke ijLdkj ikIr djr g,A

15. DISTINGUISED VISITORS

Smt. Santosh Khatod, State Awardee progressive Women Farmer visited in the Institute on the occasion of International Women Day on 08.03.2021

Sh. Jaydeep Shriwastava, CGM, NABARD visited the Institute on 13.02.2021

Dr. Ramesh Tambia Deputy Director, NABARD, Bikaner visited the Institute on 13.02.2021

Dr. Sumit Godara, MLA, Lunkarnsar, Bikaner visited the Institute on 22.06.2021 and also interact with Director, Scientists and he highly appreciated the work progress and technologies developed by the Institute as whole.

Sh. Rajendra Joshi, Sr. Journalist visited the Institute on 22.03.2021

Dr. R. P. Singh, Vice Chancellor, SKRAU, Bikaner visited the Institute on 16-07-2021

Dr. Ambrish S. Vidhyarthi, Vice Chancellor, Bikaner Technical University, Bikaner visited the Institute on 27-09-2021.

Dr. B. K. Pandey, Asstt. Director General (Hort. Sci.-II), ICAR, New Delhi visited the institute on 12.08.2021.

Sh. Sunda Ram, Padmashree Awardee visited the Institute on 17.09.2021

Dr. Satish Kumar Garg, Vice Chancellor, RAJUVAS, Bikaner visited Institute on 30.09.2021.

16. PERSONNEL

A. ICAR-CIAH, Bikaner (Rajasthn): HQ

S. No.	Name	Designation/Discipline
I. Research Management Position		
1.	Dr. B.D. Sharma	P.S. & Director (Acting)
II. Scientific		
1.	Dr. Dhurendra Singh	Principal Scientist (Plant Biotechnology)
2.	Dr. D.K. Samadia	Principal Scientist (Horticulture)
3.	Dr. S.K. Maheshwari	Principal Scientist (Plant Pathology)
4.	Dr. S.R. Meena	Principal Scientist (Agricultural Extension)
5.	Dr. M.K. Jatav	Principal Scientist (Soil Science)
6.	Dr. Deepak Kumar Sarolia	Principal Scientist (Horticulture)
7.	Dr. B.R. Choudhary	Principal Scientist (Horticulture)
8.	Dr. Ramkesh Meena	Senior Scientist (Horticulture)
9.	Dr. Mukesh Kumar Berwal	Senior Scientist (Plant Biochemistry)
10.	Dr. S.M. Haldhar	Senior Scientist-Agricultural Entomology (on lien)
11.	Sh. Roop Chand Balai	Scientist (Soil Science)
12.	Dr. Ramesh Kumar	Scientist (Horticulture-Floriculture)
13.	Dr. Chet Ram	Scientist (Plant Biotechnology)
14.	Dr. Anita Meena	Scientist (Soil Science)
15.	Sh. Jagan Singh Gora	Scientist (Horticulture)
16.	Dr. Kishan Lal Kumawat	Scientist (Horticulture)
17.	Dr. Pawan Singh Gurjar	Scientist (Fruit Science)
18.	Sh. Lal Chand	Scientist-Horticulture (on study leave)
19.	Dr. Kamlesh Kumar	Scientist (Fruit Science)
20.	Dr. Ajay Kumar Verma	Scientist (Vegetable Science)
21.	Dr. Pawan Kumar	Scientist (Genetics and Plant Breeding)
22.	Dr. Hanuman Ram	Scientist (Vegetable Science)
23.	Sh. Mahendra Kumar Choudhary	Scientist (Genetics and Plant Breeding)
III. Administrative		
1.	Shri Ramesh	Administrative Officer
2.	Shri Kuldeep Pandey	Assistant Administrative Officer
IV. Technical		
1.	Shri P.P. Pareek	Asstt. Chief Technical Officer (O.L.)
2.	Shri Sanjay Patil	Asstt. Chief Technical Officer (Artist & Photography)
3.	Shri C. L. Meena	Asstt. Chief Technical Officer (Field)
4.	Shri B. R. Khatri	Sr. Technical Officer (Computer)
5.	Shri P.R. Singh	Technical Officer (Field)
6.	Shri C. D. Rathva	Technical Assistant (Field)

