

Date of Last Update: 29-June -2023

4.7. Replies to questions asked in the parliament [Section 4(1)(d)(2)]

Details of questions asked and replies given

[Lok Sabha Questions: 2](#)

[Rajya Sabha Questions : 2](#)

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भाकृअनुप-केन्द्रीय शुष्क बागवानी संस्थान

ICAR-Central Institute for Arid Horticulture

श्री गंगानगर मार्ग, बीछवाल औद्योगिक क्षेत्र डाकघर, बीकानेर-334006, भारत

Sri Ganganagar Highway, Beechwal Industrial Area P.O., Bikaner-334006, INDIA

F.No. 07(vi)01/Misc./2022-23/

Dated: 29-06-2022

To,

Sh. Rajneesh Rajput,
Assistant Chief Technical Officer (Hort. Sci.),
ICAR- Horticultural Science, Room No. 414,
Krishi Anusandhan Bhawan-II
Pusa, New Delhi-110 012

Sub: Two hundred Thirty Ninth Report of Department- related Parliamentary Standing Committee on Home Affairs-reg.

Sir,

With reference to above subject, kindly find enclosed herewith the desired information in prescribed format pertaining to this Institute for kind perusal and reference please.

Thanking you

Yours faithfully.

(D.K. Samadia)

Director

ICAR- Central Institute for Arid Horticulture, Bikaner

Recommendation/Observation of the Parliamentary Standing Committee

S.No.	Recommendations/Observations	Ministry/Department
1.	<p>Horticulture Mission for North East and Himalayan States (HMNEH) The Committee takes note of Horticulture Mission for North East and Himalayan States (HMNEH) schemes for overall development of Horticulture in all North Eastern States. The Committee appreciates the various works being undertaken for integrated horticulture development of NE States. The Committee recommends that State Government should tap the horticulture potential of entire north-eastern region using modern technological intervention and creating infrastructure for proper storage and transportation and purchase from the farmers/producers. This will encourage and generate interest among farmers to embark upon production activities on a large scale. (Para 4.15.2)</p>	--NA--
2.	<p>Technological advancements for improvement of agricultural produce The Committee notes the efforts of the Department of Agricultural Research (DARE/ICAR) Institutes to educate farmers on relevant technologies and processes through capacity building trainings, demonstrations, exposure visits, Farm Schools, Field Days Kisan Mela, Animal Health Camps, etc. The Committee hopes that important technologies having potential to improve the agriculture produce such as Integrated Farming System, Livestock based production systems, etc. Will result in better yield and in turn help in economic wellbeing of farmers as well as in NER. (Para 4.17.2)</p>	<p>Effort of ICAR-CIAH, Bikaner for improvement of arid, arid tribal horticultural crops. Institute has being engaged in research and extension activities routinely in educating farmers of arid and semi arid region and conducting capacity building through.</p> <ol style="list-style-type: none"> 1. Training institute & SCSP (42) for farmers Demonstrations (17) Exposure visit (630 farmers/ students/clients) Field Days (19) 2. Technology – Institute released/developed varieties of different horticulture crop (58) and recently developed varieties in fruits (Bael- Thar Prakriti, Thar Shivangi, Acid Lime- Thar Vaibhav, Custard Apple- Thar Amrit, Wood Apple- Thar Prabha) and Vegetable (Ivy gourd- Thar Sadabahar, Thar Dipti, Bottle gourd- Thar Avani, Khejri-Thar Amruta, Dolichos bean- Thar Ganga, Thar Kiran, Vegetable Cowpea-Thr Jyothi, Muskmelon- Thar Mahima) 3. Production technology including cropping system : Developed Ber based cropping system, Aonla based cropping system, Kinnow production technology, Khejri based cropping system, Drip irrigation technology, Surface covering /low tunnel technology, training system, TFL seed production, green house for nursery, propagation for orchard establishment, organic production 4. Protection technology including

		<p>GAP and bio control agent “Thar Javik”.</p> <p>5. Post Harvest technology: Packaging and development of value added products like; Kachri based curry powder, snap melon puree, drying and dehydration etc.</p> <p>6. Impact study carried out on Kachri, Snap melon, Pomegranate and low tunnel technology.</p>
3.	<p>Trade and Industrial Development</p> <p>The Committee notes that a total project cost of Rs. 169.27 crores have been approved under Pradhan Mantri Matsya Sampada Yojana (PMMSY) with a Central Share of Rs. 84.71 crores during the year 2021-22. Out of the Central share, an amount of Rs. 75.08 crores has been released by the Department of Fisheries in the North Eastern States. The PMMSY is a flagship Scheme for the holistic development of Fisheries, which aims for economically viable and socially inclusive growth that provides the economic prosperity and well being of fishermen and also contributes to direct and indirect employment opportunities in fisheries sector. (Para 4.15.2)</p>	--NA--

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ICAR-Central Institute for Arid Horticulture

श्री गंगानगर मार्ग, बीछवाल औद्योगिक क्षेत्र डाकघर, बीकानेर-334006, भारत

Sri Ganganagar Highway, Beechwal Industrial Area P.O., Bikaner-334006, INDIA

F.No. 07(vi)01/Misc./2022-23/

Dated: 23-09-2022

To,

Dr. Manish Das,
Principal Scientist (Horticulture Science),
ICAR- Ministry of Agriculture and Farmers Welfare,
Krishi Anusandhan Bhawan-II
Pusa, New Delhi-110 012
Email:manish.das@icar.gov.in

Subject: Matter raised under Rule 377 by Shri Ratansinh Magansing Rathod, Hon'ble MP (Lok Sabha) reg.

Reference: Your email dated 22.09.2022.

Sir,

In context to the subject and reference, ICAR-Central Institute for Arid Horticulture (CIAH), Bikaner and regional station Central Horticultural Experimental Station (CHES), Vejalpur, Gujarat are the part of North western region of India and working together since 1 Oct. 2000. With the scientific collaboration of ICAR-CIAH, Bikaner and RS-CHES, Godhra released more than 30 varieties of fruits and vegetables and their developed technologies validation under the umbrella of AICRP on AZF, mutually for the benefits of the poor farming communities. Whereas regional station, CHES, Vejalpur located in Gujarat and crops- genotypes and technologies developed at this station suitable for tribal dominating areas of Gujarat, Rajasthan and Madhya Pradesh.

However working aspects of CHES, Godhra similar to this institute, but if council is agreed to promote tribal horticulture it may take decision in this regard.

This is for your kind perusal please.

Thanking you,

Yours faithfully.

(D.K. Samadia)
Director (Acting)



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Sri Ganganagar Highway, Beechwal Industrial Area P.O., Bikaner-334006, INDIA

F.No. 07(vi)01/Misc./2022-23/

Dated: 13-05-2022

Email: anup.bhattacharjee@icar.gov.in

To,

Dr. Anup Kumar Bhattacharjee
Principal Scientist,
ICAR- Ministry of Agriculture and Farmers Welfare,
Krishi Anusandhan Bhawan-II
Pusa, New Delhi-110 012

Subject: Lok Sabha Question Diary No. 3339 regarding "R&D in Seeds Production" for reply on 21-03-2023- reg.

Ref: Your email 17 March, 2023

Sir,

With reference to above subject, the desired information on crop and variety wise Breeder / Truthful labelled seed production for the year 2022-23 is given below in respect of this Institute for kind perusal and further needful action.

S.No.	Vegetable crop and variety	Quantity of seed produced (kg)
1.	Kachri var. AHK-119	61.0
2.	Snampmelon var. AHS-82	66.0
3.	Bottle gourd var. Thar Samridhi	11.0
4.	Cluster bean var. Thar Bhadavi	65.0
5.	Palak var. Thar Hariparna	20.0
6.	Brinjal var. Thar Rachit	0.80
7.	Longmelon var. Thar Sheetal	5.0
8.	Ridge gourd var. Thar Karni	5.5
9.	Moringa seeds	14.5
10.	Bottle gourd seeds	48.0
11.	Pumpkin seeds	1.5
12.	Tomato seeds	1.0
13.	Cowpea seeds	5.0
14.	Dolichosbean seeds	50.0

Yours faithfully.

