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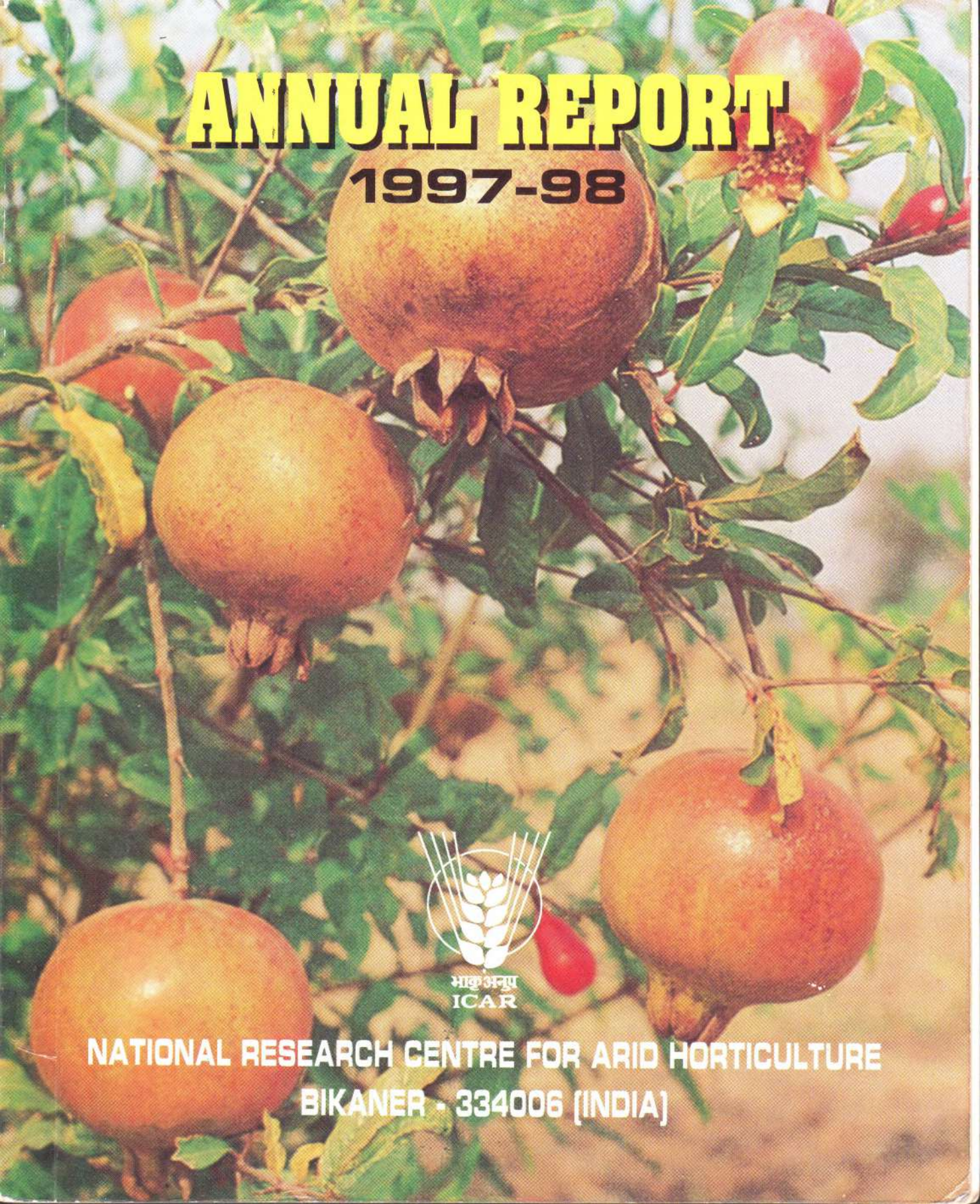

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NATIONAL RESEARCH CENTRE FOR ARID HORTICULTURE
BIKANER - 334006 (INDIA)

Annual Report
1997-98

NATIONAL RESEARCH CENTRE FOR ARID HORTICULTURE
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Director
NRC for Arid Horticulture
10th Km Milestone, Sriganganagar Road,
Beechwal, Bikaner-334006 (Rajasthan), India
Phone : 0151-250147
Fax : 0151-250145
E.mail : nrcah@400x.nicgw.nic.in
Cable : UDYANSHODH

Compiled and Edited by

Dr. O.P. Pareek
Dr. B.B. Vashistha
Dr. R.Bhargava

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Cover Photographs

Front : A fruiting twig of Anar
Back : A view of farm complex

CONTENTS

INTRODUCTION

National Research Centre for Arid Horticulture, Bikaner was established in March, 1993 to conduct research for the development of horticulture in arid region. The arid region occupies nearly 12 per cent of the land area in India. The area is marked by characteristics such as low rainfall, high PET, high wind velocity, low soil fertility and water holding capacity. It has been realised that in such situtation, horticultural crops can provide nutritional security to the people and can also ameliorate the harsh environment. This centre was therefore, established with following mandate and objectives.

Mandate

To conduct mission oriented research for improvement in productivity of horticultural crops and development of horticulture-based cropping system under arid environment; and to act as a repository of information related to arid horticulture.

Missions/objectives

*To introduce, collect, characterize, conserve and evaluate the biodiversity of horticultural crops under arid environment.

*To utilize the available biodiversity and improve the target fruit crops such as *ber*, pomegranate, *aonla*, date palm and cucurbitaceous, leguminous and solanaceous vegetables to develop high quality and productive types having tolerance to biotic and abiotic stresses.

*To study the factors related to rapid multiplication of propagules in case of established as well as new crops and the problems related to their growth and fruit development.

*To standardize agrotechniques with respect to efficient use of soil, water and nutrients for increased horticultural productivity involving water harvesting and conservation techniques under rainfed conditions, efficient use of the scarce irrigation water and nutrient management.

*To study the ecophysiological parameters of cropping system models for utilization of high temperature and radiation resources.

*To develop postharvest technology package for extended use of the horticultural produce of arid region.

*To develop integrated pest and disease management technologies for horticultural crops under arid environment.

The salient research achievements of the centre during 1997 were:

(i) Three progenies of *mateera* genotypes, *viz.* AHW-19-3-B, AHW-65-b and AHW-65-4 and 9 of *kachari, viz.* AHK-5-1, AHK-13-1, AHK-43-1, AHK-155-1, AHK-119-2, AHK-202-1, AHK-99, AHK-26-1 and AHK-109-1 were found to be promising.

(ii) Snapmelon genotypes, AHS-82-1-B, AHS-10-1-B, AHS-50-1,AHS-6-1 AHS-54-1 and AHS-19-1 were found promising.

(iii) 108 genotypes of *ber*, 27 of pomegranate, 46 of cactus pear, 2 of *aonla* and 46 genotypes of date palm were collected during this period and are under evaluation.

(iv) Presence of growth inhibiting substances in cuttings of *Capparis decidua* was demonstrated which may have role in root regeneration in this difficult to root species.

(v) Detailed spectrum of mineral nutrients in promising lines of *Prosopis cineraria (khejri)* has been worked out.

(vi) Surveillance studies revealed occurrence of few bacterial, viral and fungal diseases in the mandate crops.

(vii) The scientists of the Centre took active part in *Kisan Melas* and other extention activities and acted as resource personnel for various training programmes organised by organisations in Bikaner, including RAU.

GERMPLASM CONSERVATION

Mission A : Introduction, collection, characterisation, conservation and evaluation of horticultural biodiversity.

A.1.1. Collection , conservation and evaluation of *ber (Ziziphus mauritiana)*

The total collection of *ber* genotypes in National Repository reached 251 with the collection of 108 types during 1997 (Table 1). At present 238 genotypes are being maintained and evaluated.

Budwood of 4 selected *ber* types from Chirana (Jhunjhunu) and 7 from Bhusawar (Bharatpur) were collected and budded *in situ* in the conservation block. These have survived and are being maintained and evaluated.

A.1.2. *Boradi (Ziziphus mauritiana* var. *rotundifolia)*

Out of 22 genotypes identified during the previous survey programme, budwood of 4 genotypes (2 each from Shekhawati and Banar region) were collected during August-September, 1997. With the identification of two more genotypes of *boradi* around Bikaner (having big size fruit and heavy bearing), the total number of germplasms reached 24.

Table 1. *Ber* germplasm collection

Source	No. collected	Time of collection
FRS,Faizabad	39	August-September
Bhusawar, Bharatpur	7	August
Sasni, Mahamayanagar	5	August
IARI, New Delhi	49	August-September
BHU, Varanasi	1	September
CAZRI, Jodhpur	14	September
Banar, Jodhpur	2	September

A.1.3. Collection, conservation and evaluation of *aonla (Emblica officinalis)*

One cultivar of *aonla* from Faizabad and one from Pantnagar were collected. Some promising *aonla* types have also been identified from around Jaipur.

A.1.4. Collection, conservation and evaluation of cactus pear *(Opuntia ficus-indica)* (L.) Mill.) types/cultivars under hot arid environment

Collection of germplasm: Three cultivars, *viz*. Rosa,Gialla and Bianca were collected from Govt. Demonstration Farm, Dehradun (UP). A seedling cladode of Rosa (introduced from Israel) and a fruiting type thornless cactus pear were collected from Jodhpur and Rahuri respectively. Thus 106 types of cactus pear are being maintained at the centre.

Evaluation of cactus pear genotypes: Growth data on 44 genotypes planted in the field during 1996 were recorded. The clone 1118 and 1292 produced maximum number of cladodes (10/plant) Flowering was observed only in the indigenous ones.

Fifty one exotic genotypes imported from Texas (USA) were planted in pots in February, 1997 for evaluation. Among them, 48 genotypes survived upto September, 1997and produced new cladodes. Vegetable type cactus pear (clone 1308) sprouted within a month while the fruiting type sprouted in 2-3 months. Clone 1260 produced flowers in the pot. The new cladodes from 4 genotypes were harvested and planted in the field for further evaluation.

Damage to the cladodes was mainly due to bacterial and fungal diseases. The control measures were adopted during the establishment stage. Application of Bavistin (0.2%) was less effective while Ridomyl (0.15%) controlled the disease effectively.

Six months after planting, clones 1376, 1388, 1393 and 1458 produced the maximum number of cladodes (6/plant) than other genotypes (3-4/plant).

A.1.5. Collection, conservation and evaluation in pomegranate *(Punica granatum L.)* in arid region

The work on collection of genetic diversity of pomegranate was started in 1995 with a view to develop a National Field Repository. One hundred twenty varieties/lines have been collected from different parts of India and abroad. Only eight varieties have produced fruit.

A.1.6. Collection, conservation and evaluation of date palm *(Phoenix dactylifera)* in arid region.

Germplasm collection: Forty six date palm cultivars were collected from India and abroad in the repository (Table 2) and 3 plants of each genotype/cultivar were planted at 8 x 8 m distance. During *Kharif* season, clusterbean (RGC-936) was grown as an intercrop. Average grain yield of 80g/m^2 was obtained from the intercrop. Except one plant in Halawy and Abdul Rehman cultivar, all the plants survived and started growing after three months of planting.

Table 2. Collection of date palm varieties.

Source	No. of varieties	Time of collection
Iraq	3	April, 97
RFRS (PAU), Abohar	18	August, 97
Date palm Research Centre (RAU), Bikaner	25	September, 97

Varietal performance: An experimental block of four cultivars (Halawy, Khalas, Khuneizi and Medjool) of date palm was planted at 8 x 8 m distance. Number of suckers under 10 kg and above 10 kg were recorded. Clusterbean (RGC 936) was taken as rainfed intercrop. In Khalas and Khuneizi cultivars, growth was observed after three months of planting. Maximum survival was noticed in suckers/offshoots having more than 10 kg weight.

A.1.7. Collection, conservation and evaluation of *Prosopis cineraria*

Thirty genotypes of *khejri,* from around Bikaner, were screened by sensory tests for consecutive three years. This led to identification of some promising types yielding pods for vegetable purpose. Weighted score for pods of various genotypes are presented in Table 3 which show that genotype Nos. 2,3,13,21 and 29 are promising scoring over eighty per cent. Genotypes 1,14,20,26 scoring over seventy five per cent are also considered valuable. Thus, nine genotypes of *khejri* seem to have promise owing to good taste, appearance, tenderness, low fibre and high seed contents in their pods.

Table 3. Weighted scores of pods of different elite *khejri* trees.

Genotype No.	Pod length and appearance	Tenderness	Taste	Seed content	Total score
1	16.7	27	24	7.5	75.2
2	14.7	27	36	7.0	84.7
3	16.7	24	36	7.0	83.7
4	16.7	18	32	7.5	74.2
5	12.0	27	28	7.0	74.0
6	13.3	9	28	8.0	58.3
7	12.7	9	28	6.5	56.2
8	9.3	3	32	6.0	50.3
9	12.7	18	32	6.0	68.7
10	14.7	24	24	7.5	70.2
11	14.7	15	32	6.0	67.7
12	10.7	9	12	7.5	39.2
13	16.0	24	36	6.5	82.5
14	8.0	27	36	4.0	75.0
15	12.0	27	28	6.0	73.0
16	12.7	18	28	6.5	65.2
17	12.7	27	12	7.5	59.2
18	10.7	24	28	5.5	68.2
19	11.3	27	24	7.5	69.8
20	14.0	27	28	6.5	75.5
21	17.3	24	32	7.0	80.3
22	15.3	27	24	6.5	72.8
23	12.7	24	28	6.0	70.7
24	11.3	6	28	7.0	52.3
25	9.3	24	12	7.0	52.3
26	9.3	27	32	8.0	76.3
27	11.3	27	28	7.5	73.8
28	12.7	18	24	7.0	61.7
29	14.7	27	36	5.5	83.2
30	11.3	24	28	7.0	70.3

A.2. Collection, characterisation, evaluation and improvement of cucurbitaceous crops under arid conditions.

A.2.1. Evaluation and improvement in *mateera (Citrullus lanatus)*

Evaluation of advance lines of *mateera* (summer 1997)

Twenty five advance progenies of *mateera* were evaluated in randomised block design with three replications during summer season of 1997 at NRCAH farm. Twenty five parameters related to plant growth, maturity, yield and quality characters of fruit were considered for evaluation of these lines. Major emphasis during the screening was given on flesh content, firmness, colour, TSS and taste. Besides these parameters, yield under high temperature conditions, drought hardiness, incidence of insects and diseases were also considered.