B. ICAR-CIAH Regional Station, CHES, Vejalpur (Gujarat)

S. No.	Name	Designation/Discipline
I. Scientific		
1.	Dr. A.K. Singh	Principal Scientist (Horticulture) &I/c RS, CHES
2.	Dr. V.V. Appa Rao	Principal Scientist (Soil Science)
3.	Dr. Daya Shankar Mishra	Principal Scientist (Fruit Science)
4.	Dr. Lalu Prasad Yadav	Scientist (Vegetable Science)
5.	Dr. Gangadhara, K. Scientist	Scientist (Vegetable Science)

III. Technical		
1.	Sh. Nihal Singh	Chief Technical Officer (Field)
2.	Sh. G.U. Trivedi	Astt. Chief Technical Officer (Library)
3.	Sh. A.V. Dhobi	Astt. Chief Technical Officer (Overseer)
4.	Sh. G.R. Baira	Sr. Technical Officer (Field)
5.	Sh. R.B. Baria	Technical Officer (Field)
6.	Sh. K.K. Vankar	Technical Officer (Field)
7.	Sh. R.D. Rathva	Technical Officer (Lab)
8.	Sh. D.C. Joshi	Technical Officer (Field)
9.	Sh. K.V. Parmar	Technical Officer (Lab.)
10.	Sh. C.S. Chamar	Technical Officer (Field)
11.	Sh. B.M. Patelia	Technical Officer (Field)
12.	Sh. D.P. Patel	Technical Officer (Field)
13.	Sh. A.J. Solanki	Technical Officer (Field)
14.	Sh. B.F. Patelia	Technical Officer (Field)
15.	Sh. K.M. Parmar	Technical Officer (Mechanic)
16.	Sh. B.R. Baria	Technical Officer (Lab)
17.	Sh. B.V. Rathva	Technical Officer (Lab)

C. KVK-Panchmahal, Vejalpur (Gujarat)

S. No.	Name	Designation/Discipline
I. SR. SCI. & HEAD		
1	Dr. (Mrs). Kanak Lata	Sr. Sci. & Head
II. TECHNICAL		
1	Sh. J.K.Jadav	Astt. Chief Tech. Officer
2	Dr. Balbir Singh Khadda	Astt. Chief Tech. Officer
3	Dr. Ajay Kr. Rai	Astt. Chief Tech. Officer
4	Dr. Raj Kumar	Astt. Chief Tech. Officer
5	Dr. Shakti Khajuria	Astt. Chief Tech. Officer
6	Sh. Rakesh Meel	Technical Officer

Promotion

Scientists :

S. No.	Name of the Sr. Scientist	Placed/promoted to the next higher grade of	Date of placement
1.	Dr. Balu Ram Choudhary	Principal Scientist in the pay scale of Rs.37400 -67000+RGP of Rs.10000/- pre-revised)/Research Level 14	27-06-2020

Administrative

S. No.	Name of officer	Place of posting as U.D.C.	Date of joining as U.D.C.
1.	Smt. D.B. Patel	ICAR-CIAH, Regional Station, Vejalpur	5.2.2022 (A/N)
2.	Sh. S.C. Rathore		16.03.2022
3.	Sh. Gulla Ram		24.03.2022 (A.N.)

Technical assessment/placement

1. Granted merit promotion to Sh. Sanjay Patil, Artist-cum-Photography (T-6) to the next higher-grade ACTO (T.7-8) of Category III of TSR in the pay of Level 11 w.e.f. 30.11.2016.
2. Granted merit promotion to Sh. Kamlesh Kumar Muljibhai Parmar, T-3/Programme Assistant (Computer) to next higher grade Sr. Technical Assistant/ Programme Assistant (Computer)/T-4 w.e.f. 29.07.2009
3. Granted merit promotion to Shri Purthvisinh Sumantsinh Gohil, T-3/Programme Assistant (Laboratory Technician) to the next higher grade Sr. Technical Assistant/Programme Assistant (Lab. Technician)/T-4w.e.f. 13.08.2009.
4. Granted merit promotion to Sh. Chhuttan Lal Meena, Sr. Technical Officer (Field) (T-6) to the next higher-grade ACTO (T.7-8) of Category III of TSR in the pay of Level 11 w.e.f. 13.7.2018.
5. Granted merit promotion to Sh. A.V. Dhobi, Sr. Technical Officer (Overseer) (T-6) to the next higher-grade ACTO (T.7-8) of Category III of TSR in the pay of Level 11 w.e.f. 5.12.2017.
6. Granted merit promotion to Sh. R.B. Baria, Technical Officer (Field) (T-5) to the next higher-grade STO (T-6) of Category III of TSR in the pay of Level 10 w.e.f. 8.8.2017.
7. Granted merit promotion to Sh. Bhoj Raj Khatri, Technical Officer (Computer) (T-5) to the next higher-grade STO (T-6) of Category III of TSR in the pay of Level 10 w.e.f. 29.03.2019.
8. Granted merit promotion to Sh. Ashok Kumar Mali, Senior Technical Assistant (Driver) (T-4) to the next higher-grade Technical Officer (Driver) (T-5) of Category II of TSR in the pay Level 7 w.e.f. 29.06.2021

Regularization

Thirty three CLTS regularized to the post of Skilled Supporting Staff at ICAR-CIAH Regional Station CHES, Vejalpur (Gujarat).

Modified Assured Career Progression Scheme (MACPS)

Sl. No.	Name of Official with designation	Existing Pay Level in Pay Matrix	Date of grant of 1st /2nd Financial Up-gradation and Level in Pay Matrix
1.	Sh. Patani Vijay kumar Rameshbhai Stenographer -III	Level -4 (Pre- revised PB-1 Rs.5200-20200 + GP 2400)	28.07.2019 1st Financial Up -gradation Level -5 (Pre-revised PB -1 Rs.5200 -20200 + GP 2800)
2.	Shri Swaroop Chand Rathore LDC	Level -3 (Pre-revised PB -1 Rs. 5200 -20200+GP 2000)	13.04.2018 2nd Financial Up -gradation Level -4 (Pre-revised PB -1 Rs.5200 -20200 + GP 2400)
3.	Shri Mahesh Kumar Meena, SSS	Level-2 (Pre-revised PB -1 Rs 5200-20200+GP 1900	31.12.2019 Level-3 (Pre-revised PB -1 Rs 5200 -20200+GP 2000)

Probation clearance & confirmation

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Joining on transfer/back from deputation

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Relieving on promotion/ transfer/ deputation

1. Dr. Rekha Rani, Scientist (Agril. Economics) relieved in the afternoon of 08.10.2021 on transfer to ICAR-IIPR, Kanpur.
2. Smt. Ramyashree Devi G.S., Scientist (Plant Pathology) relieved in the afternoon of 25.10.2021 on transfer to ICAR-IGFRI, RS, Dharwad.
3. Dr. B.S. Khadda, ACTO relieved in the afternoon of 27.10.2021 on selection to the post of Deputy Director (Training), KVK, Booh, Taran Taran, GADVASU, Ludhiana.
4. Dr. Dr. P.L. Saroj, Principal Scientist

relieved in the afternoon of 17.12.2021 on transfer to ICAR-CISH, Lucknow.

Resignation/superannuation

1. Shri Dahyabhai Ratnabhai Vankar, Skilled Supporting Staff retired on superannuation from the Council's services in the afternoon of 30.09.2021.

Demise

1. Late Dr. Sanjay Singh, Head, CHES, Vejalpur, Godhra expired on 22.04.2021
2. Late Sh. M.N. Makwana, Assistant Chief Technical Officer, CHES, Vejalpur, Godhra expired on 19.04.2021

17. BUDGET

S. No.	Head	Allocation Govt.Grant 2021-22	Allocation Internal Resource + Additional amount provided by HQ out of Council's share(2021-22)	TOTAL ALLOCATION 2021-22	Expenditure (Govt.Grant) 2021-22				Expenditure (Revenue Generation) 2021-22	TOTAL EXPENDITURE 2021-22
1	2	3	4	5 (3 + 4)	6				7	8 (6 + 7)
					NEH	TSP	SCSP	Other than NEH & TSP		
1	Works									
	A. Land									
	B. Building									
	i. Office building	11100000	0	11100000		0	0	11078700	0	11078700
	ii. Residential building		0	0		0	0	0	0	0
	iii. Minor Works		0	0		0	0		0	0
2	Equipments	1200000	0	1200000		0	198919	1171770	0	1370689
3	Information Technology		0	0		0	0		0	0
4	Library Books and Journals		0	0		0	0		0	0
5	Vehicles & Vessels		0	0		0	0		0	0
6	Livestock		0	0		0	0		0	0
7	Furniture & fixtures	988000	0	988000		0	0	935377	0	935377
8	Others	0	0	0	0	0	0	0	0	0
	Total – CAPITAL (Grants for creation of Capital Assets)	13288000	0	13288000	0		198919	13185847	0	13384766
1	Establishment Expenses(Salaries)									
	i. Establishment Charges	133681000	0	133681000	0	0	0	129005006	0	129005006
	ii. Wages	15000000	0	15000000	0	0	0	14941061	0	14941061
	iii. Overtime Allowance		0	0	0	0	0		0	0
	Total – Establishment Expenses (Grant in Aid - Salaries)	148681000	0	148681000	0		0	143946067	0	143946067
1	Pension & Other Retirement Benefits	13881000		13881000	0	0	0	13653376	0	13653376
2	T.A.				0	0				0
	A. Domestic TA / Transfer TA	455000		455000		0	0	454779		454779
	B. Foreign TA		0	0	0	0	0	0	0	0
	Total – Traveling Allowance	455000	0	455000	*0*	0	*0*	*454779*	*0*	454779
3	Research & Operatinal Expenses		0			0				0
	A. Research Expenses	2562500		2562500				2562083		2562083
	B. Operational Expenses	5486000		5486000				5485919		5485919
	Total - Research & Operational Expenses	*8048500*	*0*	*8048500*	*0*	*0*	*0*	*8048002*	*0*	*8048002*
4	Administrative Expenses		0							
	A. Infrastructure	6680000		6680000		0		6679158		6679158
	B. Communication	813000		813000		0		812052		812052
	C.Repair & Maintenance									
	i. Equipments,Vehicles & Others	3713500		3713500		0		3713399		3713399
	ii. Office building	14333500		14333500		0		14333079		14333079
	iii.Residential building	856000		856000		0		853878		853878
	iv. Minor Works	460000		460000		0		459102		459102
	D. Others (excluding TA)	2062000		2062000		0		2062571		2062571
	Total - Administrative Expenses	*28918000*	*0*	*28918000*	*0*	0	*0*	*28913239*	*0*	28913239
5	Miscellaneous Expenses		0							0
	A. HRD	20500		20500		0	0	20450		20450
	B. Other Items (Fellowships, Scholarships etc.)		0	0	0	0	0		0	0
	C. Publicity & Exhibitions		0	0	0	0	0		0	0
	D. Guest House – Maintenance		0	0	0	0	0		0	0
	E. Other Miscellaneous	558000	0	558000	0	0	0	557596	0	557596
	Total - Miscellaneous Expenses	*578500*	*0*	*578500*	*0*	*2390297*	*2422214*	*578046*	*0*	5390557
	Total --Grants in Aid - General	51881000	0	51881000	0	2390297	2422214	51647442	0	56459953
	Grand Total (Capital + Establishment+General)	213850000	0	213850000	0	2390297	2621133	208779356	0	213790786
6	Loans and Advances	0		0	0		0	0	0	0
										(Rs. In lakhs)
	Swachh Bharat Mission									

Revenue Receipt

(Amount in Rs.)

