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Assessment of Different Okra Varieties for Yield, Quality and, Economical Feasibility Cultivated in the Hadoti Region of South-East Rajasthan, India

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The study focuses on the cultivation of okra, a prominent Indian vegetable with significance in both export and family consumption. Emphasizing the potential for increased okra production through the selection of high-yielding varieties, the research specifically targets the Hadoti region, aiming to identify varieties suitable for its agro-climatic conditions. The lack of such screening in the region prompted the study. The trial was conducted during the summer of 2022 and 2023 at the Instructional Farm of Career Point University, Kota, Rajasthan and the research evaluated 12 okra varieties using a randomized block design with three replications. The analysis of variance revealed significant differences among all varieties for various traits, including yield, quality and economical feasibility. The study underscores the presence of a substantial varietal effect, offering insights into optimizing okra cultivation in the Southeast climatic conditions of Rajasthan's Hadoti region. The results showed the presence of a significant varietal effect. However, the present study

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demonstrated the superiority of Punjab Selection variety over other varieties in terms of maximum mean fruit length (13.07 cm), fruit diameter (3.77 cm) and fruit weight (15.56 g), minimum mean titratable acidity (0.22%), maximum TSS (3.18 °B), ascorbic acid (19.64 mg/100g) and mucilage content (0.91%), maximum mean fruit yield per plant (0.53 kg), fruit yield per plot (11.68 kg) and fruit yield per hectare (124.30 q). However, the net return of Rs. 248575 Rs./ha and 249325 Rs./ha along with benefit-cost ratio 5.02 and 5.05 in 2022 and 2023 respectively was also obtained from okra variety Punjab Selection.

Keywords: Assessment; mucilage; TSS; weight.

1. INTRODUCTION

Okra [*Abelmoschus esculentus* (L.) Moench] holds a significant position among vegetables, known by various names globally such as lady's finger in England, Gumbo in the U.S.A., and Bhindi in India. In India, it stands as a crucial vegetable crop, cultivated for its tender green fruits during the summer and rainy seasons. Propagated through seeds, okra is valued for its delectable green fruits used in diverse culinary applications, including curries and soups [1]. Notably remunerative, it surpasses leafy vegetables in economic returns. While not commonly consumed as a leafy vegetable in India, okra's roots and stems are utilized in the preparation of gur or jaggery. Ripe okra seeds find use as a coffee substitute in Turkey [2]. Despite its economic importance, okra cultivation faces challenges, particularly from various insect pests and diseases such as jassid, fruit and shoot borer, powdery mildew, and yellow vein mosaic. The imperative to meet the growing world population's food requirements underscores the need for enhanced crop yield and resilience. Okra is widely cultivated in plains of India mostly in Uttar Pradesh, Bihar, Orissa, West Bengal, Andhra Pradesh Karnataka, and Assam. In India, okra shares a 5.28 million hectare area and 61.46 million tonnes of production with a productivity of 12.2 million tonnes per hectare [3]. Rajasthan has a 1.3 million hectare area under okra cultivation with production of 8.34 million tonnes and productivity of 5.15 MT per ha [3].

The study's primary focus is to identify superior-performing okra varieties in the Hadoti region of Rajasthan, specifically tailored for the South-East climatic conditions. This research aims to pinpoint varieties that not only adapt well to the local environment but also demonstrate resistance to biotic and abiotic stresses, ensuring optimal yield and quality. The understanding that a variety excelling in one locality may not be suitable for another emphasizes the need for region-specific assessments to enhance okra cultivation and contribute to sustainable food production.

2. MATERIALS AND METHODS

2.1 Location

Kota district is located at 25.18° N to 75.83° E Latitude in South Eastern Rajasthan. It covers an area of 221.36 km^2. Agro-climatically, the district falls in Zone V, known as Humid South Eastern Plain. The average rainfall in the region is 660.6. mm. The maximum temperature range in the summer is 40 to 48°C and a minimum of 1.0-2.6°C during winter.