Days to first harvest varied from 79 to 93 days after sowing (DAS). Number of marketable fruits per plant ranged between 2 to 50. Earliest harvest (79 DAS) and the highest number of fruits (5) per plant were recorded in AHW 65-1. Important character like TSS was found to be optimum in AHW 19-3-b (8.4%) followed by 8.2 per cent in AHW 19-3-A and AHW 65-1. In general the fruits of progenies of genotypes AHW-19 and AHW-65 had desirable pink to dark pink colour and firm flesh with TSS around 8 per cent (Table 4).

Evaluation of advance lines of *mateera* (monsoon 1997)

Thirty five advance progenies of *mateera* were evaluated in randomised block design during monsoon, 1997 with three replications under rainfed condition. Agromorphological characters, earliness, fruit yield and quality characters were recorded for evaluation and selection of lines. However, major emphasis was given on flesh contents, firmness, colour, taste and TSS alongwith yield.

Important characters of 18 selected lines are given in Table 5. It was observed that the number of days required for first harvest were minimum (71.2 DAS) in AHW 65-4 and maximum

AHW-65 Variety of Snap Melon

AHK-119 Vearity of Kachhri

Table 4. Evaluation of advance lines of *mateera* (summer season-1997)

Lines	Days to first female flower (DAS)	No. of fruit set/ plant	Days to first harvest (DAS)	Market-able fruits/ plant	Fruit weight (kg.)	Fruit length (cm)	Fruit girth (cm)	Ripe flesh thickness (cm)	Unripe flesh thickness (cm)	TSS (°Brix)	Flesh colour	Flesh firm-ness	Vine length (cm)	No.of branches /plant
AHW 1-1	49.4	6.5	93.4	2.5	5.15	40.2	61.5	16.4	2.5	7.2	P	B	4.2	6.4
AHW 12-1	42.6	8.5	86.1	4.0	3.54	24.5	55.4	14.5	1.9	6.2	LP	A	4.2	5.4
AHW 12-3	55.2	3.5	97.4	2.0	3.50	28.6	61.4	12.5	1.8	7.0	LP	B	2.5	4.2
AHW 16-1	53.4	7.5	90.4	3.8	4.15	28.6	59.2	14.1	2.0	7.5	DP	A	2.6	4.5
AHW 18-3	48.2	8.8	82.1	4.8	4.10	30.4	61.3	14.5	1.8	8.0	DP	A	4.5	6.2
AHW 19-1	46.1	8.5	80.4	4.1	3.85	31.4	62.3	12.4	1.7	8.0	P	A	3.1	5.2
AHW 19-2	47.2	8.6	80.1	4.2	4.25	32.4	61.7	13.2	1.5	8.1	DP	A	3.2	5.4
AHW 19-3a	49.4	8.4	81.4	4.4	4.17	31.7	62.1	12.9	1.5	8.2	DP	A	2.8	5.4
AHW 19-3b	48.3	8.5	82.8	4.5	3.95	33.5	59.6	12.6	1.6	8.4	DP	A	2.9	5.4
AHW 20-1	50.4	5.5	88.4	3.0	3.15	34.2	55.3	14.1	1.7	5.5	LP	A	2.1	4.2
AHW 65-1	44.5	8.2	79.4	5.0	2.85	29.1	56.4	13.2	1.8	8.2	P	A	2.5	5.5
AHW 73-1	43.4	7.5	88.6	4.7	3.75	31.4	54.6	10.4	2.2	6.5	LP	B	3.5	5.6
AHW 82-1	48.9	7.4	88.4	3.1	5.21	34.5	70.4	16.5	2.2	7.8	P	B	3.1	6.2
AHW 82-2	43.5	7.2	90.4	4.1	4.55	33.2	67.1	12.1	2.6	7.4	LP	B	3.2	5.2
AHW 108-1	46.8	8.0	87.7	4.1	3.54	28.4	54.2	12.8	1.6	8.0	DP	A	4.1	6.2
AHW 118-1	48.7	6.2	88.3	4.2	4.02	30.4	62.4	14.1	1.8	7.9	DP	A	3.0	5.2
AHW 118-2	49.4	6.4	88.4	4.4	4.24	34.2	64.5	15.2	1.8	7.6	P	A	3.2	6.1
AHW 123-1	49.5	6.8	86.2	4.0	4.81	33.4	68.4	12.4	2.8	6.0	LP	B	2.8	6.2
AHW 140-1	49.5	8.1	89.1	4.0	4.02	35.4	58.4	12.5	2.0	7.2	LP	B	3.2	5.2

P:Pink; DP: Dark pink; LP:Light pink; A:Solid; B:Semi solid

(88.5 DAS) in AHW 1-1. The number of fruits per plant ranged between 2.9 to 4.8. Individual fruit weight was maximum in AHW 19-3a (4.51 kg) and minimum 2.80 kg) in AHW 16-1. Fruit characters like weight, length, girth and flesh content were quite variable and depended on size and shape of the fruit. The line AHW 65-4 recorded the highest TSS (8.5%). All the progenies of genotype AHW 19 and AHW 65 had dark pink colour and firm flesh (solid) having mean sweetness value 8.2 per cent.

Performance of promising lines of *mateera* (summer, 1997)

Advance promising *mateera* lines namely, AHW 18-3, AHW 19-2, AHW 19-3a, AHW 19-3b, AHW 65-3, AHW 65-4, AHW 108-1 and AHW 118-2 were tested alongwith watermelon cv. Durgapura Meetha during the summer season, 1997 with three replications in randomised block design. Yield and fruit quality data were recorded for analysis of result. The maximum number of fruit set/plant (9.8) and marketable fruits/plant (5.2) were recorded in AHW 65-4. First harvesting was also earliest, i.e. 73.4 days after sowing in AHW 65-4. It was found that the line AHW 19-3b outyielded (485.9 q/ha) AHW 19-3a (482.5 q/ha) as compared to minimm fruit yield (215 q/ha) in the standard variety Durgapura Meetha. The line AHW 18-3, AHW 19-3a, AHW 19-3b, AHW 65-3 and AHW 65-4 were found to have potential not only on the basis of desirable characters like solid, dark pink flesh having sweetness more than 8.2 per cent but also for yield potential under arid situations (Table 6).

Performance of promising lines of *mateera* under rainfed conditions (monsoon 1997)

Seven selected advance lines of genotype AHW 19 and three of AHW 65 were tested in randomised block design with four replications under rainfed condition during the rainy season, 1997. The observations related to plant growth, earliness, yield and quality characters of fruit were recorded to compare the lines. Among the promising lines of genotype AHW 19-3b recorded maximum number of fruits/plant (4.81) and fruit yield (560.8 q/ha). The time of anthesis of first female flower (40.1 DAS) and harvest (78.5 DAS) also indicated earliness compared to the average value of these lines. Fruits of this line were highly

Table 5. Evaluation of advance lines of *mateera* (monsoon-1997)

Lines	Days to first female flower (DAS)	Days to first harvest (DAS)	No. of fruits/ plant	Fruit weight (kg.)	Fruit length (cm)	Fruit girth (cm)	Ripe flesh thickness (cm)	Unripe flesh thickness (cm)	TSS (°Brix)	Flesh colour	Flesh firm-ness
AHW 1-1	41.5	88.5	3.0	3.95	36.7	61.4	12.5	2.42	7.0	LP	B
AHW 16-1	46.2	85.3	2.9	2.80	28.4	57.3	13.7	2.11	6.8	LP	B
AHW 18-3a	42.4	79.4	4.1	4.25	38.5	64.3	13.8	1.94	8.0	DP	A
AHW 18-3b	43.8	80.2	4.3	3.90	36.4	64.2	14.2	2.12	8.0	DP	A
AHW 19-2	44.1	74.5	3.9	4.25	32.1	60.0	15.5	1.01	8.0	DP	A
AHW 19-3a	40.2	78.4	4.4	4.51	31.4	58.4	13.6	1.64	8.1	DP	A
AHW 19-3b	41.3	74.6	4.2	4.15	33.4	60.4	14.0	1.62	8.4	DP	A
AHW 19-3k	40.4	79.4	4.1	3.54	26.7	52.5	13.5	1.31	8.2	DP	A
AHW 19-3j	42.0	77.4	4.0	4.15	34.5	62.5	13.8	1.53	8.2	DP	A
AHW 65-3	42.0	73.1	4.1	3.25	29.5	54.5	13.4	1.47	8.0	DP	A
AHW 65-4	40.2	71.2	4.8	3.00	29.2	52.2	138	1.55	8.5	DP	A
AHW 82-1	44.1	82.4	3.1	3.75	34.7	64.3	13.5	2.14	7.9	P	B
AHW 108-1a	41.4	81.9	3.4	3.60	31.7	57.4	14.0	1.42	7.5	DP	A
AHW 108-1b	44.3	82.4	3.6	3.25	28.5	53.5	12.4	1.40	7.4	P	A
AHW 108-1g	41.7	83.4	4.1	3.25	26.7	58.4	11.4	1.81	7.9	LP	A
AHW 118-1	43.7	81.2	3.5	3.80	32.4	52.5	12.5	1.53	6.8	DP	A
AHW 118-2	43.4	81.4	3.2	3.25	32.1	53.8	13.1	1.44	7.2	DP	A
AHW 140-1	47.3	84.3	3.0	3.05	32.1	50.4	12.0	1.62	6.4	DP	A

P:Pink; DP: Dark pink; LP:Light pink; A:Solid: B:Semi solid

acceptable because of size, shape, flesh content and TSS (8.5%) (Table 7).

AHW 65-4b (428.5 q/ha) was found to be most potential line and recorded the earliest harvest (72.3 DAS) and highest number of fruits (4.42) per plant. This line also recorded maximum fruit weight (3.15 kg), ripe flesh (15.51 cm) and TSS (8.5% with solid and dark pink flesh.

A.2.2. Evaluation and improvement in *kachari (Cucumis callosus)*

Evaluation of advance lines of *kachari* (summer, 1997)

Sixteen promising lines of *kachari* were evaluated in summer of 1997 with three replications in randomized block design. The observations on plant growth, earliness in fruiting, fruit and quality were recorded. Days to anthesis of first male and female flower ranged from 30.4 to 39.2 and 35.0 to 45.4 days after sowing, respectively. The line AHK 200-1 (70.1 DAS) followed by AHK 119-2 (72.1 DAS) exhibited earliness in fruit harvest. The maximum number of branches (10.54) was in 202-1 and minimum in AHK 40-1 (5.24). The range of number of fruits/plant was 4.5 to 36.8 (AHK 43-1) (Table 8). Fruit yield and quality character values were quite variable in these lines. Therefore, the parameters like taste rating and probable utility were taken into consideration alongwith fruit yield for screening the potential lines. The line AHK 5-1, AHK 13-1, AHK 43-1, AHK 119-2, AHK 202-1 and AHK 356-1 have been found to be promising and their small mature fruits can be utilised as vegetable and for processing (dehydration). While the fruits of lines AHK 26-1, AHK 99-1, AHK 109-1, AHK 155-1 and AHK 200-1 can be used as salad or for garnishing vegetables.

Performance of promising lines of *kachari* under rainfed situation (Monsoon 1997)

Sixteen promising lines of *kachari* were tested for their yield potential under rainfed situation during the rainy season of 1997 in RBD with three replications. Observations related to growth, maturity, fruit yield and quality were recorded. The fruits of lines AHK 5-1a, AHK 13-1b, AHK 43-1a, AHK 119-2a and AHK 119-2b, AHK 202-1a and AHK 356-1a were

Table 6. Performance of promising lines of *mateera* (summer, 1997)

Lines	Days to first female flower (DAS)	No. of fruit set/ plant	Days to first harvest (DAS)	Market-able fruits/ plant	Fruit yield (q/ha)	Vine length (cm)	No. of branches /plants	Fruit weight (kg.)	Fruit length (cm)	Fruit girth (cm)	Ripe flesh thickness (cm)	Unripe flesh thickness (cm)	TSS (°Brix)	Flesh colour	Flesh firm-ness
AHW- 18-3	47.5	7.4	85.4	4.1	405.1	4.1	5.3	4.75	31.41	64.32	14.22	1.92	8.2	DP	A
AHW- 19-1	45.1	8.4	81.4	4.1	410.4	3.5	5.4	4.31	31.54	63.51	14.21	1.71	8.0	P	A
AHW-19-2	43.4	8.1	79.6	4.0	425.1	3.8	5.3	4.42	33.58	60.58	13.54	1.64	8.1	DP	A
AHW-19-3a	43.4	8.3	80.4	4.4	482.5	3.0	5.4	3.85	32.78	60.77	14.52	1.62	8.3	DP	A
AHW-19-3b	43.1	8.4	79.4	4.4	485.9	3.2	5.4	3.94	31.13	61.73	13.81	1.51	8.4	DP	A
AHW-65-2	41.2	8.5	75.1	4.9	365.1	3.1	5.6	2.85	26.42	60.44	14.54	1.42	8.2	DP	A
AHW-65-3	42.1	8.8	75.2	5.2	402.4	3.0	5.7	3.10	28.91	60.12	15.21	1.54	8.4	DP	A
AHW-65-4	42.4	9.8	73.4	5.2	479.6	3.1	6.2	3.20	26.44	59.61	15.62	1.45	8.4	DP	A
AHW-108-1	45.7	8.1	85.3	4.0	485.6	4.5	6.0	4.0	29.42	58.32	13.11	1.91	7.9	DP	A
AHW-118-2	46.4	7.2	86.8	4.4	372.8	3.1	6.2	4.2	33.21	65.31	14.42	1.82	7.8	DP	A
Durgapura Meetha	51.4	6.4	95.4	2.1	215.0	4.0	5.4	3.85	33.42	62.4	14.84	2.04	8.8	RED	A

Table 7. Yield and quality attributes of promising lines of *mateera* under rainfed situation (monsoon 1997)

Lines	Days to first female flower (DAS)	No. of fruit set/ plant	Days to first harvest (DAS)	No. of fruits/ plant	Fruit yield (q/ha)	Fruit weight (kg.)	Fruit length (cm)	Fruit girth (cm)	Ripe flesh thickness (cm)	Unripe flesh thickness (cm)	TSS (°Brix)	Flesh colour	Flesh firm-ness
AHW-19-3a	42.2	7.5	79.9	3.81	415.8	4.25	31.5	60.2	13.41	1.52	8.2	DP	A
AHW-19-3b	40.1	7.9	78.5	4.81	560.8	4.25	33.2	65.4	14.54	1.44	8.5	DP	A
AHW-19-3c	40.5	8.2	78.1	4.12	472.9	4.10	32.5	68.7	14.22	1.45	8.4	DP	A
AHW-19-3d	41.4	8.3	80.2	4.44	535.4	4.30	30.8	62.4	13.80	1.33	8.5	DP	A
AHW-19-3e	42.4	8.1	77.6	4.02	501.0	3.90	31.4	60.8	13.24	1.72	8.4	DP	A
AHW-19-3f	42.3	7.9	78.4	4.01	430.0	3.85	33.4	68.4	14.19	1.53	8.2	DP	A
AHW-19-3j	41.1	7.6	79.4	4.3	435.0	4.10	32.5	60.3	13.52	1.78	8.3	DP	A
AHW-65-4a	40.5	9.4	73.0	4.24	410.5	2.95	27.2	60.1	14.34	1.84	8.0	DP	A
AHW-65-4b	41.2	11.5	72.3	4.42	428.5	3.15	29.4	60.4	15.51	1.72	8.5	DP	A
AHW-65-4c	40.5	10.5	72.5	4.31	390.4	2.85	28.4	58.4	14.14	1.71	8.4	DP	A

smaller in size having sour acidic taste at maturity and can be utilised for processing (dehydration) and preparation of pickle, *chutnies* or vegetables.
In this group maximum fruit yield (97.64 q/ha) was recorded in AHK 119-2b which had all the desirable fruit quality characters.

