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Evaluation of different okra (*Abelmoschus esculentus* L.) hybrids for growth, yield and quality under Prayagraj agro-climatic conditions

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Abstract

A present investigation was carried at the Horticultural research farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj, Uttar Pradesh during *kharif* Season, 2023 with a view to evaluation of different okra (*Abelmoschus esculentus* L) hybrids for growth, yield and quality under Prayagraj agro climatic condition". The experiment was laid in the randomized block design with 8 treatments and 3 replication with different hybrid varieties. Nine treatment of in different combinations were applied along with hybrid varieties. Result showed that the present investigation it is concluded that, the treatment varieties of T₃ (F1 COVI PLUS) was recorded the best among all combinations, different varieties in term of growth parameters viz., Plant height (139.48 cm), Number of branches (23.40), Number of fruit per (16.08), Fruit length (22.63 cm), Fruit weight (31.69 g) and Fruit diameter (6.35 mm). Yield parameters like days to 50% flowering (42.07), No of fruit/Plant (28.19), Fruit yield/Plant (237.39 g) and Yield (10.36 t/ha), quality parameters TSS (3.92 °Brix), Ascorbic acid (2.07 mg/100g). Among the different treatments the highest gross return (254000.00 ₹/ha), net profit/ha (₹18904.00), cost benefit ratio (2.95) was obtained in hybrid varieties of F1 COVI PLUS (T₃).

Keywords: Okra, growth, yield and hybrid varieties

Introduction

Okra [*Abelmoschus esculentus* (L.) Moench] commonly known as lady's finger or that, belongs to the family Malvaceae. Okra popularly known as Bhendi' is an important warm season vegetable, widely cultivated for its tender, green fruits. It is widely adopted and popular vegetable in Indian kitchens and can be grown in summer and rainy seasons throughout India. India is the highest producer in the world and exported there by helping in earning foreign exchange. Okra is an important vegetable grown for its tender fruits which are used as a vegetable in various ways. It is also grown during early winter season of mid cool temperature. Okra is specially valued for its tender and delicious fruits. However, to a limited extent, it finds its use in dehydrated or frozen form. It has been reported to have an average nutritive value. In India, it ranks first in its consumption but its original home is Ethiopia and Sudan, the Northeastern African countries. It is one of the oldest cultivated crops and presently grown in many countries and is widely distributed from Asia to Africa, Southern Europe and America.

In India area under okra crop is 532 thousand hectare with 528.4 production 6146 thousands MT and productivity is 12 MT per hectare. In Maharashtra okra occupies about 23 thousand hectare of land with production of 241 thousand MT and productivity of 11 MT per hectare. Andhra Pradesh is leading state in production of okra 1184.2 thousand tones from area of 78.90 thousand hectare with productivity of 15 tonnes per hectare. In India, okra is cultivated throughout the country for its immature tender pods (fruits), occupying an area over 511 hectares with production of 6219 tonnes. Therefore, the present investigation entitled "Evaluation of different okra (*Abelmoschus esculentus* L) hybrids for growth, yield and quality" was be undertaken at Vegetable Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, SHUATS, Prayagraj (UP) during *kharif* season 2023.

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Materials and Methods

The okra at the 0.60 x 0.45 m spacing were used for the experiment will be conducted at Vegetable Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (UP) during *kharif* season 2023. All the facilities necessary for cultivation, including labour will be made available in the department. Geographically Prayagraj is situated at an elevation of 78 meters above sea level at 25.870 North latitude and 81.150 E longitudes. The experimental land is situated in the river basin of the Ganga and the Yamuna. Prayagraj, the region has a sub-tropical climate prevailing in the

South-East part of U.P. with both the extremes in temperature, *i.e.*, the winter and the summer. In cold winters, the temperature sometimes is as low as 20 °C in December – January and very hot summer with temperature reaching up to 48 °C in the months of May and June. The average rainfall is around 1042 mm with maximum concentration during July to September months with occasional showers in winters. In growth parameters dry weight (g/plant), crop growth rate (g/m²/day) and yield parameters were recorded and statistically analyzed using analysis of variance (ANOVA) as applicable to Randomized Block Design (Gomez, K. A. and Gomez, A. A. 1984)^[7].