2.2 Experimental Details

The present studies were carried out at the Department of Horticulture, School of Agricultural Sciences, Career Point University, Kota (Rajasthan) during the year 2022 and 2023. Twelve varieties of okra *viz.* Parbhani Kranti, Parbhani Bhindi, Arka Anamika, Shahiba, Shan, No. 55, Harita, Jhilmil, No. 64, Sonal, Shakti, and Punjab Selection were evaluated in randomized block design, replicated thrice. Raised bed planting system of 3 m at 60 x 30 cm spacing was adapted to grow the crop.

2.3 Field Preparation and Sowing

In order to get good tilth of the soil for sowing, one cross cultivation was done by tractor drawn cultivator followed by two harrowing before sowing of seed. The field was then laid out for the experiment as per plan. For sowing of experiment dibbling method was adopted. After two weeks of sowing, thinning was done to maintain proper plant to plant distance, therefore all the recommended package of practices was followed as per schedule to raise healthy crop.

2.4 Irrigation

The first irrigation was given immediately after sowing to ensure proper germination. There after there was no need of irrigation due to time to time rains which provided sufficient moisture for proper growth and development of standing crop.

2.5 Intercultural Operations

The experimental plots were kept free from weeds by two hoeing and three hand weeding.

2.6 Fertilizer Application

A dose of 150kg N, 100kg P_2O_5 and 100kg K_2O/ha along with 20 tonnes FYM/ha was applied. One third nitrogen and entire quantity of P, K and FYM was applied prior to sowing as basal dose. Remaining dose of nitrogen was applied in two splits at 30 and 60 days after sowing. The sources of NPK provided through organic or integrated sources during the crop periods.

2.7 Plant Protection Measures

The crop was sprayed with Imidaclorprid 0.5% to control insect-pest and drenching of Dithane M-45 0.2% to control diseases to keep the crop free from insect-pest and disease during entire crop growth period.

2.8 Measurement of the Yield Parameters

Fruit yield per plant (kg) was calculated from the harvested fresh marketable fruits from the five observational plants separately throughout the harvesting period at an interval of three days. It was totaled and then the average yield per plant was worked out for each genotype. The fruits yield per plot (kg) harvested from all the plants in each plot including the observational plants was weighted at each harvest. The yield of fruit per hectare was obtained from yield per plot by multiplying with the factor.

Fruit yield per ha (q) = Fruit yield per plot (kg)/ Gross plot area (m^2) x10000 m^2 / 100

2.9 Measurement of the Quality Parameters

The colour of the fruit was observed by visual observation and categorized in dark green light green and yellow green. The fruit length was measured from randomly selected five fruits from every genotype with the help of a scale and then the average was recorded. The widths of the randomly selected fruits were recorded with different position such as at base, at middle and top with the help of Vernier caliper and the average was worked out. The average fruit weight was calculated as the weight of fruit in gram from five fruits from observational plants that were selected randomly from each treatment and weighed. The total soluble solids content of the fruit was determined by using a digital hand refractometer. The acidity and the ascorbic acid content of juice was determined by the method according to A.O.A.C. [4]. The mucilage was extracted by the method advocated by Ahiakpa, et al. [5].

2.10 Measurement of the Economic Feasibility

The cost of cultivation was taken into account by calculating total expenses incurred for inputs such as seeds, fertilizers and chemicals, to reach particular a level of output. Gross return is calculated as the total amount of revenue obtained by the yield of okra during the total life time of the plants. The gross returns are calculated by considering the prices of green fruit prevailing at the time of harvest. The net returns are calculated by deducting the cost of cultivation from the gross returns. The sale rate of okra was Rs. 25/kg. The sale price was decided according to average of total days of marketing.

Net returns (Rs.) = Gross income/ha (Rs.) – Total cost of cultivation/ha (Rs.)

The benefit cost ratio will be calculated as follows;

$$\text{B:C ratio} = \frac{\text{Gross returns (Rs. ha-1)}}{\text{Cost of cultivation (Rs. ha-1)}}$$

2.11 Statistical Methodology

The data obtained in respect of all the characters has been subjected to the following statistical analyses.