The fruits of lines AHK 26-1a, AHK 26-1b, AHK 99-1b, AHK 109-1a, AHK 155-1a, AHK 155-1b, AHK 200-1a, AHK 200-1b and AHK 200-1c were bigger in size and sweet in taste at maturity and can be used for making salad or for garnishing the vegetables. In this group, maximum yield (120.5q/ha) was recorded in AHK 200-1b with all the desirable fruit quality characters. These lines were drought hardy and were free from fruitfly infestation under field conditions.

A.2.3. Evaluation and improvement in snapmelon *(Cucumis melo* var. *momordica)*

Evaluation of advance lines of snapmelon (summer 1997)

Nineteen selected lines of snapmelon were evaluated for fruit yield and quality parameters during the summer 1997 with three replications in randomised block design. The data revealed that these lines were quite variable with regard to growth, maturity, yield and fruit characters such as size, shape, flesh content, colour, taste, fruit cavity and TSS. Field observations on fruitfly infestation, incidence of powdery mildew and drought hardiness were also taken into consideration for comparison of the lines. The line AHS 10-1 (77.8 DAS) closely followed by AHS 82-1 (78.3 DAS) exhibited earliness to harvest. Maximum number of fruits (6.3) per plant were recorded in the line AHS 82-1 followed by 6.2 in AHS 10-1. The heaviest fruit was in AHS 50-1 (1.6 kg) (Table 10). On the basis of fruit yield and quality rating, the lines AHS 82-1, AHS 10-1, AHS 50-1, AHS 6-1, AHS 54-1 and AHS 19-1 were found to have potential.

Performance of snapmelon lines under rainfed situation (monsoon 1997)

Eighteen selected lines of snapmelon were evaluated with three replications in RBD for fruit yield and quality under rainfed situation in rainy season. Maximum fruit yield (260.2 q/ha) was recorded in line AHS 82-1b followed by AHS 82-1a (245.7 q/ha) and

Table 8. Evaluation of advance lines of *kachari* (summer, 1997)

Line	Days to first male flower (DAS)	Days to first female flower (DAS)	Days to first harvest (DAS)	Vine length (m)	No. of branches /plant	No. of fruits/ plant	Fruit weight (g.)	Fruit length (cm)	Fruit diameter (cm)	Fruit cavity (cm)	Flesh thickness (cm)
AHK 5-1	33.4	40.2	76.4	2.54	8.23	30.4	38.5	4.02	3.94	3.01	0.41
AHK 13-1	34.1	41.5	80.2	2.51	9.24	28.4	60.2	4.41	4.02	2.91	0.41
AHK 26-1	34.2	41.4	79.3	2.41	6.23	18.5	98.5	8.21	5.43	3.94	0.98
AHK 28-1	39.2	45.4	88.8	1.7	5.72	14.4	30.4	3.54	2.87	2.41	0.24
AHK 40-1	36.4	43.7	82.7	1.62	5.24	20.5	60.1	6.02	4.51	3.05	0.54
AHK 43-1	37.4	42.5	85.3	2.0	5.74	36.8	64.1	5.94	3.64	2.61	0.44
AHK 99-1	34.5	43.8	80.2	1.98	6.43	18.2	102.0	6.81	5.29	3.84	1.12
AHK 109-1	34.5	42.7	78.4	1.93	7.20	14.6	105.4	9.23	4.85	2.51	0.92
AHK 119-2	30.5	39.4	72.5	1.87	5.46	11.7	72.5	6.84	4.64	3.01	0.49
AHK 130-1	30.4	36.2	72.1	2.14	6.78	24.3	60.4	5.84	4.34	3.20	0.53
AHK 152-1	33.4	39.7	84.5	1.93	5.21	4.8	75.1	6.14	4.14	2.93	0.41
AHK 155-1	31.8	37.4	82.5	1.95	6.02	4.5	54.4	5.31	3.24	2.53	0.64
AHK 200-1	32.7	41.8	76.9	1.84	5.64	15.9	85.4	6.54	4.62	2.51	1.02
AHK 202-1	31.5	35.0	70.1	2.0	7.42	21.1	100.5	8.14	5.02	3.02	1.05
AHK 356-1	36.3	42.5	81.4	2.1	10.54	25.5	33.5	5.24	3.43	2.62	0.48
	30.5	35.4	80.4	1.94	9.22	26.4	51.4	4.34	3.91	2.90	0.49

AHS 10-1b (245.4 q/ha). In these lines, the number of fruits per plant ranged between 5.6 to 6.1 with average fruit weight around 900 g. The quantitative fruit characters varied depending upon size, shape and weight of fruits (Table 11). Therefore, the characters like individual fruit weight, flesh thickness, colour, taste and TSS were taken for rating of these lines. The lines AHS 82-1b and AHS 10-1b have been identified to be potential on the basis of yield and fruit quality parameters. These lines also possessed the important characters like drought hardiness, freedom from fruitfly infestation and resistance to powdery mildew under field conditions.

A.2.4. Evaluation and improvement in *Cucumis* species

Evaluation of selected lines of *Cucumis* species (summer 1997)

Five selected and variable lines of *Cucumis* species were evaluated in summer season under hot arid situation. These lines were selected from a large population of heterogenous material of *Cucumis* species, which was grown for evaluation during monsoon 1996, for use of fruit at immature stage. Tender immature fruits of these lines can be utilised as salad or for preparation of vegetable. These lines were categorised on the basis of fruit characteristics, i.e. long fruited and small fruited types.

The line AHC 2-1 and AHC 2-2 were grouped as long fruited type. Plants are monoecious and the immature fruits can be used for making salad, picking 6-10 days after anthesis of female flower. Variations were recorded within the line for fruit colour, length, diameter, weight, flesh content crispiness, seed cavity and softness at immature stage of fruit. In these two lines, anthesis of first female flower (DAS) ranged from 43.7 to 44.5 at 6.4 to 6.6 number node where first harvesting started from 53.8 to 54.4 days after sowing. The maximum number of fruit set and harvested fruits per plant were in AHC 2-1, i.e. 29.7 and 14.2, respectively. At immature stage, the fruit weight, length and diameter ranged from 285.8-294.4 g, 32.45-33.74 cm and 3.47-3.64 cm respectively while the flesh thickness ranged from 1.37-1.54 cm and seed cavity from 1.59 to 1.69 cm. Potential plants were selfed for further evaluation and improvement.

Table 9. Evaluation of promising lines of *kachari* (monsoon 1997)

Line	Days to first female flower (DAS)	Days to first harvest (DAS)	Vine length (m)	No. of branches /plant	No. of fruits/ plant	Fruit yield (q/ha)	Fruit weight (g.)	Fruit length (cm)	Fruit diameter (cm)	Fruit cavity (cm)	Flesh thickness (cm)	Probable utility
AHK 5-1a	41.5	76.8	2.04	7.96	25.4	51.67	34.64	4.09	3.08	2.88	0.42	PV
AHK 13-1b	44.5	75.4	2.47	8.41	22.4	63.58	48.54	5.02	4.34	3.02	0.37	P
AHK 26-1a	41.6	68.4	2.51	5.74	18.5	110.41	110.51	7.96	5.44	3.84	0.67	SV
AHK 26-1b	43.5	66.8	2.13	5.84	14.6	98.14	112.81	8.05	5.41	3.29	0.96	SV
AHK 43-1a	43.4	74.5	2.13	5.61	20.8	68.93	56.84	6.12	4.05	3.17	0.44	P
AHK 99-1b	42.5	64.8	2.12	6.05	14.8	97.54	110.81	7.52	6.15	3.54	1.12	S
AHK 109-1a	40.4	63.8	2.47	6.44	15.5	96.12	105.81	9.01	5.05	2.54	0.97	SV
AHK 119-2a	39.4	67.5	2.23	6.14	21.8	79.61	59.8	5.53	4.33	3.14	0.49	PV
AHK 119-2b	38.6	68.4	2.49	6.67	24.5	97.64	61.4	5.84	4.54	3.22	0.52	PV
AHK 155-1a	41.7	65.6	2.14	6.59	15.6	69.71	74.2	6.81	4.72	3.14	0.54	SV
AHK 155-1b	43.5	66.4	2.21	5.91	18.2	79.47	88.5	7.14	4.78	2.91	1.02	S
AHK 200-1a	36.5	64.8	2.42	6.24	20.4	108.46	99.5	7.14	5.34	3.09	0.94	S
AHK 200-1b	36.4	62.1	2.44	6.71	20.9	120.51	105.4	8.02	5.23	3.19	0.97	S
AHK 200-1c	35.6	63.5	2.51	7.44	20.4	109.67	108.4	7.54	4.93	3.25	0.96	S
AHK 202-1a	40.5	76.4	2.24	6.92	25.1	64.52	42.8	5.23	3.41	2.62	0.41	PV
AHK 356-1a	41.2	75.4	2.32	5.91	20.2	54.31	45.8	5.10	4.34	2.93	0.45	PV

P: Processing. V: Vegetable S: Salad

The line AHC 13-1, AHC 13-2 and AHC 13-3 were categorised as small fruited. Plants are andromonoecious in sex form and fruits can be used for salad at very immature stage, i.e. after 3-6 days of anthesis of hermaphrodite flower. Fruits of these lines were round, oblong to long in shape having dark green, green to light green stripes on the skin. Days to anthesis of first bisexual flower was recorded between 35.6 to 38.9 days after sowing at 6.1 to 6.3 number nodes on primary branches. The line AHC 13-1 recorded the maximum number of fruit set (35.4) and harvested fruits (20.4) per plant where first picking was started only after 50 days of sowing. The fruit weight, length and diameter ranged from 75.7-140.5 g, 7.51-11.34 cm and 4.05-4.17 cm, respectively. In these lines, flesh thickness ranged from 1.02-1.14 cm with soft seeded fruit cavity (1.94-2.12 cm) at immature stage (Table 12). Selected potential plants were selfed for further evaluation and improvement.

Evaluation of long fruited lines of *Cucumis* species (monsoon 1997)

Fourteen lines of long fruited *Cucumis* species were evaluated in randomized block design with three replications in rainy season of 1997. Characters related to growth, flowering, fruit maturity, yield and quality were recorded for the evaluation of these lines. However, major emphasis was given on fruit characters like shape, size, flesh thickness, crispiness and softness of seed at immature stage. The characters like drought resistance, fruitfly infestation and incidence of powdery mildew were also taken into consideration for screening of these lines. Anthesis of first female flower was recorded from 34.4 to 42.5 days after sowing. Fruits of these lines can be harvested for use 8-12 days after fertilisation of female flower, so that the first harvesting was recorded between 50.2 to 56.8 days after sowing. The maximum number of fruits per plant (15.5) were in line AHC 2-1-5 and minimum (6.5) in AHC 2-1-6. Individual fruit weight (285.8 g) and length (28.4 cm) were the highest in line AHC 2-1-5. The maximum fruit yield (241.9 q/ha) was also recorded in AHC 2-1-5 followed by AHC 2-2-1 (210 q/ha) and AHC 2-1-8(181.1 q/ha) (Table 13). These high yielding lines were found to be potential not only on the basis of yield but also earliness, number of fruits per plant and other fruit characters such as crispiness and taste at immature stage. Selected potential plants of these lines were selfed for further evaluation and improvement

Table 10. Evaluation of advance lines of snapmelon (summer 1997)