(D. K. Sarolia)

I/c PME Cell



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Sri Ganganagar Highway, Beechwal Industrial Area P.O., Bikaner-334006, INDIA

F.No. 07(vi)01/Misc./2022-23/

Dated: 09.03.2023

To,

Dr. Anup Kumar Bhattacharjee
Principal Scientist
Horticultural Science, Room No. 423
Indian Council of Agricultural Research
Krishi Anusandhan Bhawan-II
Pusa, New Delhi-110 012

Sub: Notice for Rajya Sabha Question Dy No. S2613 for 17/03/2023 regarding "Major findings of research Institutes under DARE"

Ref: Your Email dated 09.03.2023

Sir,

With reference to above subject, the point wise reply pertaining to this Institute and AICRP on AZF is mentioned below for kind perusal and further necessary please.

- (a) Whether it is a fact that Department of Agriculture Research and Education (DARE) contributes significantly to the India's research performance, if so, the details thereof;
- (b) Major research findings in the field of agricultural research by Institutes under DARE in last five years;
Furnished in Annexure-I (attached)
- (c) Number of peer-reviewed journal articles published in international journals by the faculty members and research scholars of institutes under DARE in past five years along with brief details;
Furnished in Annexure-II
- (d) The number of women scientists in these research institutions, institute wise; and
Furnished in Annexure-III
- (e) Whether allocated budget have been sufficient to carry out research activities?
Not Sufficient, as the equipment component is very weak.

Yours faithfully

(D. K. Sarolia)
I/c PME Cell

(b) Major research findings in the field of agricultural research by Institutes under DARE in last five years;
ICAR-CIAH, Bikaner

Genetic Resources and Crop Improvement Germplasm Conservation

Bikaner

Fruit Crops			Vegetable Crops		
Crops	Scientific name	No.	Crops	Scientific name	No.
Ber	<i>Ziziphus mauritiana</i>	318	Kachri	<i>Cucumis melo</i>	558
Bordi	<i>Ziziphus rotundifolia</i>	22	Mateera	<i>Citrullus lanatus</i>	192
Pomegranate	<i>Punica granatum</i>	154	Snap melon	<i>Cucumis melo</i> var. <i>momordica</i>	82
Aonla	<i>Emblica officinalis</i>	50	Chilli	<i>Capsicum</i> spp.	132
Date palm	<i>Phoenix dactylifera</i>	60	Muskmelon	<i>Cucumis melo</i>	60
Bael	<i>Aegle marmelos</i>	17	Kakdi	<i>Cucumis melo</i> var. <i>utilissimus</i>	18
Cactus pear	<i>Opuntia ficus indica</i>	80	Ivy guord	<i>Coccinia indica</i>	01
Phalsa	<i>Grewia subinaequalis</i>	06	Pumpkin	<i>Cucurbita moschata</i>	04
Fig	<i>Ficus carica</i>	03	Round melon	<i>Praecitrullus fishtulosus</i>	10
Kokum	<i>Garcinia indica</i>	04	Brinjal	<i>Solanum melongena</i>	30
Marula nut	<i>Sclerocarya birrea</i>	01	Bottle gourd	<i>Lagenaria siceraria</i>	20
Sweet orange	<i>Citrus sinensis</i>	03	Bitter gourd	<i>Momordica charantia</i>	04
Karonda	<i>Carissa congesta</i>	08	Ridge gourd	<i>Luffa acutangula</i>	20
Lasora	<i>Cordia myxa</i>	65	Sponge gourd	<i>Luffa cylindrica</i>	15
Gonda	<i>Cordia myxa</i>	01	Indian bean	<i>Lablab purpureas</i>	30
Indian aloe	<i>Aloe barbedensis</i>	02	Cluster bean	<i>Cyamopsis tetragonoloba</i>	05
Ker	<i>Capparis decidua</i>	32	Sword bean	<i>Canavalia gladiata</i>	01
Mango	<i>Mangifera indica</i>	05	Khejri	<i>Prosopis cineraria</i>	12
Guava	<i>Psidium guajava</i>	04			
	Total	835			1194

Godhra

Fruit					
Crops	Scientific name	No.	Crops	Scientific name	No.
Ber	<i>Ziziphus mauritiana</i>	55	Fig	<i>Ficus indica</i>	05
Custard apple	<i>Annona squamosa</i>	09	Mango	<i>Mangifera indica</i>	52

Pomegranate	<i>Punica granatum</i>	40	Wood apple	<i>Feronia limonia</i>	10
Aonla	<i>Emblica officinalis</i>	14	Karonda	<i>Carissa congista</i>	40
Sapota	<i>Achras zapota</i>	07	Mahua	<i>Madhuca latifolia</i>	50
Bael	<i>Aegle marmelos</i>	15	Chironji	<i>Buchanania lanzen</i>	30
Jamun	<i>Syzigium cuminii</i>	50	Rayan	<i>Manilkara hexandra</i>	30
Tamarind	<i>Tamarindus indica</i>	25	Phalsa	<i>Grewia subuaequalis</i>	02
				Total	434
Vegetables					
Drumstick	<i>Moringa oleifera</i>	11	Pumpkin	<i>Cucurbita moschata</i>	17
Drum stick	<i>Moringa oleifera</i>	30	Cluster bean	<i>C. tetragonoloba</i>	02
Bitter gourd	<i>Momordica charantia</i>	37	Okra	<i>A.esculentus</i>	02
Ridge gourd	<i>Luffa acutangula</i>	37		Total	136

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

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.

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 rind 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°C.

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.

The Institute has identified 20 varieties of arid fruits and vegetables crops 2017-18 to 2022-23 and 11 varieties recommended by State Sub Committee of Gujarat and 02 varieties notified.

1. Wood apple (Thar Gaurav)

Precocious bearing, high yielder with bigger size, quality fruit having better self life under rain-fed conditions of western India. Plant height: 6.25 m, maturity: fruit ripens after 230 days from fruit set, Spreading growth habit with drooping branches and compact canopy. Fruits are rich in pectin and protein content. Yield: 58.58 kg/plant (7th year) and 124.36 kg/plant (12th year), fruit weight: 452.25g, pulp: 50.92%, fruit shape: Oblong, Fruit colour: Greenish-white, TSS: 14.12 °Brix, Acidity: 3.85%, Total Sugar: 3.07%, reducing sugars: 1.42%, fruit pectin: 1.76%, Protein (pulp-18.13%, seed-24.38%), phosphorous (0.07%), potassium (1.73%), calcium (0.30%) and iron (16.72 mg). fruits strong pleasing aroma at full maturity. early maturing (1st week of November). It is used as table purpose and for value added products like Pickle, RTS, Chutney and powder.



2. Wood apple variety Thar Prabha: Plant has spreading growth habit with drooping branches and compact canopy. Precocious and regular bearer (start bearing in 4th year), heavy yielder, Fruits are rich in pectin and protein content. It is drought hardy and fruits emit strong pleasing aroma at full maturity. Late maturity group (3rd week of Dec.-Jan.), bunch bearing habit (3-7 fruits/ bunch) and fruit ripens after 275 days of fruit set. Yield: 110.23 kg/plant (9th year) and 183.25 kg/plant (15th year). Fruit weight: 412.25g. Pulp: 58.37%. Fruit shape: round. Fruit colour: Greenish-dull white. TSS: 19.82 °Brix. Acidity: 0.423%, Total Sugar: 3.98%. Reducing sugars: 1.52%. Fruit pectin: 1.70%, Protein (pulp-19.23%, seed-24.86%), phosphorous: 0.09%. Potassium: 1.82%. Calcium: 0.39%. Zinc: 2.15 mg and iron: 16.90 mg. It is used as table and processing purpose.



3. Bael-CHESB-21 (Thar Srishti)

Bael variety having compact canopy, precocious bearer, high yielder, high pulp content, less aromatic and attractive pulp colour and suitable to grow under adverse agro-climatic condition. It was propagated through *in-situ* patch budding. It starts flowering and fruiting in 3rd year, fruit ripening starts from 4th week of April to 1st week of May. The fruits are uniform in shape and size, luxuriant growth of plant, attractive orange colour pulp with high centric locule arrangement under rainfed semi-arid ecosystem of western India. Yield: 91.50 kg/plant (9th year), fruit weight: 1.55 kg, pulp TSS: 36.85 °B, mucilage TSS 51.05°B, acidity (0.35%) and vitamin C 19.80 mg/100 mg pulp. Pulp with highly centric locule arrangement. Late maturity (second fortnight to April) No major pest/ disease noticed under field conditions. Fruit ripens in 300 days from fruit set. Suitable for powder, slices and sharbat making and also table purpose.