Mean: It was calculated by using following formula.

$$4\ \text{Mean} = \frac{\sum x}{n}$$

Where,

Σx = The sum of all the observation
N = Number of observation

2.12 Analysis of Variance

The data based on the mean of individual plants selected for observation were statistically analyzed to find out overall total variability present in the material under study for each character and for all the populations. The first and foremost step is to carry out analysis of variance to test the significance of differences among the populations. The analysis of variance was carried out as per methods suggested by Panse and Sukhatme [6].

3. RESULTS

3.1 Yield Parameters of Okra

The fruit yield was found significantly different during the both years 2022 and 2023. Significant differences were observed amongst the different varieties of okra concerning fruit yield per plant which ranged from 0.36 to 0.53 kg. The highest fruit yield per plant was recorded in “Punjab Selection” (0.53 kg) which was significantly higher over the rest of the varieties but at par to “Sonal” (0.49 kg), whereas the minimum fruit yield per plant (0.36 kg) was found in “Parbhani Bhindi.” The fruit yield per plot was found significantly different during the years 2022 and 2023. Significant differences were observed amongst the different varieties of okra concerning fruit yield per plot which ranged from 9.48 to 11.68 kg. The maximum fruit yield per plot was recorded in “Punjab Selection” (11.68 kg) which was significantly highest over the rest of the varieties but at par with “Sonal” (9.48 kg), whereas the minimum fruit yield per plot was found in “Parbhani Bhindi” (11.08 kg). The maximum mean fruit yield per hectare was recorded in “Punjab Selection” (124.30 q) which was significantly highest over the rest of the varieties but at par with “Sonal” (121.52 q), whereas the minimum fruit yield per hectare was found in “Parbhani Bhindi” (103.74 q).

3.2 Quality Parameters of Okra

The fruit length was found significantly different during the years 2022 and 2023. Significant differences were observed amongst the different varieties of okra for fruit length which ranged from 11.06 to 13.07 cm. The maximum fruit length was recorded in “Punjab Selection” (13.07 cm) which was significantly highest over the rest of the varieties but at par with “Sonal” (12.72 cm), whereas the minimum fruit length was found in “Parbhani bhindi” (11.06 cm). The maximum fruit diameter was recorded in “Punjab Selection” (3.77 cm) which was significantly highest over the rest of the varieties but at par with “Sonal” (2.97 cm), whereas the minimum fruit diameter was found in “Parbhani bhindi” (2.69 mm). The fruit weight was found significantly different during both years. Significant differences were observed amongst the different varieties of okra for fruit weight which ranged from 12.96 to 15.20 g. The maximum mean fruit weight was recorded in “Punjab Selection” (15.56 g) which was significantly highest over the rest of the varieties but at par with “Sonal” (15.20 g), whereas the minimum fruit weight (12.96 g) was found in “Parbhani Bhindi” (Table 1). The fruits of all the okra varieties were observed for qualitative trait study of fruit colour and fruits of all the varieties were found to be dark green in colour except “Shan, No.55 and Harita” which were light green in colour (Table 1).

The TSS in okra was found significantly different for 2022 and 2023. Significant differences were observed amongst the different varieties of okra with respect to TSS in which ranged from 1.60 to 3.18 ^{0}B. The maximum mean TSS in okra was recorded in “Punjab Selection” (3.18 ^{0}B) which was significantly highest over rest of the varieties but at par with “Arka Anamika” (2.86 ^{0}B), whereas the minimum TSS in okra was found in “No. 64” (1.60 ^{0}B). The minimum mean acidity percentage in okra was recorded in “Punjab Selection” (0.22 %) which was significantly lowest over rest of the varieties but at with with “Arka Anamika” (0.23 %), whereas the maximum acidity percentage in okra was found in “No. 64” (0.44 %). The highest ascorbic acid was recorded in “Punjab Selection” (19.64 mg/100g) which was significantly highest over rest of the varieties but at par with “Arka Anamika” (18.37 mg/100g), whereas the minimum ascorbic acid was found in “No. 64” (14.82 mg/100g). The mucilage content was found significantly different during the years 2022 and 2023. Significant differences were observed amongst the different varieties of okra with respect to mucilage content which ranged from 0.71 to 0.91 per cent. The highest mean mucilage content was recorded in “Punjab Selection” (0.91%) which was significantly highest over rest of the varieties but at par with “Arka Anamika” (0.85%), whereas the minimum mucilage content was found in “No. 64” (0.71 %).