Lines	Days to first female flower (DAS)	No. of fruit set/ plant	Days to first harvest (DAS)	No of fruits/ plant	Vine length (m)	No. of branch /plants	Fruit weight (kg)	Fruit length (cm)	Fruit girth (cm)	Fruit cavity (cm)	Flesh thickness (cm)	TSS (°Brix)	Flesh colour	Fruit shape	Rating
AHS 6-1	43.5	8.5	84.2	6.1	2.15	6.24	0.515	15.0	25.8	6.41	1.43	4.9	LO	OB-RD	A
AHS 8-1	44.5	4.2	85.1	2.1	1.18	3.57	0.910	19.5	27.4	5.02	1.82	3.0	LO	OB	C
AHS 10-1	40.5	11.4	77.8	6.2	2.10	6.12	0.980	19.5	35.4	6.54	2.44	4.9	WO	OB	A
AHS 14-1	44.2	9.9	85.4	5.1	2.50	5.24	1.150	25.4	36.2	5.22	1.95	4.2	WO	OB	B
AHS 19-1	40.5	9.6	79.4	3.8	1.54	4.82	1.280	26.4	37.4	6.74	1.99	4.2	LO	OB	A
AHS 19-2	47.2	8.1	85.3	5.0	1.90	4.52	1.310	19.4	33.2	6.21	2.01	3.4	LO	OB	C
IHS 44-1	42.6	6.4	87.4	4.0	1.85	4.30	0.750	16.2	30.4	4.57	1.64	3.0	WO	OB	C
AHS 46-1	42.1	8.0	84.2	5.2	2.10	5.42	0.680	26.4	29.4	5.54	1.62	4.4	WO	OB	B
AHS 50-1	39.4	9.5	82.1	5.9	1.87	5.31	1.600	28.5	38.3	6.52	2.01	4.0	LO	OB	A
AHS 53-1	47.2	6.4	80.4	3.2	1.65	4.24	0.450	10.5	21.4	4.81	1.11	4.2	LO	OB	C
AHS 54-1	40.2	9.4	80.2	6.0	2.01	5.10	1.405	28.2	34.5	6.91	2.12	4.6	LO	OB	A
AHS 57-1	42.4	7.1	81.7	5.0	1.92	5.22	0.950	20.4	34.8	7.04	1.21	4.0	WO	OB	B
AHS 63-1	41.4	6.4	88.4	4.9	1.94	4.37	0.820	23.2	275	7.42	4.41	3.0	LO	OB	C
AHS 64-1	42.4	9.5	84.6	5.0	2.10	4.91	1.450	19.4	42.3	8.04	2.62	3.7	WO	OB-RD	B
AHS 64-2	42.5	4.9	87.2	3.1	2.12	5.01	1.525	22.4	34.5	6.51	2.21	4.0	WO	LONG	B
AHS 67-1	48.5	10.8	79.4	6.0	2.00	6.21	4.500	11.4	25.2	5.62	1.24	4.8	LO	OB-RD	B
AHS 70-1	41.4	6.4	90.7	2.1	1.87	4.05	0.875	21.4	26.2	5.31	1.41	3.2	WO	OB	C
AHS81-1	45.4	8.2	81.0	4.2	1.90	4.54	0.95	23.5	30.2	4.82	1.34	3.2	LO	LONG	C
AHS 82-1	44.6	8.9	78.3	6.3	2.10	5.47	0.850	24.4	30.6	5.41	1.81	4.8	LO	LONG	A

LO : Light orange: WO : Whitish orange: A.B & C : Good, medium and poor in taste;
OB : Oblong; RD : Round

Evaluation of lines of small fruited type *Cucumis* species (monsoon 1997)

Eight small fruited lines of *Cucumis* species were evaluated during rainy season for growth, maturity, fruit yield and quality characters at immature stage with three replications in randomised block design. The immature fruits of these lines after 3-6 days of anthesis of bisexual flowers can be used as salad. The days to anthesis of first bisexual flower and first harvest were at *par* in these lines and ranged from 34.5-38.4 and 43.2-46.1 days after sowing, respectively. The maximum number of fruits per plant were in AHC 13-1-1 (22.4) followed by AHC 13-1-8(19.6). The highest yield was recorded in AHC 13-1-8 (125.94 q/ha) closely followed by AHC 1-1 (121.84 q/ha) where individual fruit weight were 102.4 and 85.6 g, respectively. Both the lines are potential not only with regard to yield but also fruit quality characters (Table 14). The selectedpotential plants of these lines were selfed for further evaluation and improvement.

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Table 11. Evaluation of advance lines of snapmelon (monsoon 1997)

Lines	Days to first female flower (DAS)	Days to first harvest (DAS)	No. of fruits/ plant	Yield (q/ha)	Fruit weight (kg)	Fruit length (cm)	Fruit diameter (cm)	Fruit cavity (cm)	Flesh thickness (cm)	TSS (°Brix)	Flesh colour	Rating
AHS 6-1a	38.4	60.4	5.9	159.4	0.610	13.8	9.95	6.22	2.10	4.0	LO	A
AHS 6-1d	36.4	61.7	4.3	131.8	0.590	14.8	9.87	6.04	2.12	4.2	LO	A
AHS 10-1a	36.2	68.2	5.3	190.4	0.710	17.4	10.07	5.51	2.42	5.0	LO	A
AHS 10-1b	35.1	66.4	5.6	245.4	0.930	18.5	9.74	5.89	2.60	4.9	WO	A
AHS 10-1c	34.4	69.3	4.9	240.6	1.100	22.0	10.57	7.01	2.12	4.9	WO	A
AHS 14-1b	35.4	68.5	3.7	210.4	1.340	30.4	9.62	6.12	2.14	4.2	LO	B
AHS 14-1c	37.2	63.4	4.5	222.8	1.220	28.4	9.71	6.91	2.12	3.2	WO	C
AHS 19-1a	37.4	70.2	4.5	223.4	1.340	30.1	9.38	6.10	2.05	3.9	WO	B
AHS 19-1b	36.7	71.4	4.1	241.4	1.450	34.1	9.84	6.41	2.53	4.6	LO	A
AHS 50-1a	36.5	63.4	4.5	225.8	1.250	22.4	8.64	5.54	2.13	3.5	WO	B
AHS 50-1b	37.2	70.3	4.3	240.4	1.550	31.2	9.42	5.52	2.41	4.2	WO	A
AHS 50-1c	36.5	71.2	4.0	202.3	1.250	26.4	9.14	5.04	2.21	3.4	WO	C
AHS 54-1a	35.4	69.4	3.9	211.1	1.380	30.4	9.75	6.41	2.14	4.0	LP	B
AHS 54-1b	35.4	64.7	4.0	230.3	1.680	30.5	9.84	5.02	2.51	4.1	WO	A
AHS 64-1a	32.1	69.3	3.4	180.9	1.250	21.4	9.84	6.24	2.14	4.0	LO	B
AHS 67-1a	38.7	64.2	5.7	165.7	0.600	12.8	8.92	5.62	1.42	3.4	WO	B
AHS 82-1a	34.2	71.2	5.7	245.7	0.850	19.4	8.64	5.51	2.14	4.0	WO	B
AHS 82-1b	34.7	69.8	6.1	260.2	0.950	23.7	9.15	5.60	2.40	4.9	LO	A

LO: Light orange; WO: Whitish orange; A,B, &C: Good, Medium and Poor in taste

Table 12. Evaluation of selected lines of *cucumis* species (summer 1997)

Lines	Days to first male flower (DAS)	Days to first female flower (DAS)	Node to first female flower	Days to first harvest (DAS)	Vine length (m)	No. of branch /plants	No of fruit set /plant	No of harvested fruits/ plant	Fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Fruit cavity (cm)	Flesh thickness (cm)	Remarks
AHC 2-1	34.5	43.7	6.4	53.8	2.27	6.91	29.7	14.2	295.4	33.74	3.64	1.59	1.54	Monoecious, long fruited, green skin, crisp and whitish flesh, good for salad at 8-10 days after anthesis
AHC 2-2	36.5	44.5	6.6	54.4	2.54	7.31	28.9	13.4	285.8	32.45	3.47	1.69	1.37	Monoecious, skin green in colour, crisp, whitish flesh, good for salad at 10-12 days after anthesis
AHC 13-1	30.1	35.6	6.1	50.0	2.07	6.7	35.4	20.4	80.2	7.51	4.05	1.94	1.14	Andromonoecious, fruit oblong, DG-G striped, crisp flesh, good for salad at 3-6 days after anthesis
AHC 13-2	32.1	36.4	6.3	51.8	2.15	6.2	32.1	16.8	75.7	8.12	4.17	2.07	1.07	Andromonoecious, fruit oblong, DG-G striped, crisp flesh, good for salad at 3-6 days after anthesis
AHC 13-3	34.5	38.9	6.2	52.4	2.17	6.4	17.4	11.3	140.5	11.34	4.14	2.12	1.02	Andromonoecious, fruit long, DG-G striped, crisp flesh, good for salad at 3-6 days after anthesis

Table 13. Performance of lines of long fruited type *Cucumis* species (monsoon 1997)

Lines	Days to first female flower (DAS)	Days to first harvest (DAS)	No. of fruits/ plant	Fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Flesh thickness (cm)	Vine length (m)	No. of branches /plant	Fruit yield (kg/ plant	Fruit yield (q/ha)
AHC 2-1-1	42.5	56.7	9.6	180.5	21.5	3.41	0.84	2.14	5.34	1.654	100.5
AHC 2-1-2	41.4	51.5	10.2	210.5	15.6	4.12	0.91	2.05	6.14	2.102	131.3
AHC 2-1-3	36.7	50.2	10.2	280.5	26.5	3.21	0.85	2.17	6.78	2.804	174.6
AHC 2-1-4	40.2	51.4	6.5	250.1	24.4	3.14	0.86	1.94	7.12	1.504	93.6
AHC 2-1-5	36.4	50.6	15.5	285.5	28.4	3.54	1.04	2.34	7.34	3.874	241.9
AHC 2-1-6	37.5	54.8	6.5	210.5	21.8	3.64	0.91	2.25	6.18	1.365	85.9
AHC 2-1-7	37.6	52.3	10.2	205.1	22.4	3.61	1.02	2.05	5.05	2.052	128.2
AHC 2-1-8	36.2	50.2	12.5	245.2	24.5	3.86	1.05	1.93	6.12	2.914	181.1
AHC 2-1-9	38.2	53.4	10.4	255.8	23.5	4.05	1.12	1.85	6.78	2.550	159.2
AHC 2-1-10	37.6	56.8	9.5	230.4	24.8	3.86	0.84	2.01	6.10	2.182	136.4
AHC 2-1-11	38.5	54.5	11.6	250.2	24.5	3.9	1.01	1.95	7.41	2.751	171.4
AHC 2-2-1	34.4	52.5	12.4	280.4	24.8	3.64	1.02	2.10	6.72	3.361	210.2
AHC 2-2-2	35.6	52.5	10.2	210.5	20.5	3.85	0.94	1.85	5.90	2.104	131.5
AHC 2-2-3	37.4	50.4	12.0	240.5	21.2	3.47	0.92	2.42	6.42	2.800	175.2

Table 14. Performance of lines of small fruited type *Cucumis* species (monsoon 1997)

Lines	Days to first bisexual flower (DAS)	Days to first harvest (DAS)	No. of fruits/ plant	Fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Flesh thickness (cm)	Vine length (m)	No. of branches /plant	Fruit yield (kg/ plant	Fruit yield (q/ha)
AHC 13-1-1	35.4	43.4	22.4	85.6	8.14	4.14	1.17	2.15	6.71	1.82	121.84
AHC 13-1-2	36.1	43.5	19.2	74.2	7.84	4.39	1.21	2.29	6.74	1.30	87.45
AHC 13-1-3	34.5	44.4	16.6	87.3	8.13	4.05	1.15	1.94	6.82	1.34	89.37
AHC 13-1-5	37.2	45.5	16.8	92.4	7.94	4.15	1.02	2.13	6.35	1.44	95.35
AHC 13-1-8	36.2	43.2	19.6	102.4	9.13	4.09	1.21	1.87	6.47	1.87	125.94
AHC 13-1-9	36.2	44.2	15.1	97.3	7.84	3.94	1.08	1.92	5.31	1.29	80.82
AHC 13-2-1	38.4	46.1	13.3	80.4	8.12	4.12	1.03	1.75	5.43	1.07	66.42
AHC 13-2-2	36.2	43.3	11.2	72.5	7.53	4.53	1.04	1.72	5.62	0.74	55.18

GENETIC IMPROVEMENT

Mission B. Genetic improvement in arid horticultural crops

B.1. Improvement in pomegranate

Pomegranate cultivar having big size fruits with smooth, shining attractive coloured rind, soft blood red and bold aril; good juice content, high sweetness, low acid content, prolific cropping potentiality, freedom from diseases and blackening of aril would be ideal. Keeping these in view, hybridization work has been initiated. The crossed fruits were harvested and seeds have been sown in the nursery to raise F1 progenies.

VEGETATIVE PROPAGATION

Mission C. Rapid multiplication of propagules of fruit crops

C.1. Vegetative propagation of *Capparis decidua* and *Prosopis cineraria.*

An experiment was conducted in the nursery to evaluate seasonal variation in sprouting potential of cuttings of *Capparis decidua* and *Prosopis cineraria.*

The cuttings were given dip treatment in a solution containing 1000ppm IBA+1000 ppm thiamine for 3 min. and then planted in polythene tubes filled with sand and soil mixture. The planting was done at monthly interval and observations on per cent sprouting were recorded. In *Capparis decidua,* the ideal time for taking and planting cuttings is in the months of September-October when nearly 50 per cent cuttings sprouted and gave rise to plantlets.

Bioassay of growth inhibitor

Since earlier results revealed the presence of growth inhibitor in the cuttings of *Capparis decidua* and *Prosopis cineraria,* attempts were made to identify and quantify these substances in the cuttings by bioassay technique.

The results revealed that ABA-like substances are present in the cuttings of *Capparis decidua* to the level of 3.2 µg per g of tissue. The endogenous growth inhibitors may thus play an important role in rooting and sprouting of *Capparis* cuttings.

WATER MANAGEMENT

Mission E. Water management in arid horticultural crops

E.1. Effect of moisture conservation techniques and nutrients on the establishment of fruit plants in arid region

An experiment was conducted to study the effect of pit size (0,45 and 60 cm^3) and filling mixture i.e. (i) top soil + manure (ii) top soil + manure + pond silt (iii) top soil + manure + pond silt + fertilizers (100:50:50). Combinations were tried with four replications. The data given in Table 15 depict that maximum survival was recorded in 60 cm^3 pit size treatments followed by 45 cm^3 and the least by without pit plantation. In 60 cm^3 pit size the highest survival was recorded in T6 and T7 treatments while 45 cm^3 pit size, the maximum survival was recorded in T3 (top soil + pond silt + manure) followed in T4 (top soil + pond silt + manure + fertilizers).

Table 15. Effect of pit size and filling mixtures on the growth parameters of pomegranate

Treatments		Survival %	Plant height (cm)	Plant spread N-S x E-W(cm)
0.0cm	T_1	59.5	60.5	62x65
45.0cm				
TS+M	T_2	71.1	88.2	95x99
TS+M+PS	T_3	72.0	90.1	100x96
TS+M+PS+F	T_4	72.5	95.6	98x102
60.0cm				
TS+M	T_5	81.5	112.5	108x115
TS+M+PS	T_6	82.0	112.1	110x111
TS+M+PS+F	T_7	88.0	115.0	115x116

TS: Top Soil; M:Manure @ 10kg Pit^{-1} ; PS:Pond Silt; F: N_{100}:P_{50}:K_{50}

In the month of June soil moisture content was statistically at par in 60 and 45 cm^3 treatments and the lowest moisture content was observed in no pit treatment. In the month of october, the trend was the same as in June but the quantum was higher. The relative water content of leaves was at par in the 45 cm^3 and 60 cm^3 pit size when all nutrient applications were made and the lowest in no pit treatment in plants planted without pits (Table 16).