Experimental details of Treatment Combinations

No. of treatments	Hybrid symbol	Hybrid name	Source
T ₁	H1	MADHAV	IIVR, VARANASI
T ₂	H2	SHARMILI	Agria
T ₃	H3	F1 COVI PLUS	Agria
T ₄	H4	SAUNDRYA	IIVR, VARANASI
T ₅	H5	HYBRID BHINDI LILY	DSL SEEDS
T ₆	H6	KARISHMA	IIVR, VARANASI
T ₇	H7	RADHIKA	FTN AGRO
T ₈	H8	MISS OKRA 18	VNR SEEDS
T ₉	H9	SWATI	SAKTI VARDHAK HISAR
T ₁₀	H10	BHINDI F1 HYBRID (SMART)	RIGHT SEEDS

Results and Discussion

Growth Parameters

Effect of days to germination

The data pertaining to effect of different okra hybrids on days to germination is presented in Table 1. At harvesting the maximum days to germination was recorded in the treatment T₃ (F1 COVI PLUS) 6.78 followed by 6.47 with T₄ (SAUNDRYA), T₇ (RADHIKA) and T₉ (SWATI) respectively, was found to be statistically at par with T₃ (F1 COVI PLUS). At minimum day to germination 5.23 was recorded in T₆ (KARISHMA). More intensive flower setting was elicited either by improved plant growth through varieties extract application or by endogenous components, especially genotypes which chance nutrient partitioning in vegetative plant organ, days to 50% germination and increase in the transport to assimilates to the growing and yield of fruits. A similar effect was observed for bitter gourd with different varieties by Patel *et al.*, (2014)^[18].

Effect of plant height (cm) on okra

The data pertaining to effect of different okra hybrids on Plant height (cm) is presented in Table 1. Significantly maximum plant height (cm) was recorded in the treatment T₃ (F1 COVI PLUS) 139.40 cm followed by 138.03 cm with T₇ (SAUNDRYA), T₆ (KARISHMA). 132.80 cm and T₁₀ (BHINDI F1 HYBRID (SMART)) 125.75 cm respectively, was found to be statistically at par with T₃ (F1 COVI PLUS) 139.40. At minimum plant height 106.28cm was recorded in T₁. Many hybrid okra varieties are bred to have a more controlled and consistent plant height. This trait can be beneficial for farmers as it makes the plants easier to manage and harvest. Hybrid okra varieties often exhibit vigorous growth, leading to robust plants that can reach significant heights, typically ranging from 3 to 6 feet, depending on the variety and environmental conditions. The height of hybrid okra plants can contribute to better space utilization in the field. Taller plants can support more foliage and, consequently, more flowers and fruits, leading to higher yields per unit area. Similar findings are also reported by Billore *et al.* (2000)^[3], Parmar and Nema (2002)^[17] and Masum *et al.* (2013)^[12].

Effect of number of branches on okra

The data pertaining to effect of different okra hybrids on fruit length is presented in Table 1. At harvesting the maximum on number of branches was recorded in the treatment T₃ (F1 COVI PLUS) 23.67 followed by 23.40, T₄ (SAUNDRYA), T₇ (RADHIKA) 19.80 respectively, was found to be statistically at par with T₃ (F1 COVI PLUS) 23.67. At minimum on number of branches 13.47 was recorded in T₁. Similar findings were reported by Mishra *et al.*, (2020)^[22]; in okra. The findings are same concordance with reports of Meerabai *et al.*, (2007)^[13] as highly significant and positive association of fruit weight.

Effect of number of fruit per plant

The data pertaining to effect of different okra hybrids on number of fruit per plant is presented in Table 1. Significantly highest number of fruit per plant (16.08) F1 COVI PLUS (T₃) followed by SAUNDRYA (15.87) (T₄), RADHIKA (14.93) (T₇), SWATI (14.87) (T₈), respectively, was found to be statistically at par with (16.08) F1 COVI PLUS (T₃). The number of fruits produced by a hybrid okra plant can vary based on several factors, including the specific hybrid variety, growing conditions, soil fertility, climate, and overall plant health. However, hybrid okra plants are generally bred for higher productivity, and under optimal conditions, they can produce a significant number of pods per plant. On average, a well-managed hybrid okra plant can produce between 20 to 30 pods per plant during the growing season. However, under ideal conditions, some high-performing hybrid varieties can yield upwards of 50 to 100 pods per plant. This is especially crucial for organic farming, since inorganic fertilizers are not permitted. Similar findings were deduced by Malik *et al.*, (2020)^[23].

Effect of fruit length (cm)

The data pertaining to effect of different okra hybrids on number of fruit per plant is presented in Table 1. The data pertaining to effect of different okra hybrids on number of fruit per plant. Significantly highest fruit length (22.63 cm) F1 COVI PLUS (T₃) followed by SAUNDRYA (21.03 cm) (T₄), RADHIKA (20.62 cm) (T₇), SWATI (19.17 cm) (T₈), respectively, was

found to be statistically at par with (22.63 cm) F1 COVI PLUS (T₃). The number of fruits on hybrid okra plants can vary widely, typically ranging from 20 to 60 pods per plant, depending on the variety and growing conditions. Hybrid varieties are often bred for higher fruit production, resulting in more consistent and abundant yields compared to traditional varieties. Factors such as proper fertilization, irrigation, pest control, and overall plant health also play crucial roles in maximizing the number of fruits produced by hybrid okra plants. These findings are in good lines with those achieved by Malek *et al.* (2012)^[11], Rahman *et al.* (2013)^[19] and Mondal *et al.* (2014)^[15].

Effect of fruit weight (g)

The data pertaining to effect of different okra hybrids on fruit weight (g) is presented in Table 1. Significantly highest fruit weight (31.69 g) F1 COVI PLUS (T₃) followed by SAUNDRYA (30.67 g) (T₄), RADHIKA (30.22 g) (T₇), SWATI (30.13 g) (T₈), respectively, was found to be statistically at par with (31.69) F1 COVI PLUS (T₃). At minimum fruit weight 26.11 g was recorded in T₁. More intensive flower setting was elicited either by improved plant growth like node of flower, through habitability along with high genetic advance as percent of mean was observed for or by endogenous components, especially cytokinin, which chance nutrient partitioning in vegetative plant organ and increase in the transport to assimilates to the growing fruits. A similar effect was observed for bitter gourd different variety by Nayak *et al.* (2016)^[16].

Effect of fruit diameter (mm)

In present study, fruit yield was directly associated with number of fruits per plant as number of fruits per plant increases fruit yield proportionately. The data pertaining to effect of different okra hybrids on number of fruit/plant is presented in Table 1. Significantly highest fruit diameter (6.35 mm) F1 COVI PLUS (T₃) followed by SAUNDRYA (6.26 mm) (T₄), RADHIKA (6.09 mm) (T₇), SWATI (5.81 mm) (T₈), respectively, was found to be statistically at par with (31.69) F1 COVI PLUS (T₃). At minimum fruit diameter 4.46 mm was recorded in T₁. Different hybrid okra varieties may have slightly different optimal fruit diameters based on their breeding objectives. Some hybrids may produce slightly thicker pods while others may be thinner, depending on consumer preferences and culinary uses. Environmental factors, such as soil quality, water availability, and nutrient levels, can influence the size and diameter of okra fruits. Consistent and optimal growing conditions help maintain the ideal fruit size. (Anburani and Manivannan 2002),^[2] Similar results were reported by Choudhury *et al.*, (2013)^[4] and Akand *et al.*, (2015)^[11] in bitter gourd.

Yield parameter

The data pertaining to yield parameter is presented in Table 2. It is evident from the table that the effect of different okra hybrids on yield parameter significantly influenced fruit weight at clearly marked out the obvious different among the treatment with respect to different treatment.

Number of fruit per plant

The data pertaining to effect of different okra hybrids on number of fruit per plant is presented in Table 2. Significantly highest number of fruit per plant (28.19) F1 COVI PLUS (T₃) followed by SAUNDRYA (26.27) (T₄), RADHIKA (25.79) (T₇), SWATI (25.25) (T₈), respectively, was found to be statistically at par with (28.19) F1 COVI PLUS (T₃). At minimum number of fruit per plant 18.84 was recorded in (MADHAVI) T₁.

Fruit yield per plant (g)

The data pertaining to effect of different okra hybrids on fruit yield per plant (g) is presented in Table 2. Significantly highest fruit yield per plant (g) (237.39 g) F1 COVI PLUS (T₃) followed by SAUNDRYA (236.37 g) (T₄), RADHIKA (234.92 g) (T₇), SWATI (233.75) (T₉), respectively, was found to be statistically at par with (237.39 g) F1 COVI PLUS (T₃). At minimum fruit yield per plant (g) 207.33 g was recorded in (MADHAVI) T₁.