3.3 Economic Feasibility of Okra

Higher sale value and less cultivation cost are desirable characteristics for getting higher returns. Hence, the economics of the genotypes was worked out. It is revealed from the data obtained that a significantly higher marketable fruit yield of 124.15 in 2022 and 124.45 q/ha in 2023 was found for the variety "Punjab Selection". The net return of Rs 248575 Rs/ha and 249325 Rs/ha along with benefit cost ratio 5.02 and 5.03 in 2022 and 2023 respectively was obtained under okra variety "Punjab Selection" followed by "Sonal" gave fruit yield 121.37 and 121.67 q /ha and net return of Rs 2,41,625/ha and 2,42,375 with benefit cost ratio of 4.91 and 4.9203 in 2022 and 2023 respectively. While, the lowest marketable fruit yield 103.59 and 103.89 q/ha and net return of Rs 1,97,175/ha and 1,97,925/ha along with benefit cost ratio 4.19 and 4.20 03 in 2022 and 2023 respectively, were recorded in genotype "Parbhani Bhindi" (Table 3 & 4).

Table 1. Performance of different varieties of okra with respect to physical parameters

Varieties	Fruit length (cm)			Fruit diameter (cm)			Fruit weight (cm)		
	2022	2023	Pooled	2022	2023	Pooled	2022	2023	Pooled
Parbhani Kranti	11.98	12.41	12.20	3.05	3.26	3.16	13.50	13.80	13.65
Parbhani Bhindi	10.84	11.27	11.06	2.58	2.79	2.69	12.81	13.11	12.96
Arka Anamika	12.42	12.85	12.64	3.42	3.63	3.53	14.95	15.25	15.10
Shahiba	12.06	12.49	12.28	3.17	3.38	3.28	14.92	15.22	15.07
Shan	11.14	11.57	11.36	2.63	2.84	2.74	13.35	13.65	13.50
No. 55	11.53	11.96	11.75	2.71	2.92	2.82	13.75	14.05	13.90
Harita	11.43	11.86	11.65	2.81	3.02	2.92	13.49	13.79	13.64
Jhilmil	11.56	11.99	11.78	2.90	3.11	3.01	13.67	13.97	13.82
No. 64	12.13	12.56	12.35	2.53	2.74	2.64	13.86	14.16	14.01
Sonal	12.50	12.93	12.72	3.54	3.75	3.65	15.05	15.35	15.20
Shakti	12.46	12.89	12.68	2.86	3.07	2.97	13.93	14.23	14.08
Punjab Selection	12.85	13.28	13.07	3.66	3.87	3.77	15.41	15.71	15.56
SEm±	**0.33**	**0.34**	**0.35**	**0.24**	**0.17**	**0.16**	**0.47**	**0.51**	**0.35**
C.D. (p = 0.05)	**0.98**	**1.01**	**1.05**	**0.72**	**0.49**	**0.48**	**1.35**	**1.52**	**1.05**

Table 2. Performance of different varieties of okra with respect to yield parameters

Varieties	Yield per plant (kg)			Yield per plot (kg)			Yield per hectare (q)		
	2022	2023	Pooled	2022	2023	Pooled	2022	2023	Pooled
Parbhani Kranti	0.41	0.43	0.42	9.37	9.69	9.53	104.15	104.45	104.30
Parbhani Bhindi	0.42	0.44	0.36	9.32	9.64	9.48	103.59	103.89	103.74
Arka Anamika	0.50	0.52	0.48	9.97	10.29	10.13	110.81	111.11	110.96
Shahiba	0.46	0.48	0.47	9.72	10.04	9.88	108.04	108.34	108.19
Shan	0.36	0.38	0.37	9.51	9.83	9.67	105.70	106.00	105.85
No. 55	0.38	0.40	0.39	9.40	9.72	9.56	104.48	104.78	104.63
Harita	0.41	0.43	0.42	9.99	10.31	10.15	111.04	111.34	111.19
Jhilmil	0.40	0.42	0.41	9.92	10.24	10.08	110.26	110.56	110.41
No. 64	0.38	0.40	0.39	10.12	10.44	10.29	112.48	112.78	112.63
Sonal	0.48	0.50	0.49	10.92	11.24	11.08	121.37	121.67	121.52
Shakti	0.34	0.43	0.41	10.23	10.55	10.39	113.70	114.00	113.85
Punjab Selection	0.52	0.54	0.53	11.17	11.49	11.67	124.15	124.45	124.30
SEm±	**0.04**	**0.02**	**0.03**	**0.33**	**0.35**	**0.51**	**2.01**	**1.66**	**2.44**
C.D. (p = 0.05)	**0.11**	**0.06**	**0.09**	**0.98**	**1.05**	**1.50**	**5.90**	**4.89**	**6.59**

