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Mean performance of yield and its attributing characters in germplasm of okra [*Abelmoschus esculentus* (L.) Moench]

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Abstract
The present study was conducted at the College of Horticulture and Forestry, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya during the rainy season of 2022-23. The objective of this study is to find out the genetic variability within the genotypes. Plant material consisted of 31 genotypes of okra including 1 check namely Kashi Pragati in randomized block design of 45x30 cm^2 with three replications. Evaluation was done for different yield and quality traits. Among the test entries, range for total pod yield (q/ha) varied from 87.04 to 227.36 and it was highest in NDO-23-19 followed by NDO-23-30, NDO-23-24, NDO-23-21 and other 9 more performed better over the check.

Keywords: Okra, marketable yield, earliness

Introduction
Okra or lady`s finger [*Abelmoschus esculentus* (L.) Moench.] commonly known as Bhindi belongs to the family Malvaceae. It is native to Tropical Africa. Portuguese introduce the crop in other part of the world. Its cultivation spread throughout Middle East and North Africa (Tindall 1983 & Lamont 1999) [18, 13]. Now okra is grown in many parts of the world, especially in tropical and sub-tropical countries (Arapitsas, 2008 & Saifullah, 2009) [5, 16].
India accounts for about 72% of total world production and it ranks first in production in the world with an area of 0.52 million hectares and a production of 6.35 million tonnes while productivity is 12.22 t/ha (Anonymous, 2022) [3]. Andhra Pradesh is the leading state in production, approximately 1184.2 thousand tonnes from 78.90 thousand ha area, with an average productivity of 15 tons per hectare. In Uttar Pradesh, it is cultivated in 25.42 thousand hectares area and producing with 347.70 MT with an average productivity of 13.68 t/ha (Anonymous, 2022) [3].
The tender fruits are used as a vegetable and consumed boiled, or in culinary preparations as chopped and fried pieces. For off-season use, okra fruits are sliced, sundried, canned, or dehydrated. The mature seeds are roasted, grinded, and used as a replacement of coffee. Okra has a high fiber content, which helps maintain blood sugar by regulating the rate at which sugar is absorbed from the intestinal tract. Its consumption among other fruit vegetables was found beneficial in moderating blood pressure, fibrinogen concentration and plasma viscosity in Nigerian hypertensives (Adebawoo *et al*., 2007) [1].
Before implementing any breeding strategy, it is mandatory to determine the genetic diversity present in the available genotypes for yield and its components. The degree of diversity in germplasm can be determined by using genotypic and phenotypic coefficients of variation. Heritability and genetic variation influence both the impact of the environment on character expression and the extent to which improvement can be achieved after selection. (Datta and Das, 2014) [9].
Direct selection can't improve yield because it is a complex attribute dependent on several genetic and environmental factors. Yield is affected by the expression and interaction of various plant growth factors. It is essential for any crop improvement program to closely examine the relationship between yield and the factors which affect it.

Studies such as correlation and path analysis can help us understand the relationship between different variables and yield. Study of correlation revealed the type and degree of distinct relationships between attributes. The path coefficient analysis differentiates between both indirect and direct effects by dividing the correlation coefficient using additional important variables.

Materials and Methods

The experimental plant material consists of 31genotypes of okra. These genotypes were evaluated in a Randomized block design of 45x30 cm^2 with three replications during Kharif season of 2022-23. The crop will be raised using recommended Package of Practices of Vegetables by Department of vegetable Science, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya.

The data were collected on day to first flower appearance, days to 50% flowering, days to first pod harvest, first pod producing node, pod length, pod diameter, stem diameter, number of seed per pod, average pod weight, number of pod per plant, pod yield per plant, internodal length, plant height, total pod yield (Table 1). The data were analysed by windostat 9.2 data analysis software.

Results and Discussion

The days to first flower appearance per plant ranged from 35.00 (NDO-23-10) to 43.33 (NDO- 23-19), and the grand mean is 38.83. Out of thirty-one genotype 6 genotype was found significant for early flowering than the best check Kashi Pragati (37.00). A similar result was reported by Aminu *et al.,* (2017) [2], Mahapatra *et al.,* (2007) [14].