Fruit yield (t/ha)

The data pertaining to effect of different okra hybrids on fruit yield (t/ha) is presented in Table 2. Significantly highest fruit yield (t/ha) (10.16 t/ha) F1 COVI PLUS (T₃) followed by SAUNDRYA (9.80 t/ha) (T₄), RADHIKA (9.20 t/ha) (T₇), SWATI (9.00 t/ha) (T₉), respectively, was found to be statistically at par with (10.16 t/ha) F1 COVI PLUS (T₃). At minimum fruit yield (t/ha) 6.44 t/ha was recorded in (MADHAVI) T₁. Hybrid okra typically produces fruits of consistent size and quality. Enhanced flowering and fruit-setting capabilities, along with disease resistance, contribute to an increased number of pods harvested per plant. The weight of individual okra pods from hybrid varieties is often more consistent and can be slightly higher compared to traditional varieties. This contributes to the overall yield by increasing the total mass of harvested pods. Hybrid okra plants usually exhibit more vigorous growth and a faster growth rate. This results in robust plants that can support a larger number of fruits, contributing to higher yields. Some hybrid okra varieties are designed to mature earlier than traditional varieties. Early maturity allows for quicker harvests and the possibility of multiple cropping cycles within a single growing season, increasing overall yield. Hybrids are often more adaptable to varying environmental conditions, including different soil types and climatic conditions. This adaptability ensures stable yields across diverse growing regions and reduces the risk of crop failure due to adverse conditions. The consistent and prolonged fruiting period of hybrid okra varieties allows for regular and frequent harvests. This can lead to a steady supply of fresh okra over an extended period, benefiting both farmers and markets. The combination of higher yields, better fruit quality, and disease resistance in hybrid okra varieties often translates to better economic returns for farmers. Increased productivity and reduced losses contribute to higher profitability. This is especially crucial for organic farming, as inorganic fertilizers are not permitted by Parani and Nanthini (2021)^[24].

Effect of hybrid varieties on Ascorbic acid (mg/100 g) and TSS (°Brix)

The data pertaining to quality parameter is presented in Table 3.

TSS (°Brix)

The data pertaining to effect of different okra hybrids on TSS (°Brix) is presented in Table 3. Significantly highest TSS (°Brix) (3.92) F1 COVI PLUS (T₃) followed by SAUNDRYA (3.90 °Brix) (T₄), RADHIKA (3.86 °Brix) (T₇), SWATI (3.81 °Brix) (T₉), respectively, was found to be statistically at par with (3.92) F1 COVI PLUS (T₃). At minimum TSS (°Brix) 3.17 was recorded in (MADHAVI) T₁. After varying cultivars, there was an increase in the quality of solids dissolved in the liquid portion of okra, known as total soluble solids (T.S.S.). These results closely match those of Solanki and Mishra. The heightened photosynthetic and metabolic activities, which led to the synthesis of more acids, metabolites, and glucose, may be responsible for the quality increase brought about by the application of nitrogen and variety. In the end, these reserves

helped okra synthesize TSS. These results are in conformity with Kamili *et al.*, (2002)^[8].

Ascorbic acid (%)

The data pertaining to effect of different okra hybrids on Ascorbic acid (%) is presented in Table 3. Significantly highest Ascorbic acid (%) (2.07%) F1 COVI PLUS (T₃) followed by SAUNDRYA (1.96%) (T₄), RADHIKA (1.44%) (T₇), SWATI (1.35%) (T₉), respectively, was found to be statistically at par with (2.07%) F1 COVI PLUS (T₃). At minimum Ascorbic acid (%) 0.74% was recorded in (MADHAVI) T₁. This is

simultaneously reported by Kumar *et al.* and Saha *et al.* Higher levels of photosynthesis can lead to the creation of metabolites, such as ascorbic acid. Ascorbic acid synthesis may be aided by the plant's enhanced supply of energy and carbon substrates. Genes involved in the regulation or production of ascorbic acid may be expressed differently in response to TA41. It may increase the activity of the enzymes that produce ascorbic acid or decrease the activity of the enzymes that break it down. Bitter gourd plants may accumulate more ascorbic acid as a result of this gene expression regulation. Similar findings were noted by Singh *et al.*, 2011 and Kumar *et al.*, 2016.