Table 3 Performance of different varieties of okra with respect to colour and chemical parameters

Varieties	Fruit colour			Acidity (%)			TSS (B^0)		
	2022	2023	Pooled	2022	2023	Pooled	2022	2023	Pooled
Parbhani Kranti	Dark green	Dark green	Dark green	0.35	0.36	0.36	2.52	2.67	2.60
Parbhani Bhindi	Dark green	Dark green	Dark green	0.36	0.37	0.37	2.67	2.82	2.75
Arka Anamika	Dark green	Dark green	Dark green	0.22	0.23	0.23	2.78	2.93	2.86
Shahiba	Dark green	Dark green	Dark green	0.28	0.29	0.29	1.92	2.07	2.00
Shan	Light green	Light green	Light green	0.23	0.24	0.24	1.70	1.85	1.78
No. 55	Light green	Light green	Light green	0.37	0.38	0.38	1.57	1.72	1.65
Harita	Light green	Light green	Light green	0.25	0.26	0.26	1.82	1.97	1.90
Jhilmil	Dark green	Dark green	Dark green	0.33	0.34	0.34	2.32	2.47	2.40
No. 64	Dark green	Dark green	Dark green	0.43	0.44	0.44	1.52	1.67	1.60
Sonal	Dark green	Dark green	Dark green	0.34	0.35	0.35	2.43	2.58	2.51
Shakti	Dark green	Dark green	Dark green	0.32	0.33	0.33	1.97	2.12	2.05
Punjab Selection	Dark green	Dark green	Dark green	0.21	0.22	0.22	3.10	3.25	3.18
SEm±	-	-	-	**0.04**	**0.03**	**0.01**	**0.22**	**0.16**	**0.24**
C.D. ($p = 0.05$)	-	-	-	**0.11**	**0.10**	**0.04**	**0.65**	**0.48**	**0.72**

Table 4. Performance of different varieties of okra with respect to chemical parameters

Varieties	Ascorbic Acid (mg/100g)			Mucilage (%)		
	2022	2023	Pooled	2022	2023	Pooled
Parbhani Kranti	17.47	17.77	17.62	0.77	0.88	0.83
Parbhani Bhindi	17.82	18.12	17.97	0.78	0.89	0.84
Arka Anamika	18.22	18.52	18.37	0.79	0.90	0.85
Shahiba	15.62	15.92	15.77	0.70	0.81	0.76
Shan	15.07	15.37	15.22	0.65	0.76	0.71
No. 55	16.82	17.12	16.97	0.64	0.75	0.70
Harita	15.37	15.67	15.52	0.75	0.86	0.81
Jhilmil	14.37	14.67	14.52	0.63	0.74	0.69
No. 64	14.67	14.97	14.82	0.67	0.78	0.73
Sonal	17.12	17.42	17.27	0.76	0.87	0.82
Shakti	15.92	16.22	16.07	0.74	0.85	0.80
Punjab Selection	19.42	19.72	19.57	0.85	0.96	0.91
SEm±	**0.50**	**0.80**	**0.44**	**0.02**	**0.04**	**0.02**
C.D. ($p = 0.05$)	**1.46**	**2.33**	**1.31**	**0.06**	**0.12**	**0.08**

Table 5. Economics of different varieties for okra (2022)

Treatments	Fruit yield (q/ha)	Cost of Cultivation (Rs/ha)	Gross Returns (Rs/ha)	Net Returns (Rs/ha)	B: C ratio
Parbhani Kranti	104.15	61800	260375	198575	4.21
Parbhani Bhindi	103.59	61800	258975	197175	4.19
Arka Anamika	110.81	61800	277025	215225	4.48
Shahiba	108.04	61800	270100	208300	4.37
Shan	105.70	61800	264250	202450	4.28
No. 55	104.48	61800	261200	199400	4.23
Harita	111.04	61800	277600	215800	4.49
Jhilmil	110.26	61800	275650	213850	4.46
No. 64	112.48	61800	281200	219400	4.55
Sonal	121.37	61800	303425	241625	4.91
Shakti	113.70	61800	284250	222450	4.60
Punjab Selection	124.15	61800	310375	248575	5.02

Table 6. Economics of different varieties for okra (2023)

Treatments	Fruit yield (q/ha)	Cost of Cultivation (Rs/ha)	Gross Returns (Rs/ha)	Net Returns (Rs/ha)	B: C ratio
Parbhani Kranti	104.45	61800	261125	199325	4.23
Parbhani Bhindi	103.89	61800	259725	197925	4.20
Arka Anamika	111.11	61800	277775	215975	4.49
Shahiba	108.34	61800	270850	209050	4.38
Shan	106.00	61800	265000	203200	4.29
No. 55	104.78	61800	261950	200150	4.24
Harita	111.34	61800	278350	216550	4.50
Jhilmil	110.56	61800	276400	214600	4.47
No. 64	112.78	61800	281950	220150	4.56
Sonal	121.67	61800	304175	242375	4.92
Shakti	114.00	61800	285000	223200	4.61
Punjab Selection	124.45	61800	311125	249325	5.05

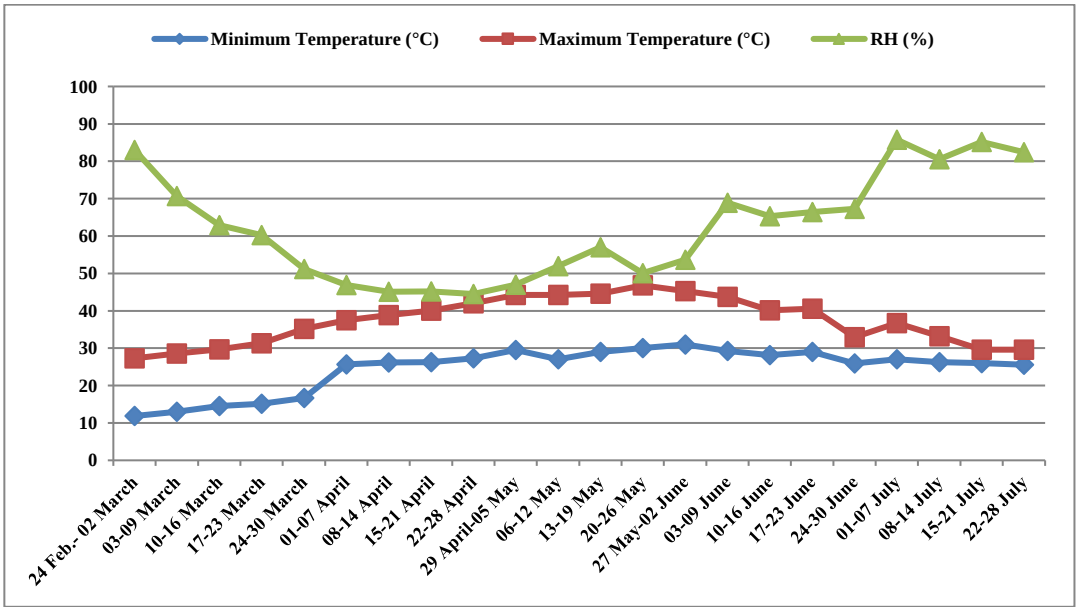

Fig. 1. Mean weekly meteorological parameters for the period of experimentation (February, 2022 to July, 2022)