Days to 50% flowering ranged from 38.67 days (NDO-23-10) to 47.33 days (NDO- 23-19). Out of thirty-one genotype 5 genotypes (NDO-23-3, NDO-23-5, NDO-23-10, NDO-2317 and NDO-23-26) was found significantly early for days to 50% flowering than the best check Kashi Pragati (40.67). A similar result was reported by Binalfew *et al.,* (2016) [7] and Pandey *et al.,* (2017) [15].

Days to first pod harvest ranged from 43.00 days (NDO-23-8) to 52.00 days (NDO- 2319) out of thirty-one genotype 9 genotypes was found significantly early for first fruit harvest than the best check variety Kashi Pragati (45.33).

First pod production node ranged from 3.48 (NDO-23-10) to 4.18 (NDO-23-19). Out of thirty-one genotypes only 8 genotypes found significantly early for first fruit producing node than the best check variety Kashi Pragati (3.67).

Pod length of genotype ranged from 9.50 cm in case of NDO-23-9 to 13.54 in case of NDO-23-1. Out of 31 genotypes Twenty-seven genotypes were found significant for longer fruit than the best check Kashi Pragati (12.84 cm). A similar result was reported by Pandey *et al.,* (2017) [15].

Pod diameter ranged from 11.33mm (NDO-23-25) to 14.80 mm (NDO-23-6) out of 31 genotypes 29 genotypes were found significantly higher pod diameter than the best check variety Kashi Pragati (14.43mm). A similar result was reported by Singh *et al.,* (2017) [17].

Average fruit weight ranged from 9.00g (NDO -23-1 and NDO-23-8), to 14.67g (NDO23-24) out of thirty-one genotypes 22 genotypes were found significantly higher pod weight then the check variety Kashi Pragati (13.50g). A similar result was reported by Koundinya *et al.,* (2013) [11].

Number of pod per plant range from 13.00 (NDO-23-8) to 26.67 (NDO-23-4) out of thirty-one genotypes 14 genotypes were found significantly maximum number of pod per plant then the best check Kashi Pragati (19.18). A similar result was reported by Jindal and Deepak (2010) [10].

The internodal length range from 4.20 cm (NDO-23-17, NDO-23-20, NDO-23-24 and NDO-23-29) to 6.00cm (NDO-23-25 and NDO-23-30) out of thirty-one genotypes four genotypes were found significantly highest internodal length then the best check Kashi Pragati (4.40 cm).

The stem diameter ranges from 10.80 mm (NDO-23-18) to 20.10 mm (NDO-23-28). Out of thirty-one genotypes 20 genotypes were found significantly highest stem diameter then the best check Kashi Pragati (15.60 mm). A similar result was reported by Chadha *et al.,* (2014) [8]; Pandey *et al.,* (2017) [15] and Ansari *et al.,* (2020) [4].

Plant height ranged from 43.87cm in case of NDO-23-8 to 110.13cm in case of NDO23-30. out of thirty-one genotypes only fourteen genotypes NDO-23-3 (82.17), NDO-23-4 (77.47), NDO-23-5 (83.53), NDO-23-6 (97.80), NDO-23-11 (75.07), NDO-23-13 (92.60),

NDO-23-14 (86.40), NDO-23-15 (82.60), NDO-23-16 (76.67), NDO-23-23 (76.20), NDO-2325 (81.60), NDO-23-27 (91.60), NDO-23-28 (93.20) and NDO-23-30 (110.13) were found significantly tall than the best check Kashi Pragati (73.80).

Number of seed per pod ranged from 31.60 (NDO-23-4) to 58.80 (NDO-23-6). Out of thirty-one genotypes only 17 genotypes were found highest number of seed per pod significant than the best check Kashi Pragati (44.80).

