

Effect of row orientation, maturity stages and pod position on seed yield and quality of okra

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Okra (*Abelmoschus esculentus* L. Moench) is a warm season crop and grown during rainy [kharif] and summer [zaid] season for tender green fruits. It is a member of malvaceae family. Kashi Pragati, a newly developed cultivar of okra from IIVR, Varanasi, is high yielding and resistant to yellow vein mosaic virus. It is a known fact that the production practices that result in maximum yield apply even more so for the production of optimum quality seeds as well. It has been observed in some crops that the row orientation during planting plays an important role in enhancing the production. In *Brassica juncea* genotypes, higher yield per plant were recorded by Mahto and Haider [1], when sown in east-west orientation. Mahto [2] also observed superior yield attributes on *Brassica juncea* plants sown in east-west orientation. Such information for okra crop could not be found in literature though it is a very popular vegetable. The stage of maturity of fruits at harvest and their position on the plant are also considered to affect the seed yield and quality. Doijode [3] has documented that several factors, which affect vegetable seed quality during production, include seed maturity and fruit position on mother plant also. Therefore, the present investigation was undertaken to study the effect of row orientation, fruit maturity stages and fruit position on the plant on seed yield and quality in okra.

The present study was conducted at the research farm of Indian Institute of Vegetable Research, Varanasi during kharif

2007 on okra cv. Kashi Pragati in a factorial design with three replications. The rows of experiment were made in east-west [R1] and north-south [R2] directions at 60 cm spacing.

The seeds in each row were placed manually at 20 cm apart and recommended cultural practices were followed. There were 25 plants in each plot measuring 3m² (3x1m). The fruits were harvested for seed from both the row orientation at turning (green to brown-M1) and full mature (brown-M2) stage from three different positions i.e. lower, middle and upper fruiting nodes. The observations were recorded from five randomly selected plants in each plot. Plant height was measured with the help of meter scale. The number of branches per plant, nodes per plant, pods per plant and seeds per pod were counted at harvesting stage. The 1000 seeds were counted with the help of an automatic seed counter (Tripette & Renaud, France) and the 1000 seed weight (g) was measured with the help of an electronic balance (Mettler-Toledo, Switzerland). The seed yield (q/ha) was calculated on the basis of plot yield. For germination test, four replications of 50 seeds each were put in rolled germination towels and placed in a seed germinator (Calton, India) at 25°C. The germination counts were performed at 4 and 14 days and the mean percentage of normal seedlings was calculated. The statistical analysis of data recorded in the study was done as per Gomez and Gomez [4].

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The results indicated that row orientation significantly affect all the parameters. The maximum plant height (100.93 cm), number of branches (2.16), nodes per plant (26.11), fruits per plant (18.38), number of seeds per pod (59.11), 1000 seed weight (60.72 g), seed yield (13.38 q/ha) and germination (89.18%) were found in east-west direction (Table 1). Similar results in *Brassica juncea* have been reported [8]. Since the references on this aspect in okra could not be found in literature, the data is supported by the studies conducted on other crop. It seems that the east-west direction rows got maximum sunlight resulting in better conservation of assimilates thereby giving better performance over the north-south directional rows.

The maturity stages had insignificant effect on all the parameters in this study except the number of seeds per pod and 1000 seed weight. Maximum number of seeds per pod (54.25) and 1000 seed weight (60.23 g) were found at turning stage (Table 1). It may be due to minimum infestation from pests and minimum loss during harvesting at this stage. Various workers [5-8] found the similar results.

Results indicate that pod positions were insignificant for all the parameters except for the number of seeds per pod and 1000 seed weight, which were noted to be significantly superior at 54.75 and 61.54 g (Table 1), respectively in the pods from lower portion on the plants compared to the middle

Table 1. Mean effect of row orientation, maturity stages and fruit position

Factors	Plant height (cm)	No. of branches per plant	No. of nodes per plant	No. of fruit per plant	No. of seed per pod	1000 seed weight (%)	Seed yield (q/ha)	Germination (%)
R ₁	100.93	2.16	26.11	18.38	59.11	60.72	13.38	89.18
R ₂	67.63	1.53	17.58	13.51	47.88	58.58	8.37	84.96
CD (p=0.05)	4.60	0.28	1.12	1.19	1.48	0.84	0.88	1.94
Maturity stages (MS)								
M ₁	83.88	1.88	22.02	16.09	54.25	60.23	11.16	97.90
M ₂	84.68	1.81	21.67	15.80	52.74	59.07	10.59	86.24
CD (p=0.05)	4.60	0.27	1.12	1.19	1.47	0.84	0.87	1.94
Fruit position (FP)								
P ₁	85.54	1.90	22.50	15.97	54.76	61.54	11.33	87.45
P ₂	85.55	1.94	21.53	15.61	52.86	58.90	10.80	86.70
P ₃	81.74	1.68	21.50	16.25	52.87	58.50	10.48	87.06
CD (p=0.05)	5.63	0.34	1.37	1.46	1.81	1.02	1.06	2.37

- Row Orientation: east-west [R₁] & north-south [R₂].
- Maturity stage: (Turning-green to brown)-M₁ & (Full mature-brown)-M₂.
- Fruit Position: Lower (P₁), Middle (P₂) & Upper fruiting nodes (P₃).

and upper portion pods. The middle and upper position showed at par effect for 1000 seed weight and germination percent. It seems that since the lower position fruits appeared first, they enjoyed maximum opportunity for light and nutrition and thus could deliver bolder and good quality seeds. These results are in conformity with those reported in peas [9] and in balsam [10].