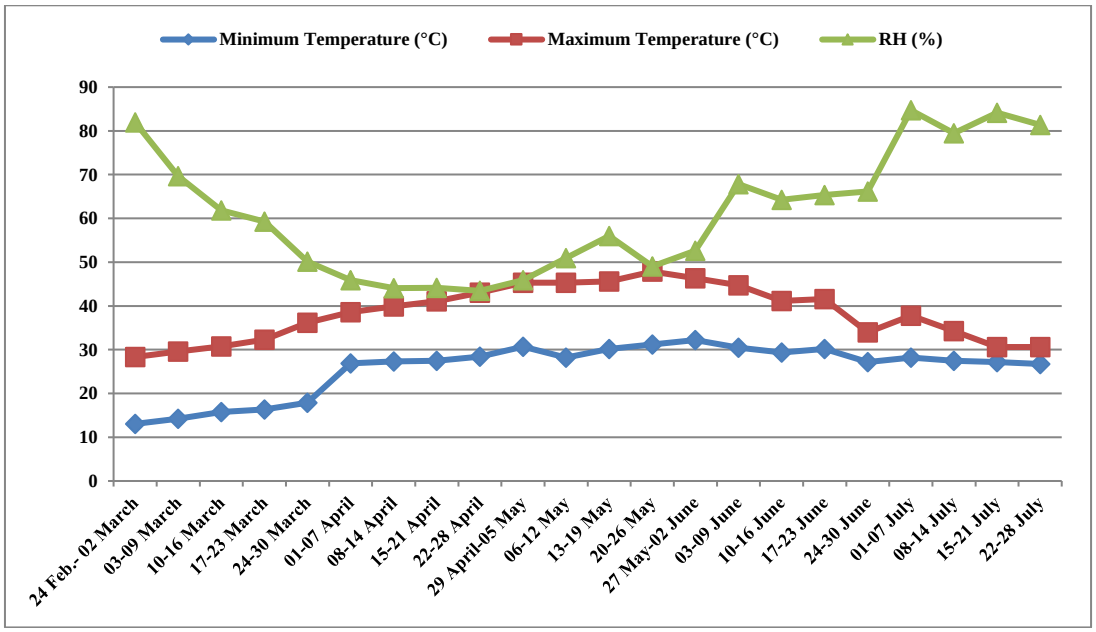

Fig. 2. Mean weekly meteorological parameters for the period of experimentation (February, 2023 to July, 2023)

4. DISCUSSION

Significant differences were observed among the different varieties of okra for the physical parameters *viz.* fruit length, fruit diameter, fruit weight and colour of okra fruit and yield parameters *viz.* fruit yield per plant, fruit yield per plot and fruit yield per hectare, and chemical parameters *viz.* TSS, acidity, ascorbic acid and mucilage percentage was also found significant on both years.

The maximum fruit length at the marketable stage was found in “Punjab Selection” (13.07 cm) while the minimum fruit length was found in “Parbhani bhindi” (11.06 cm). The significant differences in fruit length in the varieties may be due to their genetic makeup leading to differential synthesis, translocation and accumulation of photosynthates in the sink (fruit). Similar results have been reported by Singh et al. [7]; Yonas et al. [8]; Chandramouli et al. [9]; Kumar et al. [10]; Rajesh et al. [11] on same varieties of okra.

The thickest fruits (3.77 cm diameter) were recorded in ‘Arka Anamika’, while the thinnest (2.69 cm) in ‘Parbhani Kranti’. The fruit size (length and diameter) of okra at the marketable maturity stage is an important varietal characteristic that is primarily governed by its genotypic constitution and secondarily by the availability of water and nutrients coupled with the influence of the growing climate Chandra et al. [12]. The differences obtained in fruit diameter amongst the varieties and hybrids of okra could be attributed to their genetic makeup and the prevailing environmental factors. Similar results have been reported by Akotkar et al. [13].

The maximum mean fruit weight at the marketable maturity stage was recorded in ‘Punjab Selection’ (15.56 g), while the minimum mean fruit weight in ‘Parbhani Bhindi’ (12.96 g). The observed variation in fruit weight amongst the varieties and hybrids of okra might be due to their genetic makeup governing the fruit size and sink-source relationship in the diversion of photosynthates to the fruit. The results find support from Deepanshu and Shamad [14]; Kumar et al. [10].