Table 16. Effect of pit size and filling mixture on the soil moisture and plant water status

Treatments		Months			
		June		October	
		Soil moist. (%)	RWC (%)	Soil moist. (%)	RWC (%)
0.0cm	T_1	8.9	74.3	10.5	82.5
45.0cm					
TS+M	T_2	12.6	84.3	14.5	89.5
TS+M+PS	T_3	13.2	84.3	13.9	87.6
TS+M+PS+F	T_4	12.6	89.2	13.5	86.5
60.0cm					
TS+M	T_5	12.5	92.5	15.0	88.5
TS+M+PS	T_6	13.4	92.1	14.3	89.5
TS+M+PS+F	T_7	12.6	89.5	14.5	90.5

TS: Top Soil; M:Manure @ 10kg Pit^{-1} ; PS:Pond Silt; F: N_{100}:P_{50}:K_{50}

The data in Table-17 revealed that nitrogen content was maximum in 60 cm^3 pit size followed by 45 cm^3

pit size. By using filling mixture with manure alone or manure + fertigation alongwith top soil and pond silt, the nitrogen content was at par which indicate that fertilization had no additive effect. The phosphorus content in leaf was almost the same in all treatments. The potassium content was the highest in 60 and 45 cm^3 pit size treatments. Zinc and iron contents were the highest in 60 cm^3 pit size followed by 45 cm^3 treatment while copper was almost the same in all treatments.

Effect of mulching on soil moisture conservation and establishment of pomegranate

The experiment was initiated during monsoon season on Jalore Seedless pomegranate which were planted at 6x4 m distance in 60 x 60 x 60 cm pits. Mulches like black polythene (50 and 100 µ thickness, *bui* (local weed), castor leaves alongwith no mulch were tried in four replications. The preliminary observations indicate that the black polythene mulches conserved sufficient moisture for long time. The plant survival was also more in black polythene mulch treatment.

Table 17. Effect of pit size and filling mixture on leaf mineral composition

Treatments		N	P	k	Zn	Cu	Mn	Fe
		(%)			ppm			
0.0cm	T_1	1.89	0.13	1.34	22	3	42	320
45.0cm								
TS+M	T_2	2.10	0.14	1.84	35	4	56	412
TS+M+PS	T_3	2.12	0.14	1.90	38	4	60	400
TS+M+PS+F	T_4	2.14	0.16	1.90	33	4	62	400
60.0cm								
TS+M	T_5	2.18	0.16	1.90	40	4	59	415
TS+M+PS	T_6	2.19	0.18	1.90	38	4	62	425
TS+M+PS+F	T_7	2.18	0.18	1.90	38	4	65	428

TS: Top Soil; M:Manure @ 10kg Pit^{-1} ; PS:Pond Silt; F: $N_{100}:P_{50}:K_{50}$

PLANTING MODELS

Mission G. Development of planting models in horticultural crops for arid ecosystem

G.1. Intercropping in *aonla* with various legumes

Three legumes, viz. clusterbean *(Cymopsis tetragonaloba)*, cowpea *(Vigna unguiculata)* and moth bean *(Vigna aconitifolia)* were sown as intercrops in *aonla* orchard of cultivar NA 6 and NA 7 during *Kharif* 1997. Observations on soil and plant characters were recorded. Among the intercrops, clusterbean was found to be the best with respect to total biomass and nodule production in sandy soils of Bikaner. Plant growth was also improved by intercropping.

PLANT PROTECTION

Mission I. Integrated pest and disease management in arid zone horticultural crops.

I.1. Diseases in fruits and vegetables

Ber

Powdery mildew: Symptoms of the disease caused by *Microsphera alphitoides* f.sp. *ziziphi* appeared during first week of November in 40 per cent of the germplasm collection. The maximum incidence (49%) was recorded during first week of December and subsequently the intensity declined. Wild genotypes like *Z. mauritiana* var. *rotundifolia* and *Z. nummularia* were identified as alternate host for the survival of pathogen. Intensive colonization of powdery mildew fungus in the form of asexual conidia and active mycelium in most of the commercial varieties (Gola, Umran, Seb, Kaithali, Safeda, Chhuhara, Mundia) were observed. In all these genotypes first symptom appeared on immature fruits. Infection was maximum on lower surface of the leaves than on upper surface. Severely infected young fruits dropped but the pathogen could remain for several days (40-50) on the undersurface of leaves.

Mildew incidence depended on the climatic conditions between period from November to March during which the disease normally occurs in *ber* field. In general, the temperature (Max. 26°C, Min 9.7°C) and the RH (Max.79%, Min. 46%) were favourable for disease development. However, maximum incidence was recorded when temperature ranged between 8 and 10°C with 72 per cent RH in the susceptible genotypes. Powdery mildew colonization was proportionately increased with increase in RH rather than with variability in the temperature. But higher temperature (> 30°C) was not favourable for further proliferation of the fungal propagules (Fig. 1 & 2). The pathogen could switch over to wild relatives like *Z. mauritiana* var. *rotundifolia* and *Z.nummularia* when susceptible genotypes Gola, Kaithali, Chhuhara, Mundia, Safeda and Umran attained fruit maturity stage. The pathogen could form its resting structures such as dormant mycelium and cleistothecia in fallen leaves of wild cultivated genotypes during March-April. Preliminary studies by spore trap technique showed that conidia were carried by mild wind up to a distance of 250m from the point of conidial colonization. Deposition of active spores in the middle and upper portion of adjoining *ber* trees was common. Fungicide spray (Karathane, 0.01%) at fortnighly interval was found effective to suppress the disease up to less than 10 per cent level.

Fruit rot: The disease caused by *Alternaria* spp. was recorded during January-March in some genotypes like Gola, Banarasi Pewandi, Akhrota, Chonchal, Katha Phal, Golar, Pathani, Sua, ZG -3, Noki, Katha, Kakrola Gola, Umran and Seb alongwith powdery mildew infection (Fig.3). Severe infection in unripe fruits resulted in their shedding and heavy yield loss. Further studies on causal organism, mechanism of host pathogen interaction, effective management practices and seasonal influence on the occurrence of the disease in *ber* genotypes are in progress.

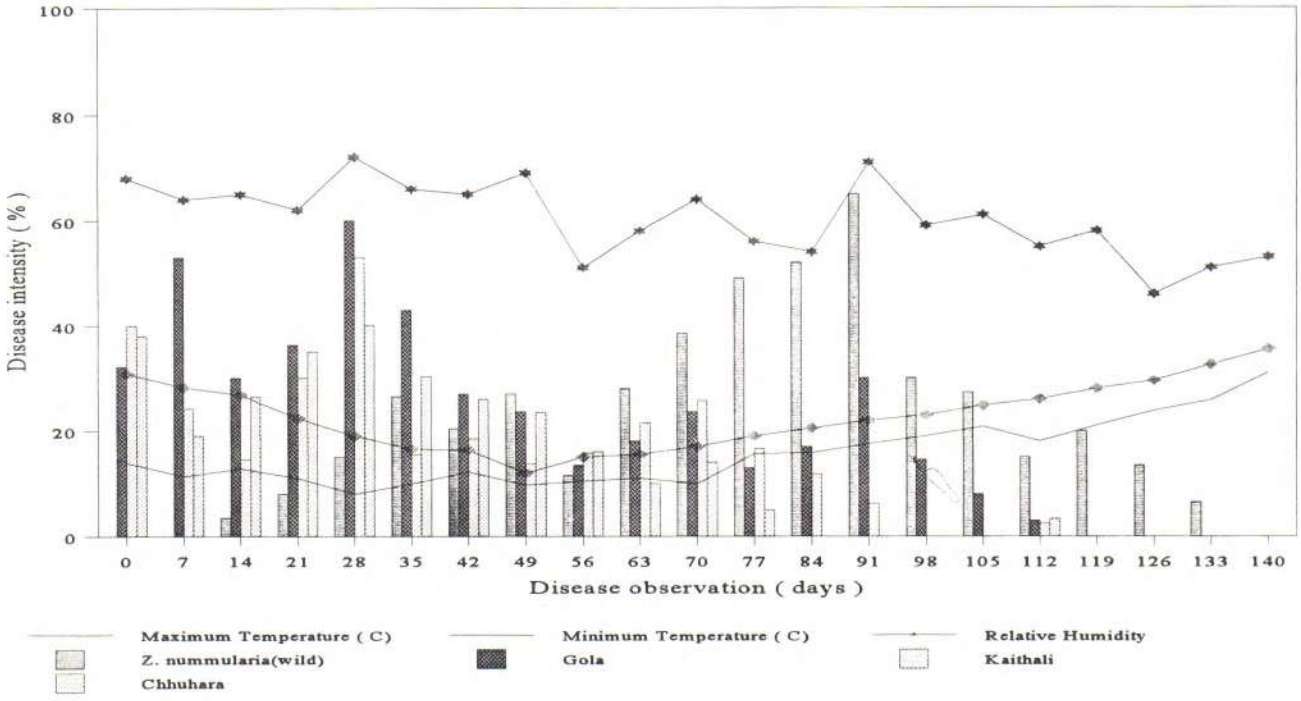
Minor diseases: Diseases like leaf spots, red rust and mycoplasma like organisms in addition to frost injury were recorded in wild as well as in few genotypes. Rust incidence was mainly confined to *Z. nummularia* and *Z. mauritiana* var. *rotundifolia.*

Pomegranate

Leaf spots: Spots are caused by

Page for Fig No. 1

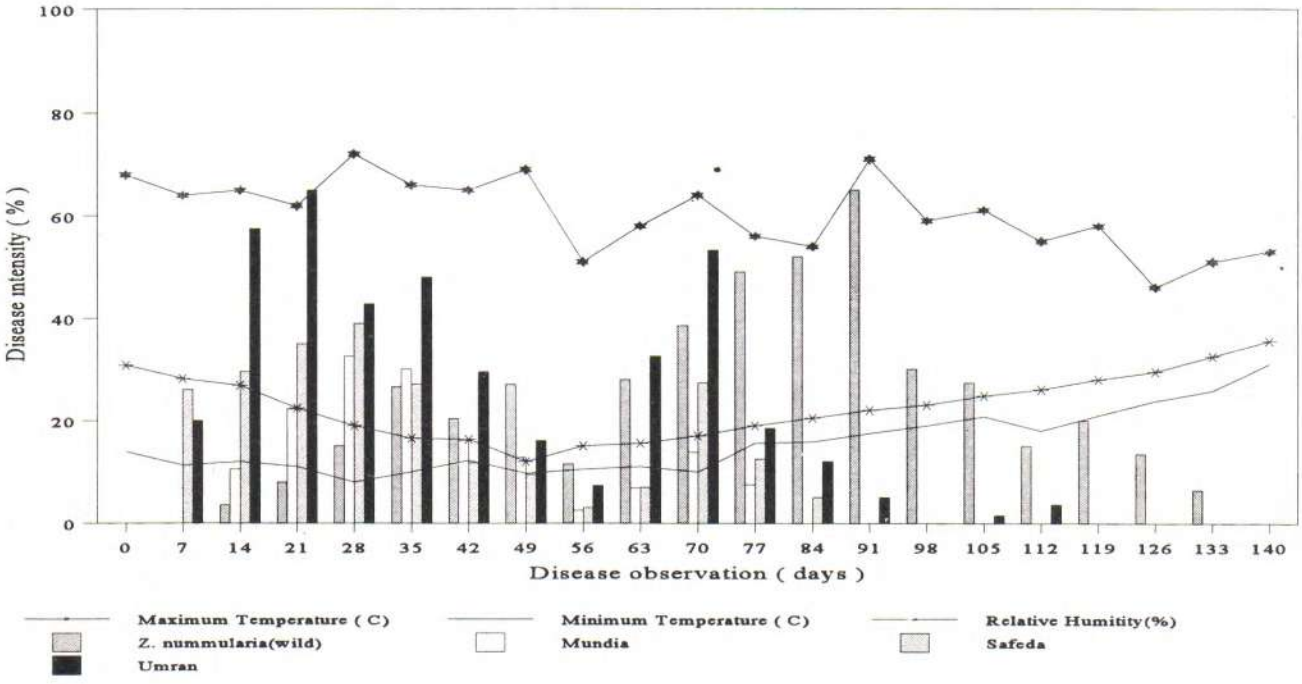
Fig. 1 Powdery mildew incidence in relation to environmental factors



Bars represent the percentage of disease incidence in different varieties of *ber*. Lines indicate the variability in environmental factors. Direct relationship between the higher relative humidity and maximum disease incidence is represented. The pathogen could survive in *Z. nummularia* at high temperature.

