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Growth, yield and seed quality traits of okra as affected by fruit positions and fruit retention loads

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Abstract
An experiment was conducted at Vegetable Research farm, Kalyanpur and Seed Testing Laboratory of Department of Seed Science & Technology, CSAUA&T, Kanpur by using Factorial Randomized Block Design and Factorial Complete Randomized Design respectively with three replications. The okra variety, Arka Anamika was tested with 12 treatment combinations (consisted of two fruit retention loads, R_1 and R_2 as factor – I and six fruit positions, P_1, P_2, P_3, P_4, P_5 and P_6 as factor – II). It is concluded that treatment combination, R_1P_1(Retention of fruits borne on 1-3 nodes for seed purpose and harvesting remaining fruits for vegetable purpose) was found to be superior for most of the yield contributing traits, green fruit yield and seed quality parameters whereas, R_1P_6(Retention of all fruits for seed purpose) was found to be superior for seed yield.

Keywords: Fruit retention loads, fruit positions, seed quality and seed yield

Introduction
Okra is one of the most important vegetable crops grown for its green fruits for vegetable purpose. There is a greater demand of its seeds from growers. Various factors influence the seed yield in okra among which position of fruit and fruit retention load are of great significance. Ability of seeds to produce more number of normal and vigorous seedlings depends on proper seed filling and maturation. Green fruit pickings promote fruit development and higher yield as it stimulates okra fruits to produce more number of fruits per plant. Quality of seed often determines the stability of yield in vegetable crops. Nucleus seeds which are of high quality should therefore be collected from fruits harvested at physiological maturity. In indeterminate flowering plants, the fruits may vary widely in seed maturity depending on the nodal positions of the seed pod. Traditionally, the whole plant of okra is harvested for seed purpose and the grower has to wait till the maturity of last fruit. Bhanuje and Raikar (2016) [2] conducted a study in brinjal and reported that treatment T7 (Retaining all fruits for seed purpose) resulted in better seed yield. Significant differences due to fruit load and green fruit pickings were noticed for seed yield, fruit yield, test weight, germination percentage, root length, shoot length, vigour index and seedling dry weight. Under low fruit load, the competition for assimilates being likely reduced, the phloem flux to fruits increased, similarly to the xylem and transpiration fluxes, without any changes in the fruit water potential (Mohammadi *et al.*, 2015) [8]. Retaining six fruits per plant resulted in increased fruit length, fruit diameter, fruit weight, 100 seed weight, seed germination percentage, seed vigour index-I and seed vigour index-II. Seed yield per plant, per plot and per hectare was highest in the treatment where twelve fruits were retained on a plant of okra. (Kumari *et al.*, 2013) [7]. Francis and Opondo (2011) [3] reported that pod position had effects on test weight of seeds, germination rate (time to reach 50% germination) and percentage germination. As regards test weight of seeds, bottom fruits produced heavier seeds than middle and top fruits. Seeds from bottom and middle fruits germinated faster than those from top fruits. The seeds harvested from bottom fruits and middle fruits showed higher germination than those from top fruits in Spider plant (*Cleome gynandra* L.).
Quality seed pays not cost, the extent of utility of the secondary inputs are directly associated with quality seed as a primary input. The vegetable crops in which green fruits are directly used as a vegetable, the scarcity of quality seed has often been observed. Okra, being an indeterminate in nature it has a peculiar fruiting behaviour. The next flowering and fruiting does not happen until formation of previous fruits are not completed. Being it, the maturity of fruits happens in different intervals and influences the source to sink system. The present investigation has been conducted to identify the judicious system of distribution of

photosynthates among the fruits vis-a-vis to seeds. The ways of picking and retention of the green fruits at different nodes would be most effective to harness the highest vigorous seed with optimum seed yield as well as fetch the purpose of green fruit to be marketed.