4. Bael – CHESB-11 (Thar Prakriti).

It belongs to late maturing group (1st week of May). The fruit of this genotype are having good flavor and aroma and rich in antioxidants. It is having very attractive uniform fruit shape (round) and size with peculiar styler end cavity. Yield: 115.75 kg/plant (12th year) fruit weight 1.40 kg, fruit size 14.05 cm × 15.10 cm, fruit girth 44.10 cm, shell thickness 0.14 cm average number of seed 60.23, total seed weight 17.40g, fibre weight 61.10 g, shell weight 190.60g, locules in cross section 14-17, TSS pulp 38.00°B, TSS mucilage 51.00°B, acidity (0.33%) and Vitamin C 22.30 mg/100g pulp.



5. Bael-CHESB-16 (Thar Shivangi) .

It belongs to late maturing group (4st week of May). It is rich in total antioxidants activity (CUPRAC (micro MTE/g): 148.30. Drooping branches, semi-spreading growth, curved petals, identical tree appearance with shining leaves are its distinct character. Yield/plant is 109.15 kg in 11th year, fruit weight 1.45 kg, fruit size 15.50cm×12.87 cm, fruit girth 44.80 cm, shell thickness 1.9 mm, total number of seed 75.32, total seed weight 19.14g, fibre weight 55.00g, shell weight 190.21g, locules in cross section 15.50, pulp 70.50% TSS pulp 37.10°B, TSS mucilage 50.50°B, acidity (0.35%) and vitamin C 24.13 mg/100g pulp.



6 Acid Lime variety Thar Vaibhav: Plant vigorous and spreading growth habit and develops loose crown with low density of spines. Dark green leaves colour and round fruit shape. Pulp light greenish and peel yellowish in colour, fruit has average 6-10 seeds/fruit, bearing in cluster and juicy as well as acidic nature. Fruit take ripens from fruit set 125-135 days in summer and 145-155 days in winter season. Fruit ripening period April- August, Sept. – Dec., Jan.- July and fruit has uniform size, shape with shelf life 9-11 days. Tree height: 3.56m. Yield: 45.85 kg/tree (5th year). Fruit weight: 42.57g. No. of fruits/tree:1425. Juice:48.98%.



TSS:7.34 0Brix. Total sugar 5.85%, Reducing sugar 3.20%, non reducing sugar 2.38, Acidity 6.84%, Ascorbic acid 43-45 mg/100g. It is suitable for processing purpose.

7. Custard apple Variety Thar Amrit: Plant having spreading growth habit with drooping branches and compact canopy. It is Precocious and regular bearer (start bearing in 2nd year), heavy yielder, fruits shape broadly cordate and golden yellow colour. Fruits emit strong aroma at full maturity, late maturing, fruit bearing occurs on lateral and terminal branches. Maturity: fruit ripens after 85-90 days from fruit set. Harvesting 1st fortnight of November. It is drought hardy and give stable economic yield during aberrant agro climatic conditions. Yield: 10.23 kg/plant (6th year) and 24.80 kg/plant (11th year) under rainfed semi-arid condition. Fruit weight: 320.12g. Pulp: 63.58%. Fruit shape: Broadly cordate. Fruit colour: Golden Yellow. TSS: 29.12 0Brix. Acidity: 0.33%. Total Sugar: 16.64%, reducing sugars: 14.40%. Ascorbic acid (45-50mg/100g). Minerals- phosphorous (38 mg/100g), potassium (38 mg/100g), calcium (218.21 mg/100g), magnesium (33.03 mg/100g), sodium (8.36 mg/100g) and iron (1.70 mg/100g). Fruits have shelf life of 4-6 days. Uses: It is used as table and processing purpose.



8. Long melon Thar Sheetal

Profuse branching with vine length 2.15-2.38 m at last fruit harvest. Ovary is long (3.5-3.8 cm). Bear light green coloured and tender fruits at edible stage. Early in harvesting and took 45-50 days in first harvesting from sowing. It is found to be moderately resistant against melon fruit fly. The fruit infestation varied from 29% to 30.67%. The sowing time is last week of December to first week of January under low tunnels and second fortnight of February in open field condition on drip irrigation system. Sowing should be done in rows made at 2.0-2.5 m and maintain 0.50-0.60 m distance from plant to plant. Application of 50-60 kg N, 60-80 kg P₂O₅ and 50-60 kg K₂O per hectare is recommended. Seed rate is 1.0-1.2 kg/ha. Fruits are free from bitterness. Major diseases such as *Fusarium* wilt, downy mildew, mosaic and *Alternaria* leaf blight have not been appeared under field condition during summer season. Fruit sets at high temperature (upto 42⁰C) with mulching of *Saccharum*. Harvest stage: 45-50 days for tender fruits. Fruit weight: 79-85 g. Fruit length: 25-30 cm. Fruit colour: Light green. Fruits free from bitterness. No. of fruit/plant: 18-22. Yield: 132-142 q/ha. Suitable for culinary and salad purpose.



9. Ivy gourd [*Coccinia indica* sy. *C. grandis* (L.) Voigt] AHIG-01

(Thar Sundari)

Developed through single plant selection) . The AHIG-01 "Thar Sundari" is stable for sequential female flowering, fruiting and morphological traits. It is short-perennial (4-5 years), gynoeocious and its vegetative propagated female plants producing good quality parthincarpic fruits, and therefore, no male plant is needed for pollination. it required minimum water (250-300 mm) during kharif season and also better with drip technology. Plant continuing flowering even when temperature reached to maximum 48 ⁰C however, slightly affecting the fruit size and shape. Yield: 2.96 kg/plant/season (268.5 q/ha). Fruit weight: 11.76-13.54 g. Plant height: 2.24-2.65 m (90 days) [Creeper type vine]. Fruit size: length 5.83-6.48 cm, diameter 1.84 cm. Fruit shape: Elongated-



long, Days taken to harvest of tender fruits: 8. Earliness for flowering and took 50-55 days for first harvesting after re-sprouting of plants. Two crop harvested annually. (spring-summer, rainy-winter season). Tolerant to high temperature (36-38 °C and abiotic stress (tolerate dry climate 40-42 °C).

It is multiplied by cuttings and clonal propagated plants and a cycle of 4-5 years should be kept for maintenance. Used for vegetable.

10. **Sponge gourd (Thar Tapish)**

(Developed through hybridization pedigree method of selection)

Tolerant to high temperature and abiotic stresses of hot arid agro-climate as spring summer season crop. Moderate spreading vie type.It is short duration (110-115 days). The genotype recorded fruit-fly (14.32-22.222%) and viral infestation during October-November and thus prophylactic spraying is recommended in August and September months to control vectors. Days to first harvesting of tender fruits (49.252.4 DAS). Potential for kitchen gardening. It is suitable both for rainy and summer season cultivation. Yield: 1.3 kg/plant (146 q/ha), Fruit weight: 116 g. No. of fruits/plant: 11, Fruit size: 21.37 cm, diameter 3.42 cm. Plant are medium with 4.82-5.33 branches. Colour: green-dark green, Fruit size: long, Fruit shape: Straight, slightly curved neck in shave and have shining lusture. Vine length: 2.43-2.6m at 90 days of plant. It is multiple-stress tolerant/ heat tolerant variety. Fresh vegetable purpose



11. **Palak (Thar Hariparna)**

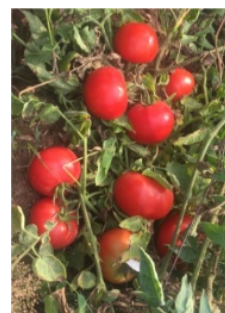
"Thar Hariparna" producing excellent quality and bigger size tender leaves for fresh vegetable use. It is developed through use of regional diversity and for better quality marketable leaf yield during winter season. Higher early plant growth vigour and more number of pickings under north-western parts of Rajasthan. It is stable for consistent growth after picking of tender leaves. Good yield with limited irrigations (drip, channel). Yield:

3.45 kg/plot (2 x 2 m size), (128.48-235.84 q/ha) Colour: Light-green-dark green, Harvesting period: October-March, Size: length 11.53 cm, width 6.42 cm, weight: 1.785g. Plant height: 39.7 cm. Flowering period: March, Seed crop harvest period: Last week of April. For vegetable use.