Pod yield per plant (g) range from 117.50 (NDO-23-8) to 306.93 (NDO-23-19). Out of thirty-one genotypes 8 genotypes NDO-23-6 (269.27), NDO-23-16 (275.10kg), NDO-23- 19 (306.93), NDO-23-21 (278.97), NDO-23-23 (275.50), NDO-23-24 (287.73), NDO-23-27 (268.80) and NDO-23-30 (292.75) were found highest pod yield per plant then the check variety Kashi Pragati (268.63). A close result was reported by Kumar *et al.,* (2023) [12].

Total highest fruit yield (q/ha) (227.36) was recorded with NDO-23-19 and lowest fruit yield per plant (87.04) was observed in NDO-23-8. Out of thirty-one genotypes 8 genotypes NDO-23-6 (199.46), NDO-23-16 (203.78), NDO-23-19 (227.36), NDO-23-21 (206.64), NDO23-23 (204.08), NDO-23-24 (213.14), NDO-23-27 (199.11) and NDO-23-30 (216.85) were found highest total pod yield then the check variety Kashi Pragati (198.99). A similar result was reported by Ashraf *et al.,* (2020) [6].

Table 1: Mean performance of 31 genotypes for thirteen characters in okra

	Days to first flowering	Days to 50% Flowering	First pod producing node	Days to first pod harvest	Pod length [cm]	pod diameter [mm]	Average pod weight [g]	Number of pod per plant	Internodal length [cm]	Stem diameter [mm]	Plant hight [cm]	Number of seed per pod	Pod yield per plant [g]	TotaL pod yield [q/hac]
NDO-23-1	40.33	44.00	3.91	47.67	13.54	13.10	9.00	17.80	5.00	10.90	64.40	46.20	160.67	119.01
NDO-23-2	39.00	43.00	3.80	46.33	13.00	13.00	10.00	17.73	4.60	11.07	62.80	33.40	178.33	132.10
NDO-23-3	36.00	40.33	3.54	44.33	12.10	13.90	12.00	18.40	5.27	11.40	82.17	48.40	220.40	163.26
NDO-23-4	42.67	46.00	4.10	50.00	13.20	12.40	9.50	26.67	5.20	11.30	77.47	31.60	253.80	188.00
NDO-23-5	35.67	39.33	3.51	43.67	11.30	13.20	10.50	21.00	5.80	17.23	83.53	43.00	220.67	163.46
NDO-23-6	39.67	42.67	3.86	47.00	12.20	14.80	12.00	22.40	5.60	16.30	97.80	58.80	269.27	199.46
NDO-23-7	39.33	43.33	3.83	47.33	11.30	12.80	13.50	16.00	4.40	16.10	61.40	33.33	216.33	160.25
NDO-23-8	36.33	41.67	3.59	43.00	11.59	12.80	9.00	13.00	4.40	15.70	43.87	50.40	117.50	87.04
NDO-23-9	39.67	44.33	3.86	47.67	9.50	12.30	9.83	16.53	4.80	16.70	57.23	54.40	162.43	120.32
NDO-23-10	35.00	38.67	3.48	43.67	11.17	12.90	9.90	17.40	5.20	12.07	72.83	33.73	172.47	127.75
NDO-23-11	37.67	41.00	3.70	45.67	11.40	13.20	11.00	17.20	5.00	15.60	75.07	56.40	189.53	140.40
NDO-23-12	41.67	45.33	4.02	49.67	11.67	13.60	11.50	20.20	5.00	14.60	64.63	49.00	232.67	172.35
NDO-23-13	42.67	46.67	4.10	49.67	9.90	13.00	14.00	19.00	5.80	19.30	92.60	52.00	266.17	197.16
NDO-23-14	36.67	41.67	3.59	45.00	11.94	11.60	11.67	20.40	5.60	12.40	86.40	55.00	237.83	176.18
NDO-23-15	40.33	44.33	3.91	49.00	11.04	11.80	10.50	18.93	5.20	15.57	82.60	48.80	199.33	147.66
NDO-23-16	37.33	42.00	3.67	44.67	11.20	13.00	14.00	19.67	5.40	11.00	76.67	37.70	275.10	203.78
NDO-23-17	36.67	40.33	3.62	44.67	10.52	12.10	13.00	19.13	4.20	15.50	62.07	33.80	249.27	184.64
NDO-23-18	37.67	42.00	3.70	46.00	11.44	12.30	12.00	18.93	5.00	10.80	69.40	49.00	226.73	167.95
NDO-23-19	43.33	47.33	4.18	52.00	11.34	12.27	14.50	21.13	4.40	12.40	72.60	42.60	306.93	227.36
NDO-23-20	42.33	46.00	4.08	49.67	11.64	13.20	13.00	19.20	4.20	11.90	61.80	38.00	249.87	185.09
NDO-23-21	39.33	43.33	3.83	47.33	11.29	11.90	14.00	19.87	5.00	12.00	71.30	39.87	278.97	206.64
NDO-23-22	39.33	43.00	3.83	47.33	11.05	12.20	13.00	19.20	4.40	12.10	62.40	43.33	249.73	184.99
NDO-23-23	40.00	44.33	3.89	48.00	12.12	12.20	14.50	18.93	5.60	12.60	76.20	57.20	275.50	204.08
NDO-23-24	36.67	40.67	3.64	45.00	12.13	11.80	14.67	19.60	4.20	11.30	61.80	31.80	287.73	213.14
NDO-23-25	37.67	41.67	3.69	46.67	10.14	11.33	10.00	18.80	6.00	14.30	81.60	41.33	188.33	139.51
NDO-23-26	35.67	39.33	3.53	45.00	10.50	11.60	10.00	19.20	5.60	11.60	71.00	37.80	192.27	142.42
NDO-23-27	40.67	44.33	3.94	49.33	11.16	12.30	13.17	20.40	5.60	19.80	91.60	33.80	268.80	199.11
NDO-23-28	37.33	41.00	3.67	45.33	11.31	11.73	12.00	19.20	5.60	20.10	93.20	36.33	230.80	170.97
NDO-23-29	38.67	43.33	3.80	47.67	11.95	12.40	10.00	17.00	4.20	11.50	62.13	35.33	170.33	126.17
NDO-23-30	41.33	46.00	4.02	49.67	11.53	12.10	14.07	20.80	6.00	17.20	110.13	46.67	292.75	216.85
Kashi Pragati (Check)	37.00	40.67	3.67	45.33	12.84	14.43	13.50	19.80	4.40	15.60	73.80	44.80	268.63	198.99
Mean	38.83	42.83	3.79	46.88	11.52	12.62	11.91	19.15	5.05	14.06	74.27	43.35	229.3	169.87