Materials and Methods

Seed, Sowing and Treatment Combinations

The experiment was conducted at Vegetable research Farm, Kalyanpur and Seed Testing laboratory of department of Seed Science and technology, C.S. Azad university of Agriculture and Technology, Kanpur, Uttar Pradesh (India) during 2017. The seeds of okra *cv*. Arka Anamika (Best tech Seeds Pvt. Ltd.) were procured from the private seed seller of Kanpur. The seeds were sown plot wise in pre-marked treatment combinations. The inter and intra row spacing of 60 X 30 centimetre was maintained in each plot and the gross plot size was 3.0 x 4.5 metre. The okra variety, Arka Anamika was tested with 12 treatment combinations (consisted of two fruit retention loads, R_1 and R_2 as factor – I and six fruit positions, P_1, P_2, P_3, P_4, P_5 and P_6 as factor – II) and replicated thrice. The description of 12 Treatment Combinations (TC) are as follows: TC_1: R_1P_1 (Retention of fruits borne on 1-3 nodes for seed purpose and harvesting remaining fruits for vegetable purpose), TC_2 : R_1P_2 (Retention of fruits borne on 4-8 nodes for seed purpose and harvesting remaining fruits for vegetable purpose), TC_3 : R_1P_3 (Retention of fruits borne on above 8th nodes for seed purpose and harvesting remaining fruits for vegetable purpose), TC_4 : R_1P_4 (Retention of fruits borne on 1-8 nodes for seed purpose and harvesting remaining fruits for vegetable purpose), TC_5 : R_1P_5 (Retention of fruits borne on 4th node & onwards for seed purpose and harvesting remaining fruits for vegetable purpose), TC_6 : R_1P_6 (Retention of fruits borne on all nodes for seed purpose), TC_7: R_2P_1 (Retention of all fruits and collection of seeds from fruits borne on 1-3 nodes), TC_8 : R_2P_2 (Retention of all fruits and collection of seeds from fruits borne on 4-8 nodes), TC_9 : R_2P_3 (Retention of all fruits and collection of seeds from fruits borne on above 8th nodes), TC_{10}: R_2P_4 (Retention of all fruits and collection of seeds from fruits borne on 1-8 nodes), TC_{11} : R_2P_5 (Retention of all fruits and collection of seeds from fruits borne on 4th node & onwards) and TC_{12}: R_2P_6 (Retention of all fruits and collection of seeds from all nodes).

Collection of Experimental Data

Five plants in each treatment and replication were randomly selected and tagged for recording the observations on growth characters. The data on seed yield was collected after harvest of the crop. Weather data recorded during the crop growth period are given in Table – 1.

The following observations were recorded in the field experiment by adopting the given procedures

Days to flower initiation: In each treatment the earlier five tagged plants were observed every day for first flower initiation from 35th day after sowing onwards and the days in which appearance of first flower was noticed was recorded as days to flower initiation from the date of sowing.

Fruit length (cm): After the harvest of the fruits from earlier tagged five plants in each treatment and replication, the five fruits were selected at random for recording the length of fruit. The length of fruit was measured from tip of fruit to point of attachment to the pedicel. The mean of five fruits was computed and expressed in centimetre.

Number of fruits per plant: The total number of fruits per plant from earlier tagged five plants from each treatment and replication in three pickings was recorded and the average number of fruits from five plants were calculated and expressed in number.

Number of seeds per fruit: The five fruits used for measuring length were used for recording the number of seeds per fruit. The seeds from each fruit were separated manually by hand and counted. The average number of seeds from five fruits were calculated and expressed in number.

Green fruit yield (kg/ha): The green fruits harvested from each plot, replication and treatment wise were weighed in kilograms (kg) and recorded as green fruit yield per plot. The green fruit yield per ha was calculated on the basis of net plot green fruit yield.

Seed yield (kg/ha): The seed yield of five earlier tagged plants was added to the seed yield of net plot area for recording the observation of seed yield per plot. The seed yield per ha was calculated on the basis of net plot seed yield.

Laboratory observations: The seeds harvested from each treatment combination were evaluated for the following seed quality parameters in the laboratory of Department of Seed Science and Technology, College of Agriculture, C S Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh (India).

Test weight (gm/1000 seeds): The one thousand seed weight in grams was recorded from each treatment combination as per the procedure given by ISTA (Anon., 2014) [1].

Standard germination (%): The laboratory germination test was conducted as per the ISTA Rules (Anon., 2014) [1] by adopting rolled towel method. Hundred seeds in four replications were taken at random from each treatment combination and uniformly placed on standard germination paper. The germination paper was kept in the seed germinator maintained at constant temperature of 25^{0}C +/- 0.5^{0}C with at 95 per cent relative humidity. The normal seedlings were evaluated on fourth day (1st count) and 21st day (final count) and the mean was expressed in percentage.

Hard seeds (%): The seed which did not absorb any moisture till end of the test period and remained hard are considered as hard seeds and number of such seeds are counted and expressed in percentage.

Seed density (g/cc): For determining the density of seeds, 100 seeds were immersed in water taken in a measuring cylinder and the rise in water was noted and expressed as cc. Each determination was replicated three times and means value recorded.