S.No.	Head of account	Amount
1	Sale of farm produce	2939600
2	Sale of vehicle, other machine tools	485400
3	Licence fee	107846
4	Interest earned on loans & advances	107024
5	Interest earned on short term deposits	1634624
6	Recoveries of Loans & Advances	66100
7	Miscellaneous Receipts	1795943
	Total	7136537.00

18. SEED AND PLANTING MATERIAL PRODUCTION

a) Fruits and native crop-plant and planting material during 2021 at ICAR-CIAH, Bikaner

S.No.	Name of crop plants	Production of Plants (No.)	Use plants in Institute R & D	Total plant sale (No.)
1.	Pomegranate	2849	546	1803
2.	Lasoda	1092	102	975
3.	Lime	2865	5	2460
4.	Karonda	3313	237	2076
5.	Phalsa	1797	200	1497
6.	*Khejri* (Budded)	19612	0	13577
7.	*Khejr*i (Rootstock)	500	100	50
8.	*Ber* (Budded)	2593	135	2008
9.	*Bael* (Rootstock)	2256	2	1255
10.	*Aonla* (Budded)	318		318
11.	*Aonla* (Rootstock)	50		0
12.	Mosambi	33		33
13.	Mulberry	205	23	182
14.	Moringa (Breeding)	1518		483
15.	Citrus Rootstock	2500	0	00
16.	Jamun Root stock	1384	41	130
17.	Fig	347	0	347
18.	Guava	138		138
19.	Custard Apple	86		76
20.	Bud sticks	220		220
	Total	43676	1391	27628

Sold and R&D activities utilized planting material for the year 2021=29019

b) Vegetable seed production during 29021 at ICAr-CIAH, Bikaner

S.N.	Name of crops	Quantity produced (kg)	Quantity sold (kg)
1	Snap melon (AHS-82)	11.00	7.00
2	Cluster bean (Thar Bhadavi)	217.00	123.00
3	Bottle Gourd (Thar Samridhi)	20.00	19.00
4	Sponge gourd (Thar Tapish)	30.800	13.00
5	Kachari (AHK-119)	62.00	31.60
6	Longmelon (Thar Sheetal)	13.500	8.90
7	Muskmelon (AHMM BR 47)	3.00	2.50
8	Ridge Guard (Thar Karni)	22.500	13.00
10	Palak (Thar Hariparna)	16.00	15.00
11	Brinjal (Thar Rachit)	2.300	2.30
	Total	398.100	235.30

c) Fruit and native crop-plant and planting material at ICAR-CIAH RS CHES, Vejalpur during 2021.

S. No.	Name of crop-plant	Number of plants produce	Number of plants sale
1.	Mango Plants grafted	6295	6241
2.	Mango Seed lings	6000	--
3.	Pomegranate Air layer	75	68
4.	Kagzi Lime Air layer	460	444
5.	Lime seedling	500	90
6.	Guava Budded	620	609
7.	Guava seedling	550	321
8.	Rayan Budded	265	262
9.	Tamrind Budded	90	86
10.	Jamun Budded	775	765
11.	Bael Budded	190	161
12.	Bael Seedlings	3200	05
13.	Custard Apple Budded	460	242
14.	Custard Apple seedlings	500	45
15.	Wood Apple Budded	05	00
16.	Wood Apple Seed lings	400	20
17.	Muhava Seedling	50	05
18.	Chironji Seedling	350	25
	Total	20785	9389

d) Fruit and native crop-plant and planting material under RFS at ICAR-CIAH RS CHES, Vejalpur during 2021