The interaction of row orientation and maturity stage showed significant effect for all the parameters (Table 1 & 2). Maximum plant height (104.72 cm) was noted in east-west direction at full maturity stage followed

by east-west direction at turning stage. Maximum number of branches per plant (2.28), nodes per plant (26.15), fruits per plant (18.60), number of seeds per pod (60.17), 1000 seed weight (62.06 g), seed yield (13.54 q/ha) and germination (90.17%) were all noted in east-west oriented rows and at full maturity stage. The results follow same pattern as their mean effect separately.

Interaction of row orientation and pod position significantly affected all the parameters. East-west direction and lower pod position resulted in significantly superior plant height (101.63 cm), number of branches

Table 2. Interaction effect of RO x MS and RO x FP

Interactions	Plant height (cm)	No. of branches per plant	No. of nodes per plant	No. of fruit per plant	No. of seed per pod	1000 seed weight (%)	Seed yield (q/ha)	Germination (%)
RO x MS								
R1M1	97.73	2.28	26.15	18.60	60.17	62.06	13.54	90.17
R1M2	104.12	2.03	26.07	18.17	58.06	59.38	13.22	88.20
R2M1	70.01	1.48	17.88	13.59	48.33	58.41	8.78	85.63
R2M2	65.24	1.59	17.28	13.43	47.42	58.76	7.96	84.29
CD (p=0.05)	6.50	0.39	1.58	1.69	2.09	1.18	1.23	2.73
RO x FP								
R1P1	101.63	2.30	26.76	18.60	60.56	62.45	13.65	90.20
R1P2	99.97	2.12	25.23	18.01	58.08	60.45	13.27	88.87
R2P3	101.18	2.05	26.33	18.53	58.68	59.25	13.23	88.48
R2P1	69.45	1.52	18.23	13.35	48.95	60.63	9.02	84.70
R2P2	71.13	1.77	17.83	13.22	47.63	57.37	8.35	84.55
R2P3	62.30	1.32	16.66	13.97	47.05	57.75	7.73	85.63
CD (p=0.05)	7.96	0.48	1.94	2.06	2.56	1.45	1.50	3.35

RO = row orientation, MS = maturity stage, FP = fruit position

Table 3. Effect of interaction of row orientation, maturity stages and fruit position (RO x MS x FP)

RO x MS FP	Plant height (cm)	No. of branches per plant	No. of nodes per plant	No. of fruit per plant	No. of seed per pod	1000 seed weight (%)	Seed yield (q/ha)	Germi X nation (%)
R1M1P1	94.77	2.37	27.17	18.83	61.60	63.27	13.73	92.07
R1M1P2	94.67	2.37	25.53	17.93	59.90	62.56	13.73	90.47
R1M1P3	103.77	2.10	25.76	19.03	59.00	60.33	13.16	87.96
R1M2P1	108.50	2.23	26.37	18.37	59.53	61.63	13.56	88.33
R1M2P2	105.27	1.87	24.93	18.10	56.27	58.33	12.80	87.27
R1M2P3	98.60	2.00	26.90	18.03	58.37	58.17	13.30	89.00
R2M1P1	73.83	1.37	19.27	14.03	50.00	59.83	9.53	86.80
R2M1P2	75.03	1.73	17.70	13.60	47.77	56.83	8.93	85.17
R2M1P3	61.17	1.33	16.67	13.13	47.23	58.56	7.86	84.93
R2M2P1	65.07	1.67	17.20	12.67	47.90	61.43	8.50	82.60
R2M2P2	67.23	1.80	17.97	12.83	47.50	57.90	7.76	83.93
R2M2P3	63.43	1.30	16.67	14.80	46.87	56.93	7.60	86.33
CD (p=0.05)	11.26	0.67	2.74	2.92	3.61	2.05	2.12	4.74

RO = row orientation, MS = maturity stage, FP = fruit position

per plant (2.30), number of nodes per plant (26.76), number of pods per plant (18.60), number of seeds per pod (60.56), 1000 seed weight (62.45 g), seed yield (13.65 q/ha) and germination (90.2%). It may also be attributed to mean effects of factors (Table 2).

East-West direction, full maturity and lower pod position showed maximum plant height (108.5 cm). It followed the same trend as mean effects of factors. Maximum number of branches per plant (2.37), number of nodes per plant (27.13), number of seeds per pod (61.60), 1000 seed weight (63.27 g), seed yield (13.73 q/h) a and germination (92.07%) were found in east-west direction, at turning stage of pod and lower pod position (Table 3). It also followed the same trend as mean effect of each factor.

It can thus be surmised that for higher yield of good quality seeds in okra its rows should be oriented in east-west direction. The

harvesting of pods should be done at turning stage before they have fully dried appearance and splitting of fruits at its ridges start. The seeds extracted from the pods on lower portion of the plants are bolder and have better quality.

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