Root length (cm): Ten normal seedlings in each treatment were randomly selected from the germination test for measuring the root length on 21st day of germination. The root length was measured from the collar region to the tip of the root. Average root length of ten seedlings was calculated and expressed in centimetre.

Shoot length (cm): The earlier ten seedlings used for the root length measurement were used for measuring the shoot length

also. The shoot length was measured from the collar region to the point of attachment of cotyledons. The average of ten seedlings was calculated and expressed in centimetre.

Total seedling length (cm): The total seedling lengths was calculated by adding root length and shoot length of each treatment combination and expressed in centimetre.

Seedling dry weight (g/10 seedlings): Randomly taken ten normal seedlings which were used for recording seedling length measurement were placed in a butter paper bag and dried for 24 hours in a hot air oven maintained at 70°C. The dried seedlings were removed and cooled in a dessicator for 30 minutes and then the dry weight of seedling was recorded in an electronic balance and expressed in gram per ten seedlings.

Speed of germination: The simplest method is to make preliminary germination counts at a standard time before germination is completed. The seed lots which produce the largest number of germinated seeds at the preliminary count will produce the fastest growing seedling and the fastest stand establishment. A refinement of the above technique is to make germination counts every day until germination is completed. An index of the speed of germination is then calculated by adding the quotients of the daily counts divided by the number of days of germination.

Seed vigour index-I: The vigour index values were calculated as per the method prescribed by Abdul-Baki and Anderson (1973) and expressed in whole number.

Seed Vigour Index-I = Germination (%) x Seedling length (cm)

Seed vigour index-II: The vigour index values were calculated as per the method prescribed by Abdul-Baki and Anderson (1973) and expressed in whole number.

Seed Vigour Index-II = Germination (%) x Seedling dry weight (mg)

Statistical Analysis

The data obtained in this study were subjected to Analysis Of Variance (ANOVA) for a Factorial Randomized Block Design (FRBD) and Factorial Completely Randomized Design (FCRD) for field experiment and laboratory experiment respectively with three replications and the means were compared using OPSTAT of CCSHAU, Hisar, Haryana, India with $P< 0.05$ being accepted as significant.

Results and Discussion

Growth Parameters

Fruit length, number of fruits per plant and number of seeds per fruit recorded significant differences due to fruit positions and fruit retention loads, while, the days to flower initiation was non-significant for fruit retention loads (Table-2). The fruit retention load R_1 (Retention of fruits borne on different nodes for seed purpose and harvesting remaining fruits for vegetable purpose) recorded higher growth as compared to R_2 (Retaining all fruits for seed purpose). Significantly maximum fruit length (10.01cm), number of fruits/plant (23.83) and number of seeds per fruit (52.58) were recorded in R_1 over R_2 fruit retention load (Table-2). Hence, the R_1 fruit retention load being considered as the best may be used to achieve higher growth response in okra crop. This might be due to the fact that under low fruit load, the competition for assimilates reduced. Kumari *et al.* (2013) [7] observed that retaining six fruits per plant resulted in increased fruit length in okra. The results are also in accordance with the findings of Mohammadi *et al.* (2015) [8] and Moniruzzaman and Quamruzzaman (2009) [9] in okra.

The days to flower initiation, fruit length, number of fruits per plant and number of seeds per fruit differed significantly due to the fruit positions. Among the different fruit positions, P_1 (Collection of seeds from fruits borne on 1-3 nodes) recorded significantly minimum days (40.71) for anthesis and maximum number of fruits per plant (23.83) and fruit length (11.29cm) while, lowest values of these traits were recorded in P_3 (Collection of seeds from fruits borne on above 8th node) (Table-2). P_1 (Collection of seeds from fruits borne on 1-3 nodes) fruit position recorded significantly maximum (58.72) number of seeds followed by P_2 (Collection of seeds from fruits borne on 4-8 nodes) (55.68) and P_4 (Collection of seeds from fruits borne on 1-8 nodes) (53.69) and minimum number of seeds (41.68) were in P_3 (Collection of seeds from fruits borne on above 8th node) (Table-2). It happened due to the reason that lower position fruits remained on the plant for longer period subsequently absorbed more nutrients and minerals and gradually decreases in apex direction. Yadav and Dhankar (2001) [13] reported higher values of seeds per fruit from lower positions of plant closely followed by middle position and significantly lower values were observed in seeds of upper position fruits of okra. These findings are in line with those of Prabhakar *et al*. (2003) [10] and Ibrahim and Oladiran (2011) [4] in okra.