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C.V.	7.32	6.86	6.11	5.93	7.19	8.61	5.43	5.63	5.77	5.13	5.11	5.50	8.82	8.82
S.E.	1.64	1.70	0.13	1.60	0.48	0.63	0.37	0.62	0.17	0.42	2.19	1.38	11.67	8.65
C.D. 5%	4.64	4.80	0.38	4.54	1.35	1.77	1.06	1.76	0.48	1.18	6.20	3.90	33.02	24.46
C.D. 1%	6.18	6.38	0.50	6.04	1.80	2.36	1.41	2.34	0.63	1.57	8.25	5.18	43.92	32.53
Range Lowest	35.00	38.67	3.48	43.00	9.50	11.33	9.00	13.00	4.20	10.80	43.87	31.60	117.50	87.04
Range Highest	43.33	47.33	4.18	52.00	13.54	14.80	14.67	26.67	6.00	20.10	110.13	58.80	306.93	227.36

Conclusion

Okra [*Abelmoschus esculentus* (L.) Moench] is one of the important vegetable crops of Malvaceae family. The present investigation was undertaken to evaluate 31genotypes of okra for horticultural traits. The genotypes viz. NDO-23-19 followed by NDO-23-30, NDO-23-24, NDO-23-21 and other 9 more performed better over the check (Kashi Pragati) in terms of total pod yield (q/ha). It can be concluded that, as a wide range of variation for almost all the economically important traits was present in this crop, so there is a vast scope for improvement through different breeding procedure.

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