Page for Fig No. 2

Fig.2 Powdery mildew incidence in relation to environmental factors



Bars represent the percentage of disease incidence in different varieties of *ber*. Lines indicate the variability inenvironmental factors. Direc relationship between the higher relative humidity and maximum disease icidence is represnted . The pathogen could survive in *Z.nummularia* at high temperature

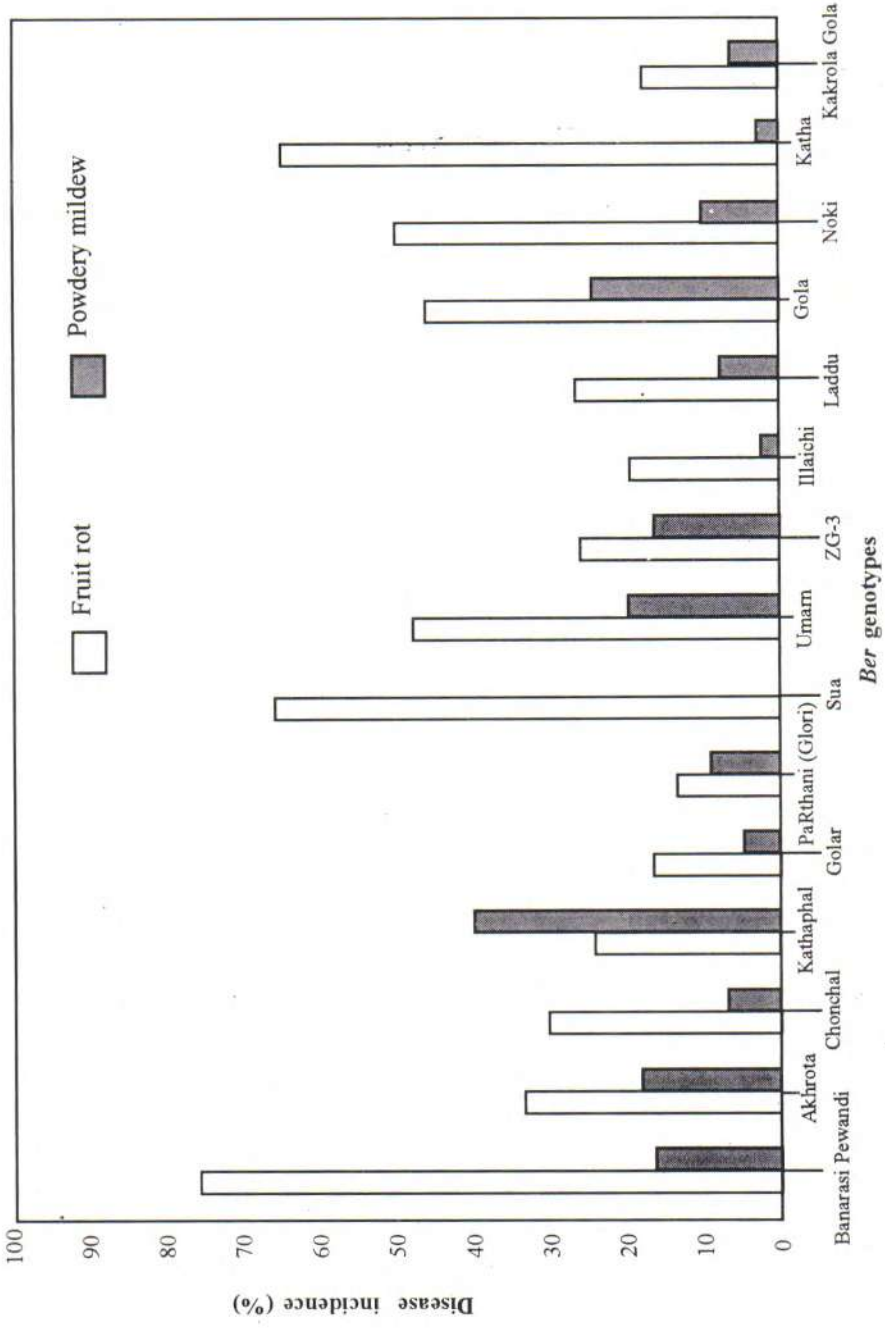


Fig. 3 Incidence of powdery mildew and fruit rot disease in *ber* genotypes

Pomegranate

Leaf spots: Spots are caused by *Xanthomonas campestris* pv. *punicae* and *Colletotrichum gloeosporioides* during November-January. Genotypes like Kazaki Anar, Jodhpur collection and Jalore Seedless were highly susceptible to bacterial leaf spot, (Table 18). In case of fungal leaf spot Bassein Seedless showed susceptible reaction than rest of the genotypes (Table 19). All other collections were moderately resistant to both the diseases.

Table 18. Bacterial leaf spot in pomegranate germplasm

Genotypes	Leaf spot (%)
Jalore Seedless	26.3
Ganesh	7.0
G-137	20.3
Kazaki Anar	56.6
Kabul (IIHR)	7.5
Mridula	2.5
Bassein Seedless	16.0
GKVK-1	21.7
Jodhpur Red	11.7
Dholka	4.0
Alah	12.3
Bendana Thin Skin	19.0
Jodhpur collection	75.0
Achik Dana	16.7

Table 19. Fungal leaf spot in pomegranate germplasm

Genotypes	Leaf spot (%)
Khog	7.5
Shirin Anar	15.0
G-137	14.0
Bassein Seedless	35.0
Alah	13.0
Kabul Yellow	8.5
Malta	12.3

Internal necrosis/ blackening of aril: Pomegranate fruits were collected from the market and studied for the pathogenicity for this serious post harvest menace. Preliminary investigation on internal necrosis/blackening of aril showed the presence of fungal mycelium. Microscopic sections stained with cotton blue-lactophenol showed intensive colonisation of coenocytic mycelium in inter-and intra-cellular compartments of arils. Studies on the causal organism, etiology and effective management of the diseases are being conducted.

Leaf blight: This disease caused by *Alternaria* spp is observed on premature and mature leaves. Symptoms on leaves start with small irregular spots which subsequently enlarge with concentric rings with dark brown margin. Severely in

fected leaves dry leaving the twigs. Presence of dormant mycelium and conidia in the debris was observed which may be responsible for further spread of the disease. In the nursery young seedlings of Jalore Seedless were serverely affected by this. Spraying of Diathane M-45 at weekly intervals minimised the incidence.

Date palm

Meristem rot: *Botryodiplodia* spp. is a major problem in newly planted suckers. Twelve of 47 collections were infected and some of them (Khadrawy, Bairyam, Dayri, Sabiah, Hayani, Zahidi, Migraf and Muskat) completely dried as a result of infection by this fungus. Offshoots which failed to root after transplanting were highly susceptible than the established ones. In some varieties (Zahidi and Muskat), meristematic rot caused by *Bacillus* spp. was also recorded. Soil drenching with copper fungicide (copper oxychloride, 0.1%) at fortnightly interval was effective in checking the infection and further spread of the disease.

***Graphiola* leaf spot:** Although it is a major disease, negligible level of incidence was noticed during the year in young leaves of date palm.

Cactus pear

Foot rot *(Phytophthora nicotianae)*: Twenty five per cent of the cactus pear collections were infected. Disease incidence was maximum during August-September. Successful control of the disease was achieved by drenching with 0.1 per cent metalaxyl (Ridomil) fungicide than carbendazim 0.1 per cent at fortnightly intervals. Swabing of cut ends before planting with metalaxyl was very effective.

Anthracnose *(Colletotrichum* spp.*)*: Disease symptoms were recorded in pads and fruits in some collections (23.5%). Most of the fodder and fruiting types were more susceptible than the vegetable types. Severely infected pads showed upward curling, and shrinking of pads and premature dropping of fruits.

Minor diseases: Diseases such as wilt caused by*Fusarium oxysporum* in A.No. 1248, 1326 and Biyanka, pad rot caused by *Alternaria* spp. and bacterial rot caused bu *Erwinia caratovara* in A.No. 1237 were recorded in cactus pear collection.

Aonla

Drying of stems after pruning was

noticed. Association of higher fungal pathogen in stem having rot/ blackening has been observed. Pasting the cut ends with copper fungicides (0.1%) could reduce further spread of the disease. Studies to find causal organism and effective control measures are in progress. Most of the plants were highly susceptible to frost injury during December-January.

Cucurbitaceous vegetables

Table 20. Major diseases of cucurbitaceous crops

A.	**Fungal**
	Downy mildew *(Pseudopernospora cubenis)*
	Powdery mildew *(Sphaerotheca fuliginea)*
	Fruit rot *(Rhizopus sp., Mucor sp.)*
B.	**Bacterial**
	Bacterial wilt *(Erwinia aracheiphila)*
	Leaf spot *(Xanthomonas campestris)*
C.	**Viral disease**
	Cucumber mosaic virus (CMV)
	Watermelon mosaic virus (WMMV)
D.	**Minor disease**
	Alternaria leaf spot *(Alternaria cucumerina)*
	Foot rot *(Fusarium solani)*
	Wilt *(Fusarium oxysporum)*
	Anthracnose *(Colletotrichum lagenarium)*
	MLO disease
	Yellow Mosaic Virus

In watermelon (mateera), Watermelon Mosaic Virus, fungal leaf spot and bacterial wilt were noticed.Powery mildew and Cucumber Mosaic Virus were common in most of the cucumber lines. In severely infected vines, flower and fruit formation were minimised. Sterility of the whole plant was common on infection at early stage.

In *kachari*, downy mildew, powdery mildew and mosaic virus disease were observed in 40-50 per cent of leaves in most of the lines. Incidence of powdery mildew and downy mildew in some of the *kachari* lines like K-109a, K-109b, K-115a, K-115b, K-200a2, K-200b1, K-200b2, K-200c1 completely destroyed the crop canopy and fruits. Higher humidity forming moisture film after rain occurrence favoured disease development.

In these crops a severe outbreak of fruit rot was recorded immediately after rain. Thirty per cent of fruits were completely rotten by the infection of *Rhizophus stolanifer* and Mucor spp. Seeds were colonized with the fungal mycelium and zygospores.

PLANT PRODUCTION

Mission K : Production of planting material

Plantation of progeny block: Two hectare area has been developed as "Progeny Block" to obtain budwood for commercial plant production. Commercially important fruit species and their cultivars (Table 21) have been planted in this block. Provision of mist unit in nursery structures have been made.

Table 21. Status of Progeny Block at NRCAH

Crop	Cultivars	
	Provision	Already planted
Ber	8	4
Anola	10	6
Guava	8	5
Pomegranate	9	4
Bael	9	8
Sweet orange	6	3
Grapefruit	2	1
Lime	8	2
Lemon	4	3
Mandarin	6	1
Mango	8	4
Khirni	2	2
Sapota	2	1
Grape	10	3
Miscellaneous	50	20

FARM AND CAMPUS DEVELOPMENT

To date, more than 40 ha farm area has been developed. Germplasm repositories and experimental plots of *ber* (8 ha), pomegranate (4 ha), *aonla* (2 ha), and date palm (3 ha) besides blocks of vegetables (3 ha) and nursery and progeny block (4 ha) have been developed. The remaining area is under seed production. 800 plant of *ber*, 700 of *aonla*, 350 of pomegranate, 300 of *bael* and 180 plants of other fruit crops were raised in respective blocks. More than 1000 plants of neem and other species are being maintained in the shelterbelt/ windbreak plantation along the fence of the farm. Approximately, 4000 running meter single row castor hedge was developed to provide a microwindbreak to protect the experimental area.

About rupees one lakh was generated as farm revenue through sale of seed and other farm produce. Massive land levelling and development work is in progress to develop the experimental plots in accordance the master plan of the farm.

Establishment of *in situ ber* orchard

Two hectare rootstocks of *boradi* planted during September-October, 1995 were converted into orchard of four cultivars (Gola, Mundia, Kaithali and Umran) of *ber* during July-October, 1997. Patch budding was done on the *in situ* raised rootstocks. It was observed that Gola gave better success during July and Mundia and Kaithali during August, whereas, better success in cultivar Umran was obtained during September (Fig 4-6). In another experiment conducted on cultivar Gola with patch and I methods of budding, patch budding proved better than I budding (Fig7).

Fig. 4 Sprouting in ber cultivars budded on 15th July

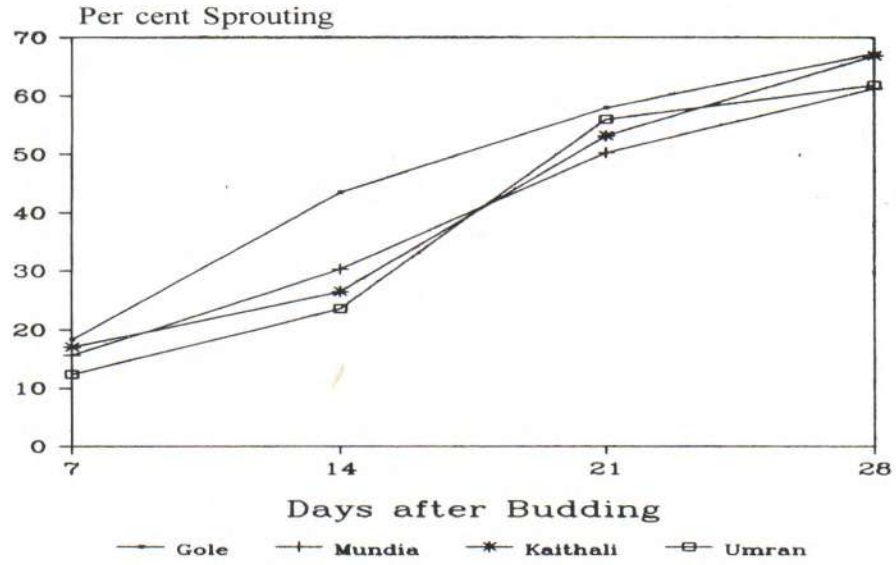


Fig. 5 Sprouting in ber cultivar budded on 16th August

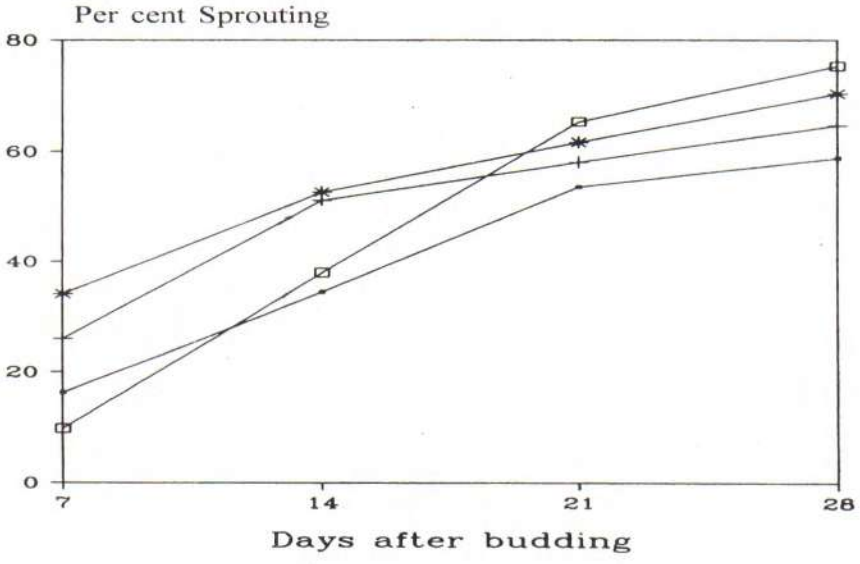


Fig. 6 Sprouting in ber cultivars budded on 16th September

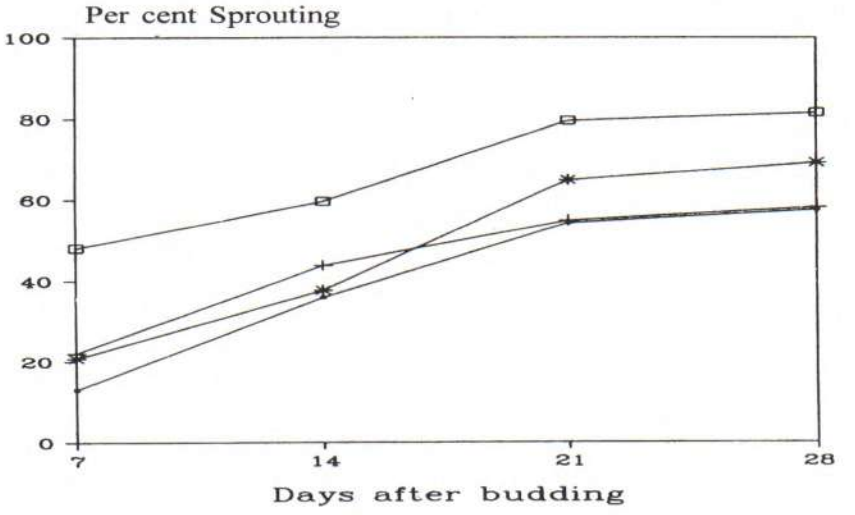
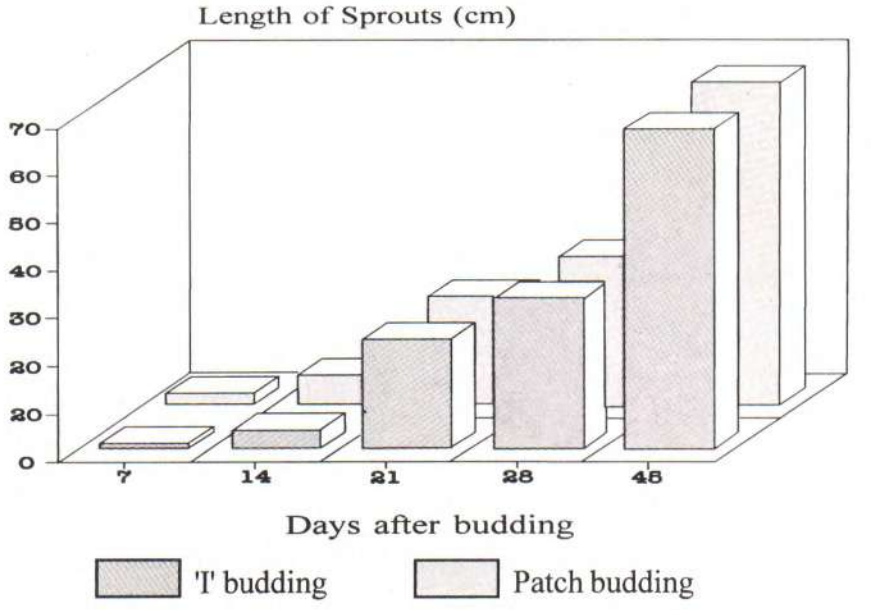


Fig. 7 Effect of budding methods on sprout length in ber



INFORMATION AND DOCUMENTATION

During 1997-98, a total 100 books were procured while 5 international and 16 Indian journals and periodicals were subscribed. The library also subscribed "CAPS CONTENTS" of 30 international and national journals from INSDOC, New Delhi. At present, the library has a collection of 425 books and subscribes 5 international and 21 national journals.

HUMAN RESOURCE DEVELOPMENT

Samadia, D.K. attended training on "The techniques in the exploration and collection of agribio -diversity" under INDOUSAID, PGR Programmes, NBPGR, New Delhi, 20-29 September, 1997.

Sh. Sua Lal and Gulla Ram, SSG-I (mali) obtained training in *aonla* budding at SKN College of Agriculture, Jobner during 16-18 August, 1997.

PUBLICATIONS

Research Paper

Bhargava, R. Changes in abscisic and gibberellic acid content during the release of potato seed dormancy. Biol. Plant. 39 :41-45, 1997.

Ezekiel, R. and Bhargava, R. Influence of presprouting period the content of endogenous growth regulators in seed potato. Indian J. Plant.Physiol. 3: 5-10,1998.

Pareek, O.P. and Vishal Nath, (1997). Propagation of *ber* and *aonla*. Agri-horticultural Society Newsletter, Rome.

Pareek, O.P. and Samadia, D.K. (1998). Breeding for sustainable fruit production in arid zone: Present status and future strategies. In: International Conference on Food Security and Crop Sciences held at Hisar, November 3-6, 1998

Pareek, O.P; Vashishtha, B.B. and Samadia, D.K. (1998). Improvement of arid zone fruits in India. Progress and Strategies. In: Tree Science Conference, 98, April 10-13, 1998, New Delhi,pp-106.

Pareek, O.P. and Vishal Nath (1998). Variability in Horticultural traits of *khejri* in *Thar* desert. Forest Genetic Resources Newsletter, Rome.

Pareek, O.P. (1998). Arid Fruit Research. In:Fifty Years of Horticultural Research in India. ICAR, New Delhi. In Press.

Singh, R.S. (1997) Note on the effect of intercropping on growth and yield of *ber (Z.mauritiana* Lamk.) in semi arid region. *Current Argic.*, 21 (1-2):117-118.

Vishal Nath (1996). Processing technology of aonla for beverage industry. New Agriculturist 7(2) : 143-146.

Extension/Popular articles

पारीक ओ.पी., सिंह आर.एस. एंव विशाल नाथ 1997. शुष्क क्षेत्र मे अनार उत्पादन। राष्ट्रीय शुष्क क्षेत्रीय उद्यानिकी अनुसंधान केन्द्र, बीकानेर । प्रसार प्रकाशन-2: 1-7.

Sharma B.D. and Yadava, N.D. (1997). Plant nutrient management in watershed areas. In: Training manual on Water Shed Development Training course. Central Arid Zone Research Institute, Bikaner p:52-54.

Sharma B.D. (1997) Sand dunes stabilization techniques in Watershed areas. In: Training manual on watershed development. Central Arid Zone Research Institute, Bikaner p. 87-90.

Books

Pareek O.P., Sharma B.D. and Sharma Suneel (1997). Waste land Horticulture. Malhotra Publishing House, New Delhi.

Reports

Annual Report 1996-97, NRCAH, Bikaner

Annual Report 1996-97, AICRP on Arid Zone Fruits

Vision 2020 Perspective Plan of NRCAH.

Extension/Lecture

Dr. O.P. Pareek, Director provided training on Research Project Management to the newly recruited Assistant Professor of RAU (Three batches).

Samadia, D.K. delivered lecture on "Vegetable Production in Watershed areas of arid region: In training programme on watershed development for WDT member, sponsored by DRDA and organised by CAZRI, Bikaner on 18.6.97.

Dr. Vishal Nath delivered following lectures

i) तोड़ाई उपरान्त फल सम्भलाव एवं परिरक्षण. जल ग्रहण क्षेत्र विकास प्रशिक्षण कार्यक्रम, केन्द्रीय रूक्ष अनुसंधान संस्थान, बीकानेर, दिनांक - 18.6.1997.

ii) फलों का मानव आहार मे महत्व एवं उपयोगिता, उद्यान सखा प्रशिक्षण कार्यक्रम, कृषि विज्ञान केन्द्र, बीछवाल, बीकानेर.

iii) फल उद्यान लगाने हेतु स्थान, स्थिति एवं मृदा का चयन, उद्यान सखा प्रशिक्षण कार्यक्रम, कृषि विज्ञान केन्द्र, बीछवाल, बीकानेर.

iv) फल वृक्ष लगाने हेतु रेखांकन, उद्यान सखा प्रशिक्षण कार्यक्रम, कृषि विज्ञान केन्द्र, बीछवाल, बीकानेर.

v) *बीज द्वारा फलदार पौधों की नर्सरी तैयार करना, उद्यान सखा प्रशिक्षण कार्यक्रम, कृषि विज्ञान केन्द्र, बीछवाल, बीकानेर.*

vi) *वनस्पतिक विधि से फलदार पौधे तैयार करने की प्रारम्भिक जानकारी, उद्यान सखा प्रशिक्षण कार्यक्रम, कृषि विज्ञान केन्द्र, बीछवाल, बीकानेर.*

vii) *ग्राफ्टिंग की विभिन्न विधियों की जानकारी, उद्यान सखा प्रशिक्षण कार्यक्रम, कृषि विज्ञान केन्द्र, बीछवाल, बीकानेर.*

viii) *साफ्ट वुड ग्राफ्टिंग की जानकारी, उद्यान सखा प्रशिक्षण कार्यक्रम, कृषि विज्ञान केन्द्र, बीछवाल, बीकानेर.*

Sh. R.S. Singh delivered following lectures:

i) Cactus pear cultivation in arid region. In WDT of DRDA, organised by CAZRI, Regional Research Station, Bikaner on 18.6.97.

ii) *Ber* and Pomegranate fruits cultivation in arid region. In training programme of state official of Soil and Water Conservation deptt., Govt. of Rajasthan held at CAD Hall, Bikaner on 28.6.97.

iii) Propagation of plants through cuttings and budding in Udyan Sakha Programme at K.V.K., Beechwal,. Bikaner on 27.9.97.

Dr. R. Bhargava provided training on Research Project Management to the newly recruited Assistant Professor of RAU (Three batches) and discussed with them the following topics-Project formulation, Project budgeting, Project monitoring, Project appraisal, Documentation and Report writing.

Extension activities

Participated in exhibition on "Environment and Nature conservation" organised by 38 Med. Regt. C/o 56 A.P.O. held at Military Station, Bikaner on 29.11.97.

Radio Talk

बी. डी. शर्मा (1997) *शुष्क उद्यनिकी विकास केन्द्र के मरु विकास हेतु प्रयास, आकाशवाणी बीकानेर, दिनांक* 4.9.97.

विशाल नाथ (1997) *मरु क्षेत्र के लिए उपयोगी वृक्ष प्रजातियां, आकाशवाणी बीकानेर, दिनांक* 10..97.

Meeting/Seminars/Symposium

Dr. O.P. Pareek attended following symposia/seminars:

(i) National Symposium on *Tamarindus indica* organised by Forest Department, Govt. of Andhra Pradesh during 27-28, June, 1997 at Biotechnology Research Centre, Tirupati.

ii) Global competitiveness in global market on horticultural commodities and researchable issues, 9-10, Dec., 1997, New Delhi.

Samadia, D.K. attended NATP "Interaction Worshop" on Plant Genetic Resources, NBPGR, New Delhi, 14-15 October, 1997.

विशाल नाथ एवं दिलीप कुमार समादिया ने यूनीसेफ द्वारा प्रायोजित, 'महिलाओं और शिशुओ का कुपोषणः बचाव एवं उन्मुलन' विषय पर आयोजित दो दिवसीय कार्यशाला (12-13 मई 1997) अजित फाउन्डेशन भवन, बीकानेर मे भाग लिया ।

Dr. Vishal Nath participated in training-cum-consultation workshop on collection, conservation and registration of germplasms at NBPGR, New Delhi during 10-12 September, 1997.

Dr. O.P. Pareek attended following meetings:

i) Director's Meeting of ICAR Institutes/NRCs with Secretary, DARE and DG, ICAR at New Delhi on 5-6 May, 1997.

ii) Divisional Meeting of Horticultural Institutes being chaired by Dy. Director General (Hort.) at New Delhi on May 6, 1997.

iii) Project Directors Meeting under the Chairmanship of Director General, ICAR at Krishi Bhavan, New Delhi, 27 August, 1997.

Sh. R.S.Singh attended Dist. Task Force & STED Project (Deptt. of Sci. & Tech., Govt. of Rajasthan) Advisory Committee meeting in collectorate, Bikaner on 28.7.97.

Award of Ph.D.degree

Samadia, D.K., Scientist (Horticulture) was awarded Ph.D. from Rajasthan Agricultural University, Bikaner.

FINANCES

Budget estimate and expenditure incurred during 1997-98 are given in Table-22

Table 22 : Budget estimate (BE), revised estimate (RE) and expenditure incurred during 1997- 98 (Rs in Lakhs)

Head	BE	RE	Expenditure
Pay and allowances	5.00	18.80	18.79
TA	1.50	1.50	1.50
Other charges including equipments	30.00	30.00	30.00
Works	73.50	73.50	73.50
Total	110.00	123.80	123.79

VISITORS

1. Dr. R.K. Rajput, Ex-Project Director, DWMR, Patna (Bihar)-801505
2. Dr. N.K. Mohta, Principal Scientist (Agronomy), IARI, New Delhi-110 012
3. Dr. V.K. Patil, Ex-V.C., Marathwada Agricultural University, Prabhani.
4. Dr. Phool Singh, Professor of Plant Physiology, CCS HAU, Hisar.
5. Dr. I.S. Singh, Head Department of Horticulture, ND, University of Agric.& Tech, Kumarganj, Faizabad
6. Dr. V.N. Pathak, Director, Academic Staff College & Distance Education, RAU, Bikaner.
7. Dr. B.S. Chundawat, Principal, Aspee College of Hort. & Forestry, GAU, Navsari.
8. Dr. B.D. Kalla, Ex-Minister, Govt of Rajasthan.

First Research Advisory Meeting of the Centre

Members of Research Advisory Committee at Farm

STAFF

In Position (As on 31.03.1998)

Scientific

Dr O.P. Pareek	Director
Dr. B.B. Vashishtha	Principal Scientist (Horticulture)
Dr. B.D. Sharma	Scientist (Sr. Scale) (Soil Science)
Dr. R. Bhargava	Scientist (Sr Scale) (Plant Physiology)
Sh. R.S. Singh	Scientist (Sr Scale) (Horticulture)
Dr. Vishal Nath	Scientist (Horticulture)
Dr. D.K. Samadia	Scientist (Horticulture)
Sh. P. Nallathambi	Scientist (Plant Pathology)
Smt. C. Umamaheswari	Scientist (Plant Pathology)

Administration

Sh. R.G. Acharya	Asst. Admn. Officer (0n deputation)
Sh. Ayaz Ahmed	Asst. Fin. & Acc. Officer
Sh. V.K. Pandey	Assistant
Sh. Shaji C.P.	Jr. Steno
Sh. Rajesh Daiya	Jr. Clerk
Sh. Kuldeep Pandey	Jr. Clerk
Sh. Rakesh Swami	Jr. Clerk

Technical

Sh. P.P. Pareek	Hindi Translator
Sh. M.K. Jain	Sr. Computer (T-II-3)
Sh. Udai Vir Singh	Field Tech. (T-II-3)
Sh. Sanjay Patil	Artist-cum-Photographer (T-II-3)
Sh. Dinesh Kumar	Lab. Tech (T-II-3)
Sh. B.R. Khatri	Computer (T-1)
Sh. Vinod Kumar	Field Tech. (T-1)
Sh. P.R. Singh	Field Tech. (T-1)
Sh. Satpal	Gypsy Driver (T-1)
Sh. Ashok Kumar Mali	Tractor Driver (T-1)

Supporting

Sh. Shiv Dayal	SSG-II
Sh. Ghan Shyam	Messenger
Sh. Rawat Singh	Mali
Sh. Sua Lal	Mali
Sh. Birdhi Chand	Mali
Sh. Gulla Ram	Mali
Sh. Shiv Lal	Mali
Sh. Mohan Lal	Mali
Sh. Manoj Kumar Vyas	Messenger

Transfers

Sh. P. Nallathambi, Scientist (P.Pathol.) joined NRCAH on 11th July, 1997 on transfer from Sugarcane Breeding Institute, Coimbatore.

Appointments

Dr. B.B. Vashishtha, Principal Scientist (Hort.)

Mrs. C.Umamaheswari, Scientist (P.Pathol.)

Sh. Dinesh Kumar, Lab. Tech. (T-II-3)

Sh. Rakesh Swami, Jr. Clerk

Sh. Manoj Kumar Vyas, Messenger

APPENDIX - I

Sanctioned staff strength as on 31.03.1998

Cadre	Strength	Filled	Vacant
Scientific	21	09	12
Administration	12	07	05
Technical	12	12	Nil
Supporting	09	09	Nil
Total	54	37	17

Acknowledgement

Thanks to all the staff of the NRCAH for successful conduct of different activities.

ALL INDIA CO-ORDINATED RESEARCH PROJECT ON ARID ZONE FRUITS

Surveys were conducted to identify and to collect the useful plant types which included elite date palms from Dhrub (Mundra, Gujarat), an early ripening *ber* from Ghazipur (Faizabad), two *ber* genotypes (Sardarkrushinagar), wood apple types (Rahuri and Aruppukottai), some tamarind types (Aruppukottai), *aonla* types from Pratapgarh (Faizabad) and six *bael* types from some district of Uttar Pradesh.

Ber cultivar Gola (at Anantpur) and Umran (at Rahuri), performed the best, whereas at Aruppukottai, Kaithali and Banarasi and at Jobner Umran and Gola gave the highest yield. Varietal trials on fig at Bangalore, indicated highest yields in Deanna on Brown Turkey rootstock. Cultivar Island Gem of custard apple showed highest vigour at Rahuri. In pomegrante, cultivar Ganesh gave the highest yield at Anantapur, while at Rahuri *Mrig bahar* crop of cultivar Bassien seedless was found to be the best. In date palm, *doka* stage was recorded during June 2nd to July 3rd in most of the varieties at Jodhpur. At Bikaner, cultivars Halawy, Khuneij, Barhee, Sewi and Khalas were considered good for fresh eating being free from astringency. Poona fig recorded the highest fruit yield at Anantapur.

In pomegranate, promising hybrid Ruby derived from multiple cross combinations, has been identified at Bangalore, cultivar Mridula (Ganesh x Gulsha Rose Pink) has been developed at Rahuri. Hybrid Arka Sahan of custard apple has been released from Bangalore with high yielding ability and long shelf life. At Faizabad, highest fruit set in *aonla* was recorded in open pollinated condition when more than one cultivar was planted in one orchard/block.

In-situ water harvesting in *ber* at Anantapur and Aruppukottai with 5% slope proved better while at Sardarkrushinagar plants without any slope performed better. The experiment on drip irrigation is in preliminary stage at the centres. However, at Rahuri irrigation on 20 and 40 per cent wetted area basis at alternate days seemed promising. At Anantapur, irrigation with 5 drippers on 50 per cent wetted area basis on alternate day resulted in maximum growth. At Sardar krushinagar, highest yield was recorded by irrigating on the basis of 20 per cent evaporation replenishment.

Mulching with black polythene at Faizabad in *aonla*, at Bawal in *ber* and at Bikaner in date palm proved promising. Organic mulches with *Aerva*

persica and *A. tomentosa (bui)* at Bikaner in date palm and paddy husk at Anantapur and Rahuri in pomegranate were also adjudged effective.

Nutritional studies conducted in *ber* revealed that application of 500 -750g nitrogen resulted in best growth and fruiting at Jobner. At Rahuri split doses of 250g N, 250g P and 50g K per tree (single dose) gave the high yield.

At Abohar application on 2000 g N + 500g K produced the highest fruit yield (96.6kg per palm) in Medjool date palm.

Rootstock experiments in progress at Faizabad and Jobner showed vigorous scion growth on *Z. rotundifolia* whereas *Ziziphus nummularia* had minimum scion growth. *In situ* raised rootstocks produced vigorous scion growth in *ber* than on rootstocks raised in polythene bags at Faizabad.

Softwood grafting during March in custard apple at Anantapur, chip budding in fig and patch budding in *aonla* at Rahuri during July-August gave the highest success. In date palm, offshoots planted with earthen ball gave better survival at farmer's field in Kachchh.

At Aruppukottai, Kaithali *ber* planted at 8x3m gave the highest yield of 85.6q/ha). At Sardarkrushinagar also, closer planting gave the highest fruit yield (80.8q/ha) in cultivar Umran but vigour was more in wider spacing. At Abohar, Blood Red and Valencia Late sweet oranges and lemon performed well as intercrops between date palm. At Mundra, sapota, pomegranate and citrus plants failed to survive due to high salinity and scarcity of water.

Techniques for preparation of *chhuhara*, jam and beverages from dates have been standardised at Mundra. Jam from local red type and *chutney* from Zahidi cultivar scored the maximum organoleptic scores.

On screening of *ber* varieties, it was observed that cultivar Mehrun, Chinese, Dandan, Bhavnagri, Vikas, Ajmeri, Banarasi were less susceptible to bark eating caterpillar at Sardarkrushinagar. At Bawal, cultivars Sanaur-3, Illaichi, BS-1, BS-2, Sanaur-7, Banarasi Kadaka, Kathaphal, Reshmi and Nauki were less susceptible to ber fruitfly. At Jobner, Kaithali was the least susceptible, while at Sardarkrushinagar, Chinese, Mehrun, Mirchia, Illaichi, Reshmi, Dandan, Surti Katha, Karaki, Ajmeri and Shamber cultivars were less susceptible to the pest.

In *ber* fruifly is a serious pest in

north-west India while in southern states, fruit borer is more serious. In Gujarat, both the pests were found to cause damage. Spittle bug was also found to cause damage in Rajasthan and Gujarat.

At Bawal and Anantapur 3 sprays at 15 days interval, with 0.03 per cent monocrotophos, second with 0.05 per cent fenthion and the third with 0.1 per cent carbaryl + XLR (III) proved most effective against fruitfly. At Jobner, two sprays with 0.03 per cent monocrotophos and one with 0.1 per cent carbaryl gave best control.

In custard apple, the incidence of mealy bug was more pronounced during October-November at Rahuri while that of scale insects on date palm was maximum during December-January at Bikaner. Galls formed by the mites on the old branches of *ber* were common in Weir (Bharatpur) while red palm weevil and rhinocerous beetles were common in date groves of Kachchh.

Studies on screening of ber cultivars against powdery mildew showed that Katha Phal, Kishmis, Narma, Sanaur 3 and BS 1 at Bawal, Sev and Illaichi at Jobner and Seo, Tsabtaso, Chinese, Sukhawani, Charkhi and Deshi Alwar at Sardarkrushinagar were resistant. At Bawal, Illaichi, Laddu, Chonchal, Poona, Kala Gola and Katha Rajasthan were observed to be resistant to *Cladosporium* leaf spot.

At Sardarkrushinagar, Russian Seedling was found to be resistant against leaf and fruit spot of pomegranate. *Aonla* cultivar NA 6, NA 8 and Francis were moderately susceptible to rust at Faizabad. At Anantapur, Pink's mammoth custard apple was found to be resistant against leaf spot disease.

Epidemiological studies showed that powdery mildew incidence increased from October reaching a peak by December at most of the centres. At Jobner, its incidence was associated with the maximum temperature of 28-32° C, minimum temperature of 6.9-11.8°C, morning RH 62-68 per cent and evening RH 21.24 per cent. At Rahuri, the ideal conditions for disease development were 30-38°C maximum temperature, 20°C minimum temperature, 84-85 per cent morning RH and 55-57 per cent evening RH with 5-7 sunshine hours per day. At Sardarkrushinagar, the conditions which favoured disease development were maximum and minimum temperature, morning and evening RH were respectively, 38.5°C and 21.4°C, 64 per cent and 29 per cent.

The leaf and fruit spot of

pomegranate was found to be maximum at Rahuri, when 29.9°C maximum temperature, 21.4°C minimum temperature, 87 per cent morning RH, 61 per cent evening RH and 3.8 sunshine hours per day prevailed.

The maximum occurrence by the r u s *aonla* at Chomu appeared during middle of August was associated with maximum temperature of 25.4-34.5°C, minimum temperature of 5.2-24.6°C, morning RH 78-83 per cent and evening RH 26-53 per cent. Fig rust started appearing by the end of September and reached a peak in January when maximum temperature was 31°C with morning RH 80 per cent and evening RH 43 per cent.

At Bawal (Haryana) *Graphiola* leaf spot of date palm appeared during September when the prevailing climatic conditions were 20-23°C maximum temperature with 78-91 per cent morning RH and 57-58 per cent evening RH.

Post harvest rotting of fruits is a serious problem in some arid zone fruits. The fungi associated with this malady have been identified. In *ber* rotting in Local, Umran, Seb and Gola cultivars was caused by *Alternaria alternata* and *Fusarium solani* at Jobner. *Aspergillus niger* and *Cladosporium oxysporum* were also found associated with rotting of *ber* fruits. At Bikaner, pre harvest spray of 0.1 per cent carbendazim and 0.4 per cent copper oxychloride have effectively reduced the rotting of harvested berries of Khadrawy and Medjool cultivars of date palm.

वार्षिक प्रतिवेदन सारांश

शुष्क क्षेत्र भारत के कुल क्षेत्रफल के लगभग 12 प्रतिशत भूभाग में फैला है । यह क्षेत्र राजस्थान, हरियाणा, पजांब, महाराष्ट, आन्धप्रदेश तथा कर्नाटक राज्यों में है । विपरीत कृषि जलवायु एवं भू-भौतिकी परिवेश के कारण इस क्षेत्र में उघानिकी उत्पादन नगण्य है। उपलब्ध प्राकृतिक ससाघनो के उचित उपयोग एवं पादपों की सूखा सहिष्णु किस्मों का समुचित विकास करके इस क्षेत्र में उघानिकी उत्पादन वढ़ाने की विपुल संभावनाएं है। इस क्षेत्र में उघानिकी उत्पादन क्षमता वढ़ाने से यहां के निवासियों की आर्थिक एवं सामाजिक परिस्थिति में सुधार लाया जा सकेगा। इन सब तथ्यों को दृष्टिगत रखते हुए भारतीय कृषि अनुसंधान परिषद, नई दिल्ली ने राष्टीय शुष्क क्षेत्रीय उघानिकी अनुसंधान केन्द्र की विधिवत स्थापना अप्रैल, 1993 में की है।

मुख्य घ्येय

शुष्क परिस्थितिकी में उघानिकी फसलों का उत्पादन वढ़ाने के लिए योजनावद्ध अनुसंघान कार्य करना तथा शुष्क क्षेत्र उघानिकी से संवद्ध सूचनाओं के प्रमुख केन्द्र के रूप में कार्य करना।

वर्ष 1997-98 के मध्य किए गये महत्वपूर्ण अनुसंधनो का संक्षिप्त विवरण।

(i) मतीरा (सिटलस) के जीन संतति, यथाः AHW 19-3-b, एवं AHW 65-4 तथा काचरी (कूकूमिस स्पीसीज) की नौ संतति, यथाः AHK 5-1, AHK 13-1, AHK 43-1, AHK 155-1, AHK 119-2, AHK 202-1, AHK 99, AHK 26-1, एवं AHK 109-1 को सर्वाधिक उपयुक्त पाया गया।

(ii) फूट काकड़ी ;स्नेप मेलनद्व जीन प्रारूपों मे AHS 82-1-b, AHS 10-1-b, AHS 50-1, AHS 6-1, AHS 54-1, एवं AHS 19-1 को इस क्षेत्र की परिस्थितियों में सर्वाधिक उपयुक्त पाया गया।

(iii) इस अवधि के मध्य वेर के 108, अनार के 27, नागफनी के 46, आंवला के 2, तथा खजूर के 46 जीन प्रारूपो का देश- विदेश के विभिन्न भागों से संग्रह कर मूल्यांकन कार्य प्रारम्भ किया।

(iv) कैर (केपरिस डेसिडुआ) की कलमों में वृद्धि तत्वों की उपस्थिति का पता लगाया जो इस कठिन जड़ीय प्रजाति के पुनरोत्पादन में सहायक सिद्ध हो सकते है।

(v) खेजड़ी (प्रोसोपिस सिनेरेरिया) के चयनित पेड़ों में खनिज लवणों का विस्तृत विवरण तैयार किया गया।

(vi) केन्द्र की ध्येयित फसलों में कुछ जीवाणु, विषाणु तथा फफूंदी व्याधियों की उपस्थिति के दृष्टिगत सावधानी स्वरूप कुछ उपाय किए गये।

(vii) केन्द्र के वैज्ञानिकों ने विभिन्न किसान मेलों एवं अन्य विस्तार गतिविधियों में सक्रिय भाग लेकर किसानों आदि को नयी तकनीकियों की जानकारी उपलब्ध करवाकर लाभान्वित किया। इसके अतिरिक्त बीकानेर स्थित राजस्थान कृषि विश्वविघालय एवं अन्य संस्थाओं के विभिन्न प्रशिक्षण कार्यक्रमों में प्रशिक्षकों की अग्रणी भूमिका निभाई।