Yield Parameters

Significant difference in green fruits yield was found due to the fruit positions. The P_1 fruit position was found to be highest (3624.00 Kg/ha) contributor of green fruits yield followed by P_2 (3113.00 Kg/ha) and P_3 (2446.00 Kg/ha) while the minimum was recorded with P_5 (906.00 Kg/ha) (Table-3). The increase in green fruit yield in case of P_1 (collection of seeds from 1-3 nodes) may be due to the higher number of green fruits harvested for vegetable purpose. Moniruzzaman and Quamruzzaman (2009) [9] reported that the treatment of picking of 10 green fruits produced the highest green fruit yield/ha. In okra. As far as the fruit retention loads are concerned, green fruits were not harvested in R_2 fruit retention load (Retaining all fruits for seed purpose).

Seed yield exhibited significant differences due to fruit retention loads and variation in growth parameters. The fruit retention load R_1 recorded significantly highest seed yield (434.66 kg/ha) over the R_2 (406.83kg/ha) (Table-3). The P_6 fruit position recorded significantly highest (779.50 kg/ha) seed yield followed by P_4 (627.50 Kg/ ha.) and P_2 (440.50 Kg./ha.) while, minimum (164.00 kg/ha) seed yield was recorded in P_3 fruit position (Table-3). The increase in seed yield in case of P_6 (collection of seeds from all fruits) may be due to the higher number of fruits were taken for collection of seeds. These findings are in agreement with the findings of Bhanuje and Raikar (2016) [2] in brinjal and Kumari *et al.* (2013) [7] in okra.

Seed Quality Parameters

Influence of fruit positions and fruit retention loads on standard germination % and per cent hard seeds exhibited significant differences. Significantly highest (79.11%) germination was recorded with R_1 (Retention of fruits borne

on different nodes for seed purpose and harvesting remaining fruits for vegetable purpose) over R_2 (Retaining all fruits for seed purpose) (76.14%) (Table - 4). Kumari *et al.* (2013) [7] found out that retaining six fruits per plant in okra crop resulted to increase the seed germination percentage. These results are in agreement with the findings of Victor *et al*. (1993) in bell pepper. Fruit positions also exhibited significant differences on standard germination (%). The P_1 (Collection of seeds from fruits borne on 1-3 nodes) position of the fruit recorded significantly highest (83.76%) germination, while minimum (67.24%) germination was recorded in P_3 (Collection of seeds from fruits borne on above 8th nodes) position of the fruit (Table-4). Lowest germination percentage in the seeds of top position fruits may be due to poor supply of photosynthates at maturity and resultant shrivelled seeds which are affected by insects at later periods of crop harvesting. Seeds obtained from lower and middle position fruits were found to be of better vigour and viability as compared to seeds of upper position fruits. Francis and Opondo (2011) [3] reported that the seeds harvested from bottom fruits and middle fruits showed higher germination than those from top fruits in Spider plant. These findings are in accordance with the findings of Yadav and Dhankhar (2001) [13] in okra.

Significantly lowest per cent hard seeds were recorded in R_1 fruit retention load (6.42%) over R_2 (8.54%) (Table-4). The P_1 fruit position recorded significantly minimum (5.87%) hard seeds while maximum was found in P_3 (10.37%) fruit position (Table-4). The number of hard seeds varied with the fruit positions. It was significantly lower in fruit harvested from lower and middle nodes. This may be reasoned out to fruits at lower nodes get maximum share of assimilate and water during fruit formation, seed development and maturation. Incidentally, fruits at higher nodes lag behind in the competition for assimilate as the time available for assimilation of storage reserves is quite shorter.

Furthermore, the seed quality assessed by test weight, root length, shoot length, total seedling length, seedling dry weight, seed vigour index-I and II, seed density and speed of germination exhibited significant differences due to fruit retention loads (Table-5, 6 and 7). The R_1 (Retention of fruits borne on different nodes for seed purpose and harvesting remaining fruits for vegetable purpose) fruit retention load recorded significantly higher values for test weight (62.84g), root length (13.90cm), shoot length (19.22 cm), total seedling length (34.00 cm), seedling dry weight (0.229 g), seed vigour index –I (2762.39), seed vigour index –II (18.46), seed density (16.07 g/cc) and speed of germination (17.75) over R_2 (Table-5, 6 and 7). It may be attributed to the reason that retaining selected fruits for seed purpose on the plant absorbed more nutrients and minerals as compared to retaining all fruits for seed purpose on the same plant. The similar findings were also reported by Kumar *et al*., (2007) [6] in sweet pepper, Jