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## Evaluation and characterization of okra (*Abelmoschus esculentus* L. Moench.) genotypes in Gwalior region

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### Abstract

The Okra (*Abelmoschus esculentus*) is a significant vegetable crop and is classified under the Malvaceae family. Okra is an African word native to North Africa, including the region between Ethiopia and Sudan. It is a summer and monsoon plant growing from the tropics to the subtropics. Okra has a few other financial employments moreover. White peered toward black or brown seeds of the develop natural product are now and then broiled and utilized as a substitute for coffee powder. The seeds are moreover a source of an edible oil contained to the degree of 20 percent. This trial was carried out to evaluate the Study on Genetic heritability, variability and genetic advances in Okra (*Abelmoschus esculentus*) during the Kharif season of 2022-23 at the CRC-1 Farm, School of Agriculture, ITM University, Gwalior Madhya Pradesh.). The experimental material comprised of eighteen genotypes including check, which were collected from different source are grown in Gwalior Chambal region which comes under Grid Region of Agro-climatic zone. The genotypes were grown in a randomized block design with three replicates during Kharif season keeping row to row distance of 45 cm and plant to plant distance of 10 cm while seeds are placed about 2 cm deep during the year 2022-2023. The experiment was laid out in Randomized Block Design. The results revealed that the Out of eighteen genotypes VRO-4, PUSA MAKHMALI, AZAD BHINDI-2, PUSA SAWANI, HRB-9-2 from ITM University Gwalior (M.P), were found superior for yield and this germplasm may be recommended for large scale cultivation in Gwalior region and these superior genotypes can be used in breeding programme.

**Keywords:** Characterization, okra (*Abelmoschus esculentus* L. Moench.), genotypes

### 1. Introduction

Okra is the powerhouse of variable nutrients. It is a good source of vitamin C, providing 20 per cent of daily value for a 2000 calorie diet in 100g. It is low in calories and is fat free. Okra is surprising versatile vegetable. The correlation measures the mutual relationship between different traits of a plant; it helps to access the best yield contributing traits. Path analysis deals with a close system of variables that are linearly related. Okra [*Abelmoschus esculentus* (L.) Moench  $2n = 2x=130$ ] is one of the important members of the family Malvaceae and is well-known by many regional names as lady's finger in England, Gumbo in USA, Bhindi in Pakistan and India. Okra is an African word and is native to northern Africa including the area of Ethiopia and Sudan.

Okra plants are characterized by indeterminate growth. Okra is an herbaceous, annual, 1-2 m tall, stem erect, green or with reddish tinge, leaves alternate, broadly cordate, palmately 3-7 lobed, hirsute and serrate. The flower structure combines hermaphroditism and self-compatibility. Flowers are solitary, auxiliary with about 2 cm long peduncle, epi calyx up to 10, narrow hairy bracteoles which fall before the reach's maturity, calyx split longitudinally as flowers opens, petals 5, yellow with crimson spot on claw, 5-7 cm long, staminal column united to the base of petals with numerous stamens, ovary superior, stigma 5-9 deep red. The style is surrounded by a staminal column which may bear more than 100 anthers. The pollen may come in contact with the stigmas through a lengthening of the staminal column or through insect foraging. Thus, the flowers of okra are self-fertile. The pollen grain is large with many pores, and every pore a potential tube source; therefore, many tubes can develop from one pollen grain (Purewal and Randhawa, 1947) [6]. Fruit is capsule, light green or sometimes red in colour pyramidal-oblong, beaked, longitudinally furrowed, 10-30 cm long, dehiscing longitudinally when ripe. Seeds green to dark brown, rounded with numerous stamens, ovary superior, stigma 5-9 deep red. Okra, scientifically known as *Abelmoschus esculentus*, is an annual, warm-season flowering plant that belongs to the Malvaceae family.

Originating from the African continent, this herbaceous plant has become widely cultivated for its edible green pods, which are a popular ingredient in various culinary traditions worldwide.

Botanically, okra exhibits a robust growth habit, reaching heights of 4 to 6 feet, with sturdy stems and large, vibrant green leaves. The flowers of the okra plant are striking, resembling those of hibiscus, with a range of colors from pale yellow to deep red. These flowers ultimately give way to elongated, slender pods, measuring around 5 to 12 centimetres in length, containing numerous small, flat, and rounded seeds. Okra thrives in warm climates and well-drained soils, making it commonly cultivated in tropical and subtropical regions. It is a highly adaptable plant, capable of withstanding drought conditions, although it prefers a consistent water supply for optimal growth and yield.

The unique culinary appeal of okra lies in its mucilaginous or slimy texture, attributed to the presence of soluble fiber and pectin in the pods. This characteristic makes okra an excellent thickening agent in soups and stews while also contributing to its potential health benefits. In addition to its culinary significance, okra is a valuable source of essential nutrients. It is rich in vitamins C and K, providing antioxidants that may contribute to overall health and well-being. Furthermore, okra contains minerals such as potassium, magnesium, and calcium, adding to its nutritional value.

As a culturally significant and economically important crop, ongoing research continues to explore the diverse potential applications of okra, from its use in traditional medicine to its role in sustainable agriculture

## 2. Materials and Methods

The present investigation was carried out at the Horticulture Research Farm, [CRC-1 Crop research Centre-1] Department of Horticulture, School of Agriculture, ITM University, Gwalior (M.P.). The experimental material comprised of eighteen genotypes including check, which were collected from different source are grown in Gwalior Chambal region which comes under Grid Region of Agro-climatic zone. The genotypes were grown in a randomized block design with three replicates during kharif season keep row to row distance of 45 cm and plant to plant distance of 10 cm while seeds are placed about 2 cm deep during the year 2022-2023.

Cultural and agronomic practices were followed as per the standard recommendations and need based plant protection measures were taken up to maintain a healthy crop stand. The experimental material includes different experimental techniques and methodology adopted during the course of investigation which have been described in this chapter.

### 2.1 Locale of Study

The present investigation was carried out at the Horticulture Research Farm, [CRC-1 Crop research Centre-1] Department of Horticulture, School of Agriculture, ITM University, Gwalior (M.P.) which has a sub-tropical climate, The research farm is located at latitude of 26°14' N and longitude of 79°14' E with an elevation of 206 m above the mean sea level. The field at Research Farm, of School of Agriculture, ITM University, Gwalior having homogenous fertility and uniform textural make up was selected for the field experimentation. Although its southern part is surrounded by hills, above sea level is only a few hundred feet height.

## 2.2 Sampling Design

The genotypes were grown in a randomized block design with three replicates during kharif season keep row to row distance of 45 cm and plant to plant distance of 10 cm while seeds are placed about 2 cm deep during the year 2022-2023. Various growth parameters such as Days to First flowering, Days to 50% flowering, Plant height 30 DAS, Plant height 50 DAS, Plant height 75 DAS, Crop duration, No. of leaves per plant, No. of branches per plant, Days to 1st harvest, Days to Maturity, Fruit length (cm), Fruit diameter (cm), Average fruit weight, No. of fruits per plant and Average Yield

## 3. Result and Discussion

### 3.1 Analysis of Variance

The data recorded on fourteen traits from the experiment were subjected to analysis of variance. Mean squares due to treatments were highly significant for all the fourteen traits (Table 1), indicating therefore significant differences among the genotypes with respect to the traits under study. In other words, the genotypes performances in relation to these traits were statistically diverse, indicating that there is plenty of room for selection in the okra germplasm now available.

### 3.2 Mean Performance of Genotypes

The mean performance, general means and range of 18 entries for fourteen characters had been given in table 2.

#### 3.2.1 Days to first flowering

Days to first flowering ranged from 43.00 to 51.33 days. The grand mean for days to first flowering was 48.09 Days. Out of 18 genotypes genotype VRO-5 (43.00 days) followed by VRO-4 (45.33 days), GO-3 (45.33 days), K. Satdhari (46.00 days), HRB-108-2 (46.67 days) and VRO-3 (46.67 days) were found significant for earliness.

#### 3.2.2 Days to 50% flowering:

Days to 50% per cent flowering ranged from 53.66 to 61.33 days. The grand mean for days to 50% per cent flowering was 58.55 days. Out of 18 genotypes VRO-5 (51.33 days) followed by GO-3 (52.00 days), HRB-108-2 (52.00 days), VRO-3 (52.33 days), VRO-4 (52.67 days) and Pusa Sawani (53.00 days) were showed significant for earliness.

#### 3.2.3 Plant height 30 DAS

Plant height 30 days after sowing ranged from 14.02 cm to 30.23 cm. The grand mean for Plant height 30 DAS was 22.03 cm. Out of 18 genotypes Pusa makhani (30.23 cm) followed by Pusa Sawani (28.75 cm), VRO-4 (26.18 cm), Punjab-8 (24.08 cm), Arka Abhay (24.56 cm) and GO-3 (23.76 cm) were found significant for earliness.

#### 3.2.4 Plant height 50 DAS:

Plant height 50 DAS ranged from 33.26 cm to 91.39 cm. The grand mean for Plant height 30 DAS was 58.68 cm. Out of 18 genotypes Pusa makhmali (91.39 cm) followed by Pusa Sawani (69.81 cm), VRO-4 (68.38 cm), Punjab-8 (64.74 cm), BO-13 (63.52 cm) and IIVR-11 (61.55 cm) were found significant for earliness.

#### 3.2.5 Plant height 75 DAS:

Plant height 75 DAS ranged from 66.53 to 181.45. The grand mean for Plant height 75 DAS was 117.34 cm. Out of 18 genotypes only six genotypes' Pusa makhmali (181.45 cm)

followed by Pusa Sawani (140.29 cm), VRO-4 (136.77 cm), Punjab-8 (129.48 cm), BO-13 (127.04 cm) and IIVR-11 (123.10 cm) were found significant for Plant height 75 DAS.

**Table 1:** Analysis of variance (mean squares) for fourteen quantitative characters in okra.

S. No.	Traits	Source of variation		
		Replication	Treatments	Error
	<b>D.F</b>	2	17	34
1	Days to first flowering	5.41	17.32**	4.8
2	Days to 50% flowering	2.72	14.51**	4.27
3	Days to Maturity	44.22*	69.57**	9.95
4	Crop Duration	41.17**	144.24**	10.01
5	Plant height 30 DAS	440.55**	47.56**	7.85
6	Plant height 50 DAS	639.73**	436.89**	13.02
7	Plant height 75 DAS	1077.99**	1722.41**	24.83
8	No. of leaves per plant	28.95**	9.74**	1.06
9	No. of Branches per Plant	6.05**	4.31**	0.29
10	Fruit Diameter (cm)	12.99**	3.51**	0.63
11	Number of fruit per plant	97.02**	18.59**	3.65
12	Fruit length (cm)	26.67**	41.71**	1.9
13	Avg fruit weight (gm)	61.91**	35.36**	5.17
14	Avg Yield at final picking (kg/plot)	0.04	1.41**	0.11

**Table 2:** Mean performance of 18 genotypes for fourteen characters in okra.

S. No.	Genotypes	Plant height 30 DAS	Plant height 50 DAS	Plant height 75 DAS	No. of leaves per plant	No. of Branches per Plant	Days to first flowering	Days to 50% flowering	Days to Maturity	Crop Duration	Fruit Diameter (cm)	Number of fruit per plant	Fruit length (cm)	Avg fruit weight (gm)	Avg Yield at final picking (kg/plot)
1	VRO5	14.02	33.27	66.53	4.33	2	43	53.67	57.33	71.33	6.12	12.00	8.71	13.76	1.66
2	HRB-231	17.1	42.79	85.57	6.07	2.33	50.67	60.67	50.67	64.67	6.83	13.67	13.37	17.91	2.22
3	K.SATDHARI	20.52	61.54	123.08	9.53	2.33	46	60.33	42.67	56.67	4.67	15.33	15.40	18.06	2.73
4	HRB-108-2	20.62	61.29	122.57	9.6	2.67	46.67	56.67	48.67	62.67	5.46	15.33	17.08	15.02	2.32
5	JBS-2	18.33	52.13	104.27	8.47	2.67	50.33	60.33	49.33	63.33	8.32	15.33	13.97	14.43	2.16
6	PHULIUTKARSH	21.18	50.73	101.45	7.47	3	51	61	55.67	69.67	6.68	13.33	19.64	16.82	2.27
7	VRO-3	18.61	50.65	101.29	7.93	3.67	46.67	56.67	56.67	70.67	7.52	14.67	16.26	18.09	2.41
8	HRB-9-2	21.27	55.07	110.13	8.53	4	49.33	59.33	57.33	78.33	5.73	17.00	16.79	20.28	2.88
9	AZAD BHINDI-2	19.97	54.24	108.48	8.53	4	47.33	57.33	50.67	71.67	7.68	16.00	17.12	22.95	3.36
10	VRO-4	26.19	68.39	136.77	10.5	5	45.33	56.67	53.33	74.33	7.82	18.33	18.06	24.21	3.73
11	PUSA SAWANI	28.76	69.81	140.29	10.27	5	47.33	58.67	58.33	79.33	5.77	18.00	19.03	19.32	3.04
12	BO-13	21.44	63.52	127.04	9.93	4	47.33	58	60	81	6.56	14.00	13.09	15.56	2.13
13	PUSA MAKHMAL	30.23	91.39	181.45	12.8	6	50.67	60.67	54.33	75.33	5.69	19.33	18.45	19.34	3.41
14	GO-3	23.76	58.35	116.69	8.6	5	45.33	55.33	59	80	7.75	18.33	20.14	17.51	2.86
15	PUNJAB-8	24.09	64.74	129.48	9.73	4.67	49.67	59.67	60.33	81.33	5.65	16.33	13.38	17.33	2.80
16	BCO-1	23.22	57.47	114.95	8.6	2.33	51.33	61.33	55.33	69.33	6.58	13.00	18.26	16.65	2.23
17	ARKA ABHAY	24.56	59.45	118.89	8.33	2.67	47.33	57.33	56.67	70.67	8.35	10.67	9.44	15.30	1.65
18	IIVR-11	22.82	61.55	123.11	9.4	2.67	50.33	60.33	60.67	74.67	7.47	11.67	23.49	9.03	0.99
	Mean	22.04	58.69	117.34	8.81	3.56	48.09	58.56	54.83	71.94	6.70	15.13	16.20	17.31	2.49
	Min	10.12	27	59	3.6	2	40	52	40	54	4.00	9.00	7.68	7.79	0.81
	Max	38.08	101.14	194	13.4	7	56	66	63	84	9.75	24.00	24.90	26.54	4.03
	S.Em.±	1.62	2.08	2.88	0.59	0.31	1.26	1.19	1.82	0.61	0.46	1.10	0.80	1.31	0.19
	C.D. at 5%	4.65	5.99	8.27	1.71	0.9	3.64	3.43	5.23	3.13	1.32	3.17	2.29	3.77	0.56
	C.V. (%)	12.72	6.15	4.25	11.67	15.17	4.56	3.53	5.75	6.23	11.87	12.62	8.50	13.13	13.50

**3.2.6 Number of leaves per plant**

Number of leaves/plants varied from 4.33 to 12.80. The grand mean for Number of leaves/plants was 8.81. Among the 18 genotypes VRO-5 (95.33) followed by HRB 231 (96.00), Phuli utkarsh (97.67), VRO-3 (98.67) and Arka abhay (99.67) were to be found significant in early group for the Amount of leaves/plant.

**3.2.7 Number of branches per plant**

Number of branches/plants varied from 2 to 6. The grand mean for Number of branches/plants was 3.55. Among the 18 genotypes Pusa makhmali (6.00) followed by Pusa Sawani (5.00), VRO-4 (5.00), GO-3 (5.00) and Punjab-8 (4.66) were to be found significant.