Table 1: Effect of different okra hybrids on growth parameters

Treatment	Days to germination	Days to 50% germination	Plant height (cm)	Number of branches	Number of fruits per plant	Fruits length (cm)	Fruits weight (g)	Fruits diameter (mm)
T ₁	5.29	5.47	119.36	13.47	12.28	15.71	26.11	4.46
T ₂	5.33	6.00	124.12	16.80	13.93	17.56	28.47	5.38
T ₃	6.78	8.28	139.40	23.67	16.08	22.63	31.69	6.35
T ₄	6.47	7.72	106.28	23.40	15.87	21.03	30.67	6.26
T ₅	5.55	6.10	119.53	17.07	14.21	17.64	28.59	5.49
T ₆	5.23	6.00	132.80	15.87	13.87	16.71	28.20	5.25
T ₇	6.17	7.40	138.08	19.80	14.93	20.62	30.22	6.09
T ₈	5.90	7.00	108.42	14.40	13.20	15.75	27.01	5.08
T ₉	6.07	6.80	107.94	18.73	14.87	19.17	30.13	5.81
T ₁₀	5.94	6.64	125.75	18.47	14.67	18.80	28.82	5.66
F test	S	S	S	S	S	S	NS	S
SEM	0.34	0.35	6.63	1.54	0.79	1.47	1.58	0.30
CD at 5%	0.71	0.74	13.94	3.25	1.67	3.10	3.33	0.63
C.V.	7.09	6.47	6.65	10.43	6.78	9.74	6.71	6.61

Table 2: Effect of different okra hybrids on yield parameters

Hybrids	Days to 50% flowering	No. of fruit/ plant	Fruit yield/plant (g/plant)	Fruits yield (t/ha)
Madhavi	36.76	18.84	207.33	6.44
Sharmili	38.33	22.01	215.00	8.00
F1 Covi Plus	42.07	28.19	237.39	10.16
Saundrya	42.03	26.27	236.37	9.80
Hybrid Bhindi Lily	39.94	23.43	227.47	8.20
Karishma	38.09	21.60	222.25	7.97
Radhika	41.04	25.79	234.92	9.20
Miss Okra 18	37.51	20.73	221.04	7.66
Swati	40.09	25.25	233.75	9.00
Bhindi F1 Hybrid (Smart)	39.95	23.80	208.73	8.33
F-Test	S	S	S	S
S.Ed	1.65	2.47	7.15	0.65
C.D. (5%)	3.47	5.20	21.25	1.37
C.V	5.11	12.86	5.52	9.42

Table 3: Effect of different okra hybrids on quality parameters

Hybrids	Ascorbic Acid (mg/100g)	TSS (0Brix)
Madhavi	3.17	0.74
Sharmili	3.61	1.17
F1 Covi Plus	3.92	2.07
Saundrya	3.90	1.96
Hybrid Bhindi Lily	3.65	1.03
Karishma	3.59	0.90
Radhika	3.86	1.44
Miss Okra 18	3.50	0.87
Swati	3.81	1.35
Bhindi F1 Hybrid (Smart)	3.73	1.19
F-Test	S	S
S.Ed	0.14	0.04
C.D. (5%)	0.30	0.09
C.V	4.81	4.26

Table 4: Effect of different okra hybrids on economics

Okra Hybrids	Cost of Cultivation	Gross Return (Rs./ha)	Net Return (Rs./ha)	B:C Ratio
Madhavi	64296.00	161000.00	96704.00	1.50
Sharmili	64296.00	200000.00	135704.00	2.11
F1 Covi Plus	64296.00	254000.00	189704.00	2.95
Saundrya	64296.00	245000.00	180704.00	2.81
Hybrid Bhindi Lily	64296.00	205000.00	140704.00	2.19
Karishma	64296.00	199250.00	134954.00	2.10
Radhika	64296.00	230000.00	165704.00	2.58
Miss Okra 18	64296.00	191583.33	127287.33	1.98
Swati	64296.00	225000.00	160704.00	2.50
Bhindi F1 Hybrid (Smart)	64296.00	208333.33	144037.33	2.24

Conclusion

Based on the result of the above experimental finding it is concluded that the hybrid F1 COVI PLUS of (10.16 yield t/ha) (Treatment 3), have highest growth metrics and yield characteristics while also being economically viable. However, additional tests are required to corroborate the findings because they are based only one season.

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