Fruit colour is very important characters regarding marketing because consumers often associated bright, vivid colour with freshness. Okra with rich green perceived as fresher and of higher quality, leading to increased sale. The fruits of all the okra varieties were observed for qualitative trait study of fruit colour and fruits of all the varieties and hybrids were found to be dark green in colour except “Shan, No.55 and Harita” which were light green in colour.

The highest mean fruit yield per plant was recorded in “Punjab Selection” (0.53 kg) whereas the minimum fruit yield per plant was found in

"Parbhani Bhindi" (0.36 kg). The yield per plant had high positively genotypic and phenotypic correlation with the high number of branches per plant with more nodes on the plant, providing the site for fruit production. The observed variation in yield per plant amongst the varieties of okra might be due to their genetic makeup governing the number and size of fruits due to varying and sink- source relationships. The findings lend support from Akotkar et al. [13]; Bagwale et al. [15] for fruit yield per hectare; Mishra et al. [16]; Darshan et al. [17]; Kumari et al. [18] for fruit yield per plant and fruit yield per plot;

The maximum mean fruit yield per plot (11.68 kg) and estimated fruit yield per hectare (124.30 q) were recorded in 'Punjab Selection' whereas the lowest fruit yield per plot (11.08 kg) and per hectare (103.74 q) were recorded in 'Parbhani Bhindi'. It is evident from the results that fruit yield per plant had directly influenced the fruit yield per unit area which had a high positive correlation with fruit yield per plant for genotypic as well as phenotypic correlation. Similar results have been reported by Chandra et al. [12]; Deepanshu and Shamad [14]; Chandramouli et al. [9].

The minimum mean acidity percentage in okra was recorded in "Punjab Selection" (0.22 %) which was significantly lowest over the rest of the varieties while the maximum acidity percentage in okra was found in "No. 64" (0.44 %). Similarly maximum mean TSS in okra was recorded in "Punjab Selection" (3.18 ^{0}B) which was significantly highest over rest of the varieties whereas the minimum mean TSS in okra was found in "No. 64" (1.60 ^{0}B). It is evident that the results directly influenced the chemical quality of okra might be due to genotypic correlation. The finding of Bendale et al. [19]; Yonas et al. [8]; Priyanka et al. [20] were similar to the present findings.

The ascorbic acid was found significantly different during the both years 2022 and 2023. The highest ascorbic acid was recorded in "Punjab Selection" (19.64 mg/100g) which was significantly highest over the rest of the varieties whereas the minimum ascorbic acid was found in "No. 64" (14.82 mg/100g). On the other hand highest mucilage content was recorded in "Punjab Selection" (0.91 %) whereas the minimum mucilage content was found in "No. 64" (0.71 %). Similar results have been reported by Chandra et al. [12]; Deepanshu and Shamad [14]; Chandramouli et al. [9].

It is revealed from the data obtained that a significantly highest marketable fruit yield of 124.15 in 2022 and 124.45 q/ha in 2023. The net return of Rs 248575 Rs/ha and 249325 Rs/ha along with benefit cost ratio 5.02 and 5.05 in 2022 and 2023 respectively was obtained under the okra variety "Punjab Selection" followed by "Sonal" gave fruit yield 121.37 and 121.67 q /ha and net return of Rs 2,41,625/ha and 2,42,375 with benefit cost ratio of 4.91 and 4.9203 in 2022 and 2023 respectively. While, the lowest marketable fruit yield 103.59 and 103.89 q/ha and net return of Rs 1,97,175/ha and 1,97,925/ha along with benefit cost ratio 4.19 and 4.20 in 2022 and 2023 respectively, were recorded in genotype "Parbhani Bhindi". It is evident from the results that the maximum benefit cost ratio had directly influenced the fruit yield per unit area which had high positive correlation with economic feasibility for genotypic as well as phenotypic correlation. Similar results have been reported by Chandra et al. [12]; Deepanshu and Shamad [14]; Chandramouli et al. [9].

5. CONCLUSION

Based on the overall effect the variety Punjab Selection was highest in terms of physical, chemical and yield characteristics hence, variety Punjab Selection may be considered worth for better harvest of the crop under Hadoti region of South-East Rajasthan.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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