**3.2.8 Number of fruits per plant**

The Number of fruits per plant ranged from 10.66 to 19.33. The grand mean for Number of fruits per plant was 15.12. Out

of 18 genotypes the genotypes were found significant for Number of fruits per plant in which top five genotypes were, Pusa makhmali (19.33) followed by VRO-4 (18.33), GO-3 (18.33), Pusa sawani (18.00) and HRB-9-2 (17.00).

**3.2.9 Fruit Length (cm)**

Fruit length ranged from 8.71 to 23.48 cm. The grand mean for Fruit length was 16.20 cm. Out of 18 genotypes only four genotypes' IIVR-11 (23.48cm) followed by GO-3 (20.14cm), Phuli utkarsh (19.64 cm), Pusa sawani (19.02 cm) and Pusa makhmali (18.45 cm) were found significant for Fruit length.

**3.2.10 Fruit Diameter (cm)**

Fruit diameter ranged from 4.66 to 8.35 cm. The grand mean for fruit diameter was 6.70 cm. Out of 18 genotypes Arka abhay (8.35 cm) followed by JBS-2 (8.31 cm), VR-4 (7.81 cm), GO-3 (7.75 cm), Azad bhindi (7.68 cm), and VRO-3 (7.51 cm) were found significant for fruit diameter.

### 3.2.11 Crop duration

Crop duration ranged from 56.66 to 81.33. The grand mean for Crop duration was 71.94. Out of 18 genotypes K. satdhari (5.66) followed by HRB-108-2 (62.66), JBS-2 (63.33) and HRB 231 (64.66) were found significant for Crop duration.

### 3.2.12 Average fruits weight (g)

Average fruit weight ranged from 9.02 g to 24.20 g. The grand mean for Average fruit weight was 17.30 g. Out of 18 genotypes VRO-4 (24.20 g) followed by Azad bhindi (22.95 g), HRB-9-2 (20.28 g), Pusa makhmali (19.34 g), Pusa sawani (19.31 g) were found significant for average fruit weight.

### 3.2.13 Days to maturity

Days to maturity Days ranged from 42.66 to 60.66. The grand mean for days to maturity was 54.83. Out of 18 genotypes K. Satdhari (42.66) followed by HRB-108-2 (48.66), JBS-2 (49.33), Azad bhindi (50.66) And HBS-231 (50.66) were found significant for days to maturity.

### 3.2.14 Fruit yield per plant (kg)

Fruit yield per plant ranged from 0.99 kg to 3.72 kg. The grand mean for Fruit yield per plant was 2.49 kg. Out of 18 genotypes VRO-4 (3.72 kg) followed by Pusa makhmali (3.41 kg), Azad bhindi (3.36 kg), HRB-9-2 (2.88 kg), GO-3 (2.86 kg), and K.Satdhari (2.73 kg) were found significant for Fruit yield per plant.

## 4. Conclusion

The analysis of variance (mean of squares) for fourteen quantitative characters were highly significant for all the traits indicating ample variation among the genotypes. Out of eighteen genotypes VRO-4, PUSA MAKHMALI, AZAD BHINDI-2, PUSA SAWANI, HRB-9-2 from ITM University Gwalior (M.P), were found superior for yield and this germplasm may be recommended for large scale cultivation in Gwalior region and these superior genotypes can be used in breeding programme. The highest phenotypic as well as genotypic coefficients of variation were observed in case of Number of branches per plant (35.93% and 32.57%) followed by Average fruit yield per plot (29.58% and 26.32%) Fruit length (24.04% and 22.48%) number of leaves per plant (22.56% and 19.31%) and Average fruit weight (22.55% and 18.33%). Heritability estimates were high for plant height 50 DAS, fruit length, no. of branches per plant, crop duration, average yield, no. of leaves per plant, whereas days to maturity, average fruit weight, plant height 30 DAS fruit diameter indicating scope of high selection response.

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