12. **Tomato (Thar Annant)**

The plants grow up to 160.2 cm (Indeterminate type), Highly vigorous growing, densely foliated dark green leaves, 19.3 cm inflorescence length and distinguished by indeterminate plant habit, fruit size, fruit color and yield potential over parents. Medium maturity type. Moderate incidence of TCLV at field condition. No incidence of major pest at field condition. Spacing 90 x 90 cm and needs staking. It has 4.5% TSS, High flesh thickness and deep red colour with larger fruits. Suits for



moisture and heat stress condition. Yield: 4.7 kg/ plant and 52-54 t/ha, Fruit weight: 124.4 g, Large fruit size (11.5 x 23.7 cm), Shape: Round, Color: Deep Red. No. of fruits/plant: 62, Lycopene content: 7.0 mg. Plant height: 160.2 cm. No. of branching: 15. Indeterminate type. Suitable for table and processing purpose.

13 Ivy Gourd (Thar Sadabahar)

This genotype responds well round the year in respect to flowering and fruit production under the hot semi-arid conditions. It is also suitable for growing in backyard of home to get fruits round the year. The attractive dark green shining colour fruits with discontinuous strips, round oblong fruit shape without neck under hot semi-arid conditions. The genotype is drought tolerant and suitable for round the year fruit production. The yield is 32.9kg/plant and yielding 26.86 t/ha, fruit weight 29.3g. The fruits are rich in vitamin-C (49.2 mg/100 g). 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. Suitable for vegetable and culinary purpose.



14. Bottle gourd (Thar Avani) Earliness, dense foliage, more flesh and heavy yielder, 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 22.8cm in length and weight of each fruit layed between 750-860g. Each plant produces about 12.91 kg with per ha yield potential of 43.0 tones under semi-arid conditions. Least incidence of powdery mildew found at field level. Being vigorous growth habit, spacing of 2.0m x 1.5m has been found optimum for commercial cultivation. Seed rate is 1.0-1.5kg/ha. It can be grown in rainy and summer crop. Harvesting of fruits at green stage enhances the number of fruits per plant. Bottle gourds are infested with many pests and diseases. The main pest of bottle gourd is fruit fly, the adult flies make a sting on young immature fruit and lays the eggs. White coloured maggot's starts developing inside the fruit. Hence placing bait to attract the adult flies is advisable to control them. Powdery mildew is the serious diseases affecting rainy season crop, while this genotype affected very less (5-10%) under semi arid condition of western India. This variety posses export qualities. The fruits are characterized with high flesh thickness, high TSS (8.1-8.7°brix), with attractive creamy white flesh colour. Average yield under normal conditions was found 12.0 kg/plant and yielding 39.9t/ha in a soil applied with 50:25:50g urea, SSP and MOP to each plant at 30days after sowing. Produces 16-20 fruits per plant and weighing about 700-800 g.



15. Khejri (Thar Amruta)

Average plant height: 3.81 m (6th Year), spreading: 3.62 m x 3.75 m. Harvesting: Budded plants group started economic sangri at 3-4 year age. Dehydrated pods rich in nutraceutical value and contains 50.2% carbohydrate, 17.2% protein, 1.8% fat, 23.7% crude fibre, 3.2% calcium, 0.4% phosphorus and 3.9% trace elements. Yield: Green pod- 5.88-6.68 kg per plant (35.12 q/ha) at 7-8 year old plant), dry leaves- 6.72-8.23 kg per plant (37.37 q/ha), fuel wood- 9.23-11.25 kg/plant.



Tender pods at marketable stage are light green, straight, roundish-flat and weight is 0.852 to 1.796 g. Tolerates extremes of high (50 °C) and low (-6 °C) temperature.

16. Ivy gourd Variety Thar Dipti:

Vines are vigorous growing densely foliated with dark green trilobed leaves, high yield potential during summer season. Shining dark green stripless unique fruit appearance, small medium size and pointed styler end fruits. It is also suitable for growing in backyard of home to get fruits round the year (maximum during August and minimum during January month) . No disease/serious pest incidence is found at field condition and tolerant to heat stress as well as drought under hot semi-arid conditions. Propagation through stem cuttings (10-12 cm long). Yield: 24.4 kg/plant and 19.92 t/ha. Maturity: 51-56 days after planting, Fruits/vine 1497, Mean fruit weight: 14.2 g, Fruit length: 5.2 cm. Fruit girth: 2.5 cm. Rich in vitamin C (51.4 mg/100g). TSS - 2.6%, Acidity -0.15% at edible/ tender stage. It is suitable for culinary purpose.



17. Dolichos bean Variety Thar Ganga:

The plants have climbing growth habit and grow up to 4.5-4.7 m. needs support/stacking with bamboo iron pods for higher yield/commercial cultivation. Plant grows vigorously having dark green leaves with whitish flowers, long green slightly curved pod. The first harvest of fresh pods starts at 98 to 110 days after sowing. Higher yield potential and rich in anthocyanins and other antioxidants, moderately resistance to dolichos bean yellow mosaic virus disease under field conditions. Yield: 8-10 kg/plant and 68-72 t/ha. Pod weight: 15.2 g, Pod length: 17.5 cm, Pod girth: 5.21 cm, total of 800-1200 pod/plant, harvesting period: 98-110 days after sowing. Rich source of proteins (4.8g/100g), flavonoids (40.2 mg cat.equi/100g), α -carotenes (12.8mg/100g), Vitamin C (7.2g/100g), antioxidants like total phenols (264.6 mg GAE/100g), and total antioxidants (345.5 mg AAE/100 g). It is suitable for vegetable purpose.



18. Dolichos bean Variety Thar Kiran:

The plants have climbing growth habit and grow upto 3.5-4.0m, needs support/stacking with bamboo or iron pods for commercial cultivation. Plant grows vigorously having dark green

leaves with purple pigmentation in their stem, petiole, flower, leaf veins and pod. Higher yield potential and rich in anthocyanins and other antioxidants. Resistance to dolichos bean yellow mosaic virus disease under field conditions least infestation of white fly and pod borer. Yield: 7-9 kg/plant and 60-63 t/ha, Pod weight: 8.4g. Pod length: 10.8 cm, Pod girth: 5.33 cm. Total of 1100-1600 pods/plant, Harvesting period: 100-110 days after sowing. Rich source of anthocyanins (190 mg/100g), proteins (5.4g/100g), and other antioxidants like total phenols (376.5 mg GAE/100g), flavonoids (42.6 mg cat.equi/100g), α -carotenes (5.4 mg/100g), Vitamin C (89.34mg/100g) and lycopene (1.5mg/100g). It is suitable for vegetable purpose.

19. Cowpea Variety Thar Jyothi: Characteristics:

The plant have short stature (bushy growth habit) and grow upto 50-56 cm height, photo insensitivity dark green leaves with dark green pods early flowering and maturing with heavy yielder.. Sowing time: Early June to end of July, Oct.-Nov. (Southern India), Feb.-March in north Indian plains, April-May in hills. Harvesting: 45 days after sowing. Yield:1.52-2.0 kg plant and 20-25 t/hectare. Pod length 23.5-26.5 cm, Pod girth 2.5 cm Pod weight 9.0-9.6 gm, pod maturity: 48-50 DAS. Pod shelf: long. Pod colour: dark green. Proteins: 4.56 g/100g. Total phenols: 2.43mg/lg. Total antioxidants activity: 14.0, micro moles trolox. equi./g. Vitamin-C: 55.8 mg/100g. Mosaic virus diseases: 1-5%, Rust diseases: 0-1%. Seed rate: 20-30 kg/ha. Suitable for vegetable purpose



20. Muskmelon. Variety Thar Mahima: Characteristics:

Profuse branching with short vine length (1.6-2.0 meter) at last fruit harvest. Leaf having deep lobing, Fruits are netted with sutures flesh colour is salmon orange. Early in harvesting and produced first harvest in 75-80 DAS with produced 4-5 fruits/vine. Long shelf life, moderately resistance against fruit fly under field condition and fruit infestation varied from 26.76 to 28.21 %. Sowing season is spring – summer (mid Feb. under open field condition last week of December to 1st Jan. under low tunnel). Yield: 193.7 q/ha. Fruit weight: 780-900 g. Fruit shape: round diameter (10.3 to 11.0 cm). Sex form: Andromonoecious. Flesh thickness: 2.8-3.2cm. Shelf life: 4-5 days at room temperature when harvested at colour turning stage of rind. TSS: 11.58-11.80%. Seed cavity: 4.27-5.58 cm. Seed rate:1.5-2.0 kg/ha.



Variety Notified for Rajasthan State

1. **Ridge gourd variety Thar Karni:** Early in harvesting and take 51-55 days to first picking from sowing. Fruits 20-25 cm long weighing 90-110 g and cylindrical with 10 longitudinal shallow ridges. Plants bear short internodes and profusely branched. Yield potential is 180-240 q/ ha depending upon sowing season and climatic conditions. It is suitable for cultivation during spring-summer and kharif seasons. It is tolerant to mosaic disease under field conditions. Recommended for cultivation in Rajasthan vide gazette notification number S.O. 3254 (E) dated 20-07-2022.