S. No.	Name of plants	Number of plants produce	Number of plants sale
1.	Mango Plants grafted	10322	7459
2.	Mango Seed lings	5560	--
3.	Aonla Budded	121	111
4.	Aonla Seedlings	1800	--
5.	Pomegranate Air layer	405	251
6.	Kagzi Lime Air layer	3812	2580
7.	Lime seedling	3365	360
8.	Guava Budded	368	161
9.	Guava seedling	1189	100
10.	Karonda Seedlings	850	843
11.	Rayan Budded	155	150
12.	Tamrind Budded	352	338
13.	Jamun Budded	2421	2345
14.	Jamun Seedlings	5060	--
15.	Bael Budded	2410	2402
16.	Bael Seedlings	2500	--
17.	Custard Apple Budded	137	56
18.	Custard Apple seedlings	1211	722
19.	Chironji Budded	14	13
	Total	42052	17891

Vegetable seed production at ICAR-CIAH RS CHES, Vejalpur during 2021.

S. No.	Name of plants	Production (kg)	Sale (kg)
1.	Drumstick	20	14.0
2.	Bottle gourd	15	3.0
3.	Pumpkin	1	0.5
4.	Tomato	1	0.5
5.	Cowpea	10	-
6.	Dolichus bean	25	-
7.	Cluster bean	2	-
	Total	74.0	18.0

19. METEOROLOGICAL DATA

ICAR-CIAH, Bikaner

Month	Temperature (^{0}C)		R.H. (%)		Wind .Vel	Sun Shine	Total rainfall	Evap.
	Max.	Min.	RH-I	RH-II	(Km/Hr)	BSS (hr)	(mm)	(mm)
Jan.	22.35	4.71	78.52	37.35	3.44	6.71	0.00	7.58
Feb	29.48	10.41	66.31	21.83	4.34	9.22	0.00	9.24
March	35.23	16.60	58.65	25.42	6.11	7.32	2.60	7.97
April	38.60	20.33	39.17	16.77	6.58	9.44	1.60	10.20
	40.40	25.63	49.81	26.16	8.39	8.51	10.20	9.52
June	40.53	27.55	57.07	34.23	9.96	5.85	59.00	8.87
July	39.45	27.84	68.65	45.29	9.95	1.86	64.60	9.32
Aug	38.34	26.94	65.97	41.16	8.57	8.98	54.20	9.35
Sep	35.00	24.75	84.83	57.63	4.99	7.07	119.80	7.70
Oct	34.37	19.18	71.68	35.29	4.61	9.03	12.60	9.10
Nov	30.47	10.45	67.67	24.20	3.18	8.57	0.00	8.37
Dec	23.82	5.66	78.90	34.90	2.55	6.57	0.00	7.39
Jan.	20.27	6.44	85.39	50.68	3.51	6.65	22.60	7.68
Feb	26.74	9.62	73.34	24.34	5.16	9.08	7.40	9.14
March	36.92	16.98	66.26	17.68	5.42	8.87	0.00	9.26

Monthly weather data Godhra, Gujarat, for the year 2021(January-December)

Month	Temperature (^{o}C)			Humidity (%)	Rainfall (mm)	Rainy days
	Maximum	Minimum	Mean	RH		
January	28	16	23	50		
February	33	19	22	43		
March	37	23	29	34		
April	41	22	34	35		
May	42	29	36	42		
June	38	28	33	58	84.7	18
July	34	26	30	76	135 0.9	29
August	33	25	28	79	278.1	30
September	32	28	30	74	137.1	23
October	33	21	27	55	99.4	06
November	33	27	29	52	45.4	03
December	30	17	23	51	20.7	01

भाकृअनुप
ICAR

हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद

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