2. **Longmelon variety Thar Sheetal:** Early in harvesting and took 45-50 days in first harvesting from sowing. It produced 25-30 cm long fruits which are light green at tender and edible stage. The fruits are free from bitterness. It is equally suitable for cultivation in spring-summer and kharif seasons under open field conditions. Also suitable for cultivation under low tunnels for off-season cultivation. Yield potential varied from 150-200 q/ ha depending upon sowing season, prevailing climatic conditions, management practices, harvesting stage, etc. It is able to set fruits at high temperature (upto 42oC) during summer season under hot arid conditions. Recommended for cultivation in Rajasthan vide gazette notification number S.O. 3254 (E) dated 20-07-2022.

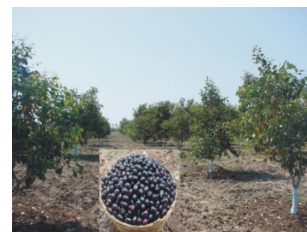


3. **Sponge gourd variety Thar Tapish:** Tolerant to high temperature and abiotic stresses of hot arid agro-climate as spring summer season crop. Moderate spreading vie type. It is short duration (110-115 days). The genotype recorded fruit-fly (14.32-22.222%) and viral infestation during October-November and thus prophylactic spraying is recommended in August and September months to control vectors. Days to first harvesting of tender fruits (49.252.4 DAS). Potential for kitchen gardening. It is suitable both for rainy and summer season cultivation. Yield: 1.3 kg/plant (146 q/ha), Fruit weight: 116 g. No. of fruits/plant: 11, Fruit size: 21.37 cm, diameter 3.42 cm. Plant are medium with 4.82-5.33 branches. Colour: green-dark green, Fruit size: long, Fruit shape: Straight, slightly curved neck in shave and have shining lusture. Vine length: 2.43-2.6m at 90 days of plant. It is multiple-stress tolerant/ heat tolerant variety. Uses as fresh vegetable purpose.



Eleven Variety Recommended for Released & Notification for Gujarat State during 52th State Seed Sub-Committee of Gujarat State held on 02-06-2021 and proposal has been submitted to The joint Secretary (Seeds), New Delhi for notification on 23-08-2021.

1. Jamun (*Syzygium cuminii* skeel.) GJ-2, (**Goma priyanka**) for Dry arid and Semi-arid Released region of Country: It is semi-dwarf and having spreading type growth pattern. Average fruit weight is 20.00 g with 86.00 per cent pulp. It is in great demand by the farmers of Gujarat and other parts of India. It is capable to grow under adverse agro-climatic condition and being a medicinal tree, this will not only provide economic security to the farmers but also improve the health and nutritional security to them. Fruits are used as an effective medicine against diabetes, heart and liver trouble. The proposed genotype has high yielding ability. It recorded 40 % yield superiority over local one. It is prolific bearer with ideal fruit size having excellent quality attributes.



2. Karonda (*Carissa carandas* L) CH ESK-2 (**Thar Kamal**) for Dry arid and Semi-arid region of Country: The selected genotype was tested under field conditions for 9 years (2005-2014). The selection out performed in respect of flowering pattern, fruiting and fruit quality attributes. It is spreading type, starts flowering in 3rd year, regular bearer, ripens in the month of June and recorded 4.97 g average fruit weight, 93.64 per cent pulp and 9.54° Brix TSS. Fruit yield per plant was recorded 13.00 kg during 9th year and recorded 57.96 per cent more yield over Pant Manohar under rainfed conditions of hot semi-arid ecosystem.



3. Chironji (*Buchanania lanzan* Spreng.) CHESC-7 (**Thar Priya**) for Dry arid and Semi-arid region of Country: It is semi-dwarf, spreading growth habit, dense foliage and drooping branches, early, precocious bearer (starts flowering in 4th year) and suitable for high density planting under rainfed conditions of hot semi-arid ecosystem. It ripens in the month of April and recorded 1.15 g average fruit weight, 57.56 per cent pulp and 23.90° Brix TSS. Fruit yield kg per plant was recorded 13.20 during 9th year of orchard life under rainfed conditions of hot semi-arid ecosystem. It is capable to grow under adverse agro-climatic condition and this will not only provide economic security to the farmers but also improve the health and nutritional security to them. The proposed genotype has high yielding ability. It recorded 30% yield superiority over check. It is prolific bearer with ideal fruit size having excellent quality attributes.

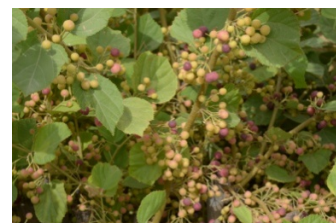


4. Tamarind (*Tamarindus indica* L.) CHEST-13 (**Goma Prateek**): It is semi-dwarf, spreading growth habit, dense foliage and drooping branches, early, precocious bearer (starts flowering in 4th year) and suitable for high density planting under rainfed conditions of hot semi-arid ecosystem. It is semi dwarf ripens in the first week of March and recorded 26.70 g average pod weight, 50.50 per cent pulp



and 71.00°Brix TSS. Fruit yield per plant was recorded 58.50kg during 9th year of orchard life under rainfed conditions. It is capable to grow under adverse agro-climatic condition and this will not only provide economic security to the farmers but also improve the health and nutritional security to them. The proposed genotype has high yielding ability. It recorded 30.00% yield superiority over check. It is prolific bearer with ideal fruit size having excellent quality attributes.

5. Phalsa (*Grewia subinaequalis* D.C.) CHESP -13 (**Thar Pragati**): It is spreading type, starts flowering in 2nd year, regular bearer, ripens in second week of April and recorded 2.10 g average fruit weight, 90.45 per cent pulp and 20.12° Brix T.S.S. Fruit yield per plant was recorded 3.60 kg/ plant during 4th year of (50 percent more yield over check) planting under rainfed conditions of hot semi-arid ecosystem.



6. Bael (*Aegle marmelos* Correa) CHESB-1 (**Goma Yashi**): Goma Yashi will be the first variety developed in Gujarat State. It is in great demand by the farmers of Gujarat. It is capable to grow under adverse agro-climatic condition and being a medicinal tree; this will not only provide economic security to the farmers but also improve the health and nutrition security, because this fruit will be available in the market when other regional fruits are less in the market. It is highly suitable for high density planting (5mx5m), accommodating 400 plants per ha and have ability to double the economic yield under rainfed condition. The proposed genotype has high yielding ability. It recorded 32.68% yield superiority over NB-5. It is prolific bearer with ideal fruit size having excellent quality attributes.



7. Bael (*Aegle marmelos* Correa) CHESB-5 (**Thar Divya**): It is semi-dwarf, spreading growth habit, dense foliage and drooping branches, early, precocious bearer (starts flowering in 4th year) and suitable for high density planting under rainfed conditions of hot semi-arid ecosystem. It ripens in the month of April and recorded 1.15 g average fruit weight, 57.56 per cent pulp and 23.90° Brix TSS. Fruit yield kg per plant was recorded 13.20 during 9th year of orchard life under rainfed conditions of hot semi-arid ecosystem. It is capable to grow under adverse agro-climatic condition and this will not only provide economic security to the farmers but also improve the health and nutritional security to them. The proposed genotype has high yielding ability. It recorded 30% yield superiority over check. It is prolific bearer with ideal fruit size having excellent quality attributes.



8. Pumpkin (*Cucurbita moschata* Duch.ex. Poir.) CHES (**Thar Kavi**): Thar Kavi is developed from hybridization



followed by selection from the segregating population of cross between CM16 x CM19. Plants are moderately vigorous growing, densely foliated dark green leaves with prominent white patches, Female flower produces at 12-13 node and anthesis commences at 43 days after sowing. Plants come to harvestable stage at 80-85 days after sowing for green fruits and 110-120 days for ripe fruits. The fruits are very smaller in size (800-900g) with yellowish spots over the fruit surface and greenish lines at floral end of the fruit. As plants are of very compact, more plant population per ha can be accommodated. Least incidence of powdery mildew and pumpkin mosaic virus observed till first harvest. Plants are of moderately resistant to fruit fly incidence at field conditions. This genotype is inferior for fruit size (88.8%) and superior for yield (30%) as compared to the check variety Arka Chandan.

9. Moringa (*Moringa oleifera* Lam) CHESD-1 (**Thar Harsha**): Thar Harsha is a new high yielding drought tolerant cultivar of drumstick, developed at Central Horticultural Experiment Station (ICAR-CIAH), Vejalpur, Gujarat and was released by the Central Institute for Arid Horticulture, Bikaner during 2016. It is an annual type selection from popular variety PKM-1. Its pods are of attractive dark green in colour with length of 100.5cm (a long pod type). The plants are densely foliated and have broad leaves with dark green colour. It is a late flowering and late maturing type which comes to harvest during March-May. The tree sturdy nature facilitate the set pods to reach marketable size despite of prevailing severe drought situations and recorded with 20-30 per cent greater marketable yield and 85.9 per cent more total yield as compared to check under drought conditions. Each tree can bear on an average 45-48kg pods. The pod contains higher protein (9.3g/100g), vitamin C (246mg) and vitamin A content (9783IU) per 100g. The plants and pods of this variety are least affected by leaf eating cater pillar and fruit fly under semi arid conditions.



10. Mahua (*Bassia latifolia* Roxb.) CHESM-10 (**Thar Madhu**): The selected genotype was propagated through soft wood grafting and tested under field conditions for 10 years (2005-2015). The selection out performed in respect of flowering pattern, fruiting and fruit quality attributes. It starts flowering in 5th year, regular bearer, ripens in the month of June and recorded 29.00 g average fruit weight, 14.26° Brix TSS. Fruit yield kg per plant was recorded 20.14 and dry flower yield 6.32 kg during 10th year of orchard life under rainfed conditions of hot semi-arid ecosystem.



11. Khirni (*Monilcara hexandra* (Roxb.) Dubard) Correa) CHESK-10 (**Thar Rituraj**). It is in great demand by the farmers of Gujarat. It is capable to grow under adverse agro-climatic condition and being a medicinal tree; this will not only provide economic security to the farmers but also improve the health and nutrition security. It is highly suitable for high density planting (5mx5m), accommodating 400 plants per ha and have ability to give economic yield under rainfed condition. The proposed genotype has high yielding ability. It recorded 45.45% yield superiority over local check. It is prolific bearer with bold size having excellent quality attributes.



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 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 training systems, canopy volume (3.4 m³) and yield (21.21 kg/plant & 11.77 t/ha) both under Y-shape and fruiting density (681.9 fruits per m³) 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) + coarse cotton cloth followed by grass mulch + NAA (15 ppm) + ascorbic acid (96.10, 25.30 and 4.00%) and grass mulch + ZnSO₄ (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 OB), 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 pome-granate, 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).

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 GA3 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 GA3 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 range 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 P₂O₅, 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 (0.5ECIW and 4ECIW 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 4EC+ 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.

With the salinity level 4EC (dSm⁻¹), with 100% organic fertilizer is registered for maximum fruit weight, length, diameter and fruit volume. While combination of 50 % organic and 50% inorganic with 4EC saline water were also good treatment for kachri fruit yield under saline water irrigation.

The leafy vegetables (fenugreek, spinach, coriander and radish) were studied under the three salinity level of water (0.5 dS m^{-1} , 2.0 dS m^{-1} , 4.0 dS m^{-1}) with the recommended dose of fertilizer. It was observed that the growth and yield parameter were good in saline irrigation water (4.0 dS m^{-1}) treated plot in all leafy vegetables except coriander crop. The yield of fenugreek crop was 89.05 q/ha , 79.12 q/ha and 55.84 q/ha in saline water (4EC dSm^{-1}), conjunctive water ($\text{EC } 2.0 \text{ dSm}^{-1}$) and canal water (0.5EC dSm^{-1}) treated plots respectively. The highest spinach yield was recorded in saline irrigation water treated plot that was 323.23 q/ha and 189.33 q/ha , 171 q/ha in conjunctive water ($\text{EC } 2.0 \text{ dSm}^{-1}$) and canal water ($\text{EC } 0.5 \text{ dSm}^{-1}$) treated plots respectively.

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 ($14.23 \text{ fruits/plant}$) 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 ($\text{Temp. } 40 \pm 2^\circ\text{C}$ and $\text{RH } 50\text{-}60\%$). 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 ($\text{temp. } 42 \pm 2^\circ\text{C}$ and $\text{RH } 55\text{-}60\%$) 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.

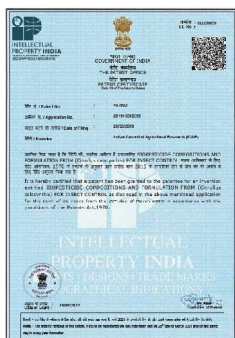
Plant Protection

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.

For the first time, beet armyworm was observed on ridge gourd, *Luffa acutangula* in the hot arid region of north-western India, (i.e., Thar Desert) and identified as *Spodoptera exigua*. Beet armyworm is a polyphagous pest and serious pest of ridge gourd cause to leaves, flowers and fruits of plants. Smaller larvae devour the parenchyma of leaves, so all that remains is the thin epidermis and veins. Larger larvae tend to burrow holes through thick areas of plants. Ridge gourd fruits are most susceptible to injury, starting from young fruit to maturity of fruits. The beet armyworm is damage to summer as well as rainy season but more incidences was recorded in the rainy season crop.

Patented

The patent office, Govt. of India has granted and issued certificate of patent for an invention entitled bio-pesticide compositions and formulation from (*Citrullus colocynthis*) for insect control under Patents Act, 1970. In a press release the Director of the Institute Dr. D. K. Samadia has stated that this product is absolutely safe and effective to control insect-pests in arid zone fruits and vegetables. He congratulated Dr. S. M. Haldhar, Scientist (Entomology) and his team for this achievement. The Institute has released this product with the name of "**Thar Jaivik 41 EC**" in 2019 and had sent for patent.



This bio-pesticide is effective against *Helicoverpa armigera*, *Spodoptera litura*, white fly and aphid with safe to natural enemies. The data on phytotoxicity effect on plant was also recorded and found that no effect was observed on plant when applied 10 times more dose of the recommended dose of bio-pesticide (Thar Jaivik 41 EC). It's also observed that their no effect on fruits and vegetables after 3 days spraying of bio-pesticide (Thar Jaivik 41 EC) for eating the humans. Indian arid zone is characterized by high temperature and low and variable precipitation, which limit the scope for high crop productivity. The existing low productivity could be increased by following improved new technologies and inputs. The area and yield potential of arid horticultural crops has increased many-fold because of the development of new varieties, agro-techniques and plant protection measures in arid region. Insect-pests are major constraints for increasing the production of arid horticulture crops in India. Chemical pesticides have played an important role in managing pests and diseases and increasing arid horticulture crops production in the past, but, their indiscriminate use for over three decades has led to several problems such as development of resistance in pest to pesticides, pesticides residues, destruction of beneficial insects and the outbreak of secondary pests. These negative effects have provided the impetus for the development of alternatives including botanical pesticides. Organic botanical pesticides are an important group of naturally occurring, often slow-acting crop protectants that are usually safer to humans and with minimal residual effects. On the basis of above background, we have made bio-pesticide formulation that is Thar Jaivik 41 EC from tumba (*Citrullus colocynthis*) and desi cow urine.

Bottom-up effects of different host plant resistance cultivars on ber (*Ziziphus mauritiana*)-fruit fly (*Carpomyia vesuviana*) interactions

The 54 ber cultivars were taken for preliminary screening against *C. vesuviana* and significant differences were found in percentage fruit infestation. The ber cultivars under study indicated significantly low incidence in Tikadi and Katha followed by Illaichi (15.60%) and Mehrun (16.73%). Significantly greater incidence of fruit fly was registered in Sanaur-5, Sanaur-4 and Sanaur-3 with a magnitude of 79.53, 81.63 and 81.87 %, respectively. On the basis of fruit fly incidence, Mehrun, Tikadi, Katha and Illaichi were considered as resistant; Banarasi Karaka, Banarasi Pawandi, Chuhara, Chirana-1, Golar, Kaithali, Neharu (Mandal), Surati, Tesbetes, Thar Bhubhraj, Thar Sevika and Thornless were found to be susceptible whereas, Sanaur-3, Sanaur-4 and Sanaur-5 were highly susceptible to fruit fly. The per cent fruit infestation was the highest in Sanaur-3 (81.87 %) and the lowest in Tikadi (10.87 %) followed by Katha (13.50 %).

The fruit infestation ranged from 10.87 to 81.87 % which was significantly lower in resistant cultivars and higher in susceptible cultivars.

Host plant genotypes determine bottom-up effect of *Cucumis melo* var. *callosus* against melon fruit fly

The melon fruit fly, *Bactrocera cucurbitae* (Coquillett) (Tephritidae: Diptera) is an important pest of cucurbits and is found to be effecting kachri (*Cucumis melo* var. *callosus*), leading to significant losses in yield potential under hot arid agro-climate of India. The objectives of this study were to identify and categorize sources of resistance in kachri genotypes to *B. cucurbitae* from the arid region of India. The genotype IC-350933 and IC-370479 were found highly resistant; IC-351005, IC-351088, IC-258153 and DKS 2011/01 were found resistant; IC-350895, IC-350924, IC-350958, IC-350964, IC-350970, IC-351073, IC-351142, IC-351202, IC-258140 and IC-373479 were moderately resistant; IC-350903, IC-350919, IC-350941, IC-351012, IC-351030 and IC-258137 were susceptible; IC-351258 and DKS 2011/12 were found the highly susceptible genotype to melon fruit fly infestation.

AHCM-22-1 (IC-0621779), a lasora (*Cordia myxa*) germplasm with tingid bug resistance

The tingid bug, *Dictyla cheriani* is a major pest of lasora in India and its outbreaks cause substantial crop losses to growers. The lace bugs sucked the sap from newly emerging leaves and young branches, which led to the leaves turned yellow and suppression of growth of the tree through drying of leaves and young branches. The maximum incidence of tingid bug is usually observed in October in two different phenotypic characters (51.67% on bold & 76.67% on small seeded plants) and minimum was in January (11.67% on bold & 21.67% on small seeded plants).

Field screening of a pomegranate (*Punica granatum*) germplasm resistance against the false spider mite (*Tenuipalpus punicae*)

The percentage of infested leaves (PIL) significantly differed among the 73 pomegranate accessions analyzed ranging between 5.8% (HP Collec.) and 63.3% (Bedana Suri). In absence of previous information on the classification of the severity of *T. punicae* infestation, we divided our accessions in five classes according to the distribution of the percent of infested leaves (PIL).

Field efficacy of botanicals and inorganic salts against mosaic disease on

The field trials were conducted during rainy season of 2018 and 2019 to test efficacy of botanicals and inorganic salts against management of mosaic disease in ridge gourd. In this study, naturally infected leaf samples exhibiting characteristic mosaic disease symptoms were collected during experiments. Among 11 treatments, imidacloprid (@ 0.05%) was found the most efficient treatment against mosaic disease with minimum per cent disease index (15.90%) and per cent disease reduction (61.69%). Next best treatment was neem leaf extract (@ 10%) with per cent disease index of 19.34 % and per cent disease reduction of 53.41%, followed by tumba fruit extract @ 10% (21.18% PDI and 48.97% disease reduction). Least effective treatment was borex (500 ppm) with PDI of 36.89%, followed by salicylic acid (500 ppm) with PDI of 35.36% against mosaic disease on ridge gourd in pooled data.

Effect of botanicals, inorganic salts and fungicide for management of Fusarium wilt of muskmelon under hot arid region of Rajasthan

The field trials were carried out on muskmelon susceptible variety 'RM-50' against Fusarium wilt during summer season of 2019 and 2020 at this Institute. Among 11 treatments,

carbendazim (0.1%) was found the most effective treatment for management of *Fusarium* wilt with minimum disease incidence (PDI) of 15.83% and 60.84 per cent disease reduction, followed by neem leaf extract @ 10% with disease incidence of 21.89 % and 45.84% disease reduction. Least effective inorganic salts were borex @ 500 ppm and salicylic acid @ 500 ppm having 36.93% and 37.19% disease incidence (PDI) as well as 8.63% and 7.99 per cent disease reduction, respectively. Maximum disease incidence (40.42% PDI) was found in case of control.

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.

Inter Institutional linkages/programmes organised/assisted

Strengthened functional linkage with sister organization / Institutions of the ICAR, KVKs, ATIC and Directorate of Extension of SKRAU, Bikaner, CAZRI Regional Station Bikaner, State Govt. Deptt. of Agriculture/ Horticulture, CAD/IGNP departments, press media persons, NGOs, etc. to facilitate the transfer of technologies developed at CIAH on local farmer's field and to encourage the arid horticultural development. The above institutions were assisted and cooperated as and when they required our assistance and help in successful completion of their programmes like extension programmes, trainings, interface meetings, assistance in technological campaign/ programmes, technological support and advice, other issues related to human resource development.

Developed Low tunnel technology for vegetable production

Low tunnel is a flexible transparent covering which is installed over individual row of sown/transplanted cucurbits. It enhances plant growth by warming the air around the plants during winter season and the photosynthetic activities of the plant by increasing the concentration of carbon dioxide inside the tunnels. When the night temperature during winter season goes below 8⁰C for a period of 30-40 days it warms the soil and protect the plants from low temperature which stimulates germination, early growth and improves the quality of crop. Thus, the plants can be grown successfully during winter or off-season and by this way the crop can be advanced the by 30-50 days than the normal season.



For installation of this technology, preparation of 45-60 cm deep trenches is recommended to increase height of tunnel so that temperature inside tunnel can be 8-10⁰C higher than outside temperature. Trenches should be made in East-West direction to protect the covering material from wind. The best time of sowing was found to be last week of December to first week of January with drip irrigation. Sowing of 2-3 pre-germinated seed per dripper should be done maintaining distance of 50 cm (P x P) and 2.0 m (R x R). Semi-circular GI wires (2.0 m long with 4-6 mm diameter) are fixed manually at a distance of 3-4 m over the row after sowing of seed. The width of two ends of hoops is kept 60-70 cm with a height of 80 cm above soil surface. Biodegradable plastic sheet of 25-50 micron is recommended as covering material. Hardening should be done carefully by removal of plastic during morning hours and covering in evening hours for 2-3 days. The plastic sheet should be completely removed in II or III week of

February when minimum temperature raises (10-12⁰C). Desert soil being sandy in texture gets warm soon in March-April which causes drying of vines, pistillate flowers and tender fruits touching the ground. Therefore, thatching with *Saccharum* should be done to protect from high soil temperature and to ensure proper direction to vines. This technology is suitable for cultivation of muskmelon, longmelon, watermelon, bottle gourd, ridge gourd, *tinda*, summer squash, *etc.* in hot arid region offers good opportunity for early and off season production of quality produce.

Developed Cultivation of Kachri variety AHK-119:

In the districts of Nagaur, Jodhpur, Barmer, Bikaner, Jaisalmer, Hanumagarh, Churu etc. of Western Rajasthan, kachri crop (*Cucumis callosus*) is grown in about 3,000 ha. Out of which 2500 ha area is covered by improved variety AHK-119 in two season *i.e.* February-June and June-November by the farmers.



Earlier farmers were growing local type of kachri and they were not getting proper yield and market price. AHK-119 variety developed by the Institute is giving average yield of 95-100 q/ha of uniform fruit size with attractive colour. Kachri is used for vegetable, chutney, pickle making and dehydration purpose. It is commercially used as ingredient in Channa Masala. After development of the variety areas is being increasing and out of total area, 80% area is cultivated with AHK-119 variety. There is a good demand of seed of improved variety of kachri. The farmers are getting about Rs. 1.00 lakh profit per ha/season.

AICRP on Arid Zone Fruits

1. Pomegranate –Bhagwa:

Pomegranate variety released under AICRP-AZF Bhagwa by Rahuri centre revolutionized pomegranate cultivation in the country. It occupied more than 86% of total pomegranate area in the country with around 88 % of total production. Out of total export of pomegranate (49,760 tonnes/year), about 39,808 tonnes/year alone comes from cultivar Bhagwa, which fetched Rs. 597.12 crore/annum of foreign exchange to the country. After release of cultivar Bhagwa during 2003-04, there is an increase of 121.43% in area, 279.09% in production, 70.55% in productivity and 381.42% in export quantity of pomegranate in India. Thus, according to an estimate, cultivar Bhagwa alone is contributing Rs. 8220.12 crore/annum to the national GDP. This impact of Bhagwa variety at National level was documented in DARE-ICAR research priorities and technologies for farmers welfare significant achievements 2014- 2021. Pomegranate variety Bhagwa has been registered under PPV&FRA, New Delhi with Regd. No. REG/2016/1740 Vide F. No. PPV & FRA / Reg.2016 /1740 /EN/ 2020 / 467/Dated 9/11/2020.



2. Pomegranate variety- Phule Bhagwa Super

The pomegranate variety Phule Bhagwa Super was recommended by AICRP Arid zone fruits annual group meeting 2021. The important features of this selection are very attractive dark saffron rind colour with glossiness on rind surface, bold arils, deep red aril colour, soft seed, sweet in taste with medium fruits and high yielding capacity (171.40 q/ha). It mature in 175-180 days. The TSS is 15.45% and acidity is 0.37%. Fruits are medium in size (271.00 – 299.00 g). Seeds are soft (Mellowness 1.18 kg/cm²). Fruits are more juicy (51.34%) with 15.79% T.S.S. and 0.39% acidity. Maximum anthocyanin content (53.12 mg/100g). Fruit yield 24 kg/tree, 172.00 q/ha and Average number of fruits per tree 78-90. Suitable for both export and domestic market.



3. Tamarind - Ananta Rudhira

Tamarind variety Ananta Rudhira released under AICRP-AZF by Anantpur centre. The variety is a natural selection from wild abundant population from Andhra Pradesh. Tree form is rounded, drooping at the ends. Pulp texture is firm, blood red (unripe), reddish brown (ripe) and sweet acidic in taste. The variety is moderate to heavy regular bearer. The yield potential is 131.83 kg/plant with 43.3 % pulp recovery. The variety has 60.40% carbohydrate, 26.13% total sugars, tartaric acid 16.65% and high amount of beta carotene (67.06 µ per 100g and also rich in iron (111.72 mg/100g) and calcium (1.59 %). It is notified in The Gazette of India by Central Seed Committee under Section 5 of Seed Act , 1966 (54 of 1966) by Central Govt. of India on 20th July 2022.



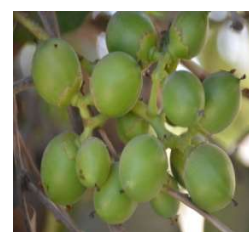
4. Tamarind - Thettu Amalika

Tamarind variety Thettu Amalika released under AICRP-AZF by Anantpur centre. Heavy yielder with regular bearing habit. Pods are big, broad, slightly curved with rounded ends and somewhat compressed. Pulp is firm, soft which is thick and blackish brown. It is also notified in The Gazette of India by Central Seed Committee under Section 5 of Seed Act, 1966 (54 of 1966) by Central Govt. of India on 20th July 2022.



5. Lasora - Karan Lasora

The variety is developed by SKNCOA, Jobner centre, Rajasthan during Annual Research Workers Group Meeting 2018. Flowering starts in last week of March to end of April and fruiting from first week of May to first fortnight of June. The most peculiar character is dual time fruiting i.e. April-May and off season fruiting in winters. The fruits are bigger in size, good cluster with pulp content with pulp stone ratio of 16.48 and fruit quality is good for making pickle. After drying the fruit pulp recovery percent is 17.32. The average bunch weight is 180-220g, 20-27 fruit number in a bunch and average fruit



yield is 80-90kg per plant. This variety is recommended for paired row at wider spacing or boundary plantation.

6. Bael – Narendra Bael-8

This bael variety was identified during the Annual Research Workers Group Meeting of ICAR-AICRP on Arid Zone Fruits organized from 28 - 30 April, 2022 at ANDUAT, Ayodhya (UP). It is recommended for cultivation under arid and semi-arid regions of India. Narendra Bael-8 is late ripening variety and fruits have very less fibre, pale yellow pulp, TSS 38.77 °Brix and less mucilage content. Fruits weight is 1.23 kg with average yield 108.89 kg/plant.



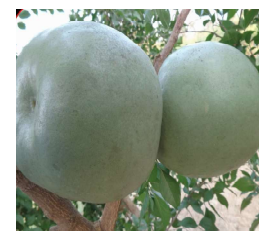
7. Bael – Narendra Bael-11

This bael variety was identified during the Annual Research Workers Group Meeting of ICAR-AICRP on Arid Zone Fruits organized from 28 - 30 April, 2022 at ANDUAT, Ayodhya (UP). It is recommended for cultivation under arid and semi-arid regions of India. Narendra Bael-11 is early ripening variety suitable for processing. Fruits have whitish yellow pulp with less mucilage content, TSS 33.98 °Brix and ascorbic acid 35.15 mg/100 g of pulp. Fruits weight is 1.87 kg with average yield 99.60 kg/plant.



8. Bael – Narendra Bael-10

This bael variety was identified during the Annual Research Workers Group Meeting 2021. It is recommended for cultivation under arid and semi-arid regions of India. It is early ripening (March) and earliest among the released varieties. It has compact foliage, less fruit sunscald and very less thorns and starts bearing in 4th year. Drought tolerant, luxuriant growth and higher fruit yield under less precipitation and high temperature. Attractive light yellow colour of pulp of complete ripened fruit. It is highly suitable for powder and RTS owing to attractive pulp colour and fiber content. Average yield/plant is 104.34 kg, fruit weight 1.87 kg, fruit size 26.51 cm x 25.02 cm, shell thickness 2.49 mm, total number of seed 80-110, locules in cross section 11-12, TSS pulp 30.890 B, acidity (0.40%) and vitamin C 21.81 mg/100g pulp, pulp colour-pale yellow, pulp taste-sweet were recorded. Average yield under normal conditions 84.15-112.20 kg/plant 212.85 q/hectare.



9. Narendra Aonla-25

This bael variety was identified during the Annual Research Workers Group Meeting 2021 by Ayodhya centre. It is early flowering (starts from last week of February) and start bearing in 4th year. It found suitable to grow under sub-tropical ecosystem. Early ripening (November) and earliest among the released varieties. Attractive creamy yellow colour of pulp of complete ripened fruit, fruit shape-flattened round. Average yield/plant (2016-2020) 34.73 kg/plant, fruit



weight 52.76g , fruit size 4.18 cm x 4.41 cm, total number of seed 06, segments-6, TSS pulp 11.50⁰Brix, acidity (0.89%) and vitamin C-545.93 mg / 100 g pulp.

10. Narendra Aonla-26

This bael variety was identified during the Annual Research Workers Group Meeting 2021 by Ayodhya centre. It is early flowering (Last week of February) and ripening in the month of December. It start bearing in 5th year and suitable for sub-tropical ecosystem. Attractive bright green yellow colour of fruits with smooth thin skin of complete ripened fruits and fruit shape flattened round. Average of 5 years (2016-2020) yield/plant is 55.56 kg, fruit weight 45.68 g, fruit size 3.93 cm x 4.15 cm, total number of seed 06, segments-6. TSS pulp 10.85⁰ Brix, acidity (1.10%) and vitamin C 483.68 mg /100 g pulp.



11. Custard apple- Phule Janaki

This bael variety was identified during the Annual Research Workers Group Meeting 2018 by MPKV, Rahuri centre. Trees are semi-spreading in nature with dark green foliage. Fruits are large in size (392.71 g). Maximum number of fruit/tree (57.57). Fruit surface is rough with yellowish green colour. Fruit shape is oval and aroles are mammal in shape. Pulp milky white and soft texture with less seeds and higher pulp (58.96%). Higher yield (20.69 kg/tree 55.07 q/ha) and TSS (%) (25.54 %). Recommended for release in Maharashtra on the basis of attractive green fruits, maximum pulp, less seeds, bigger fruits and higher yield.



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Annexure-III**Women Scientists****ICAR-CIAH, Bikaner**

S. No.	Name and Designation of the women scientist
1.	Dr. Anita Meena, Scientist (Soil Sciences)

AICRP on AZF

S. No.	Name of the Centre	Name and Designation of the women scientist
1.	Horticultural Research Station, Dr. Y.S.R. Horticultural University, DCMS Buildings, Kamala nagar, Anantapur-515 001	1. Dr. P. Deepthi, Scientist (Plant Pathology) 2. Dr. B. Vimla, Scientist (Horticulture)
2.	ICAR-Indian Institute of Horticultural Research Hessaraghatta Lake Post, Bengaluru	1. Dr. Linta Vincent, Scientist
3.	Tamil Nadu Agricultural University, Regional Agricultural Research Station, Kovilangulam-626101 Distt. Virudhunagar (Tamil Nadu)	1. Dr. R. Akila Asstt. Prof. (Plant Pathology)
4.	Department of Horticulture, MPKV, Rahuri-Distt. Ahamad Nagar- (MS) 413722	1. Prof. (Smt.) Suvarna B. Deore Asstt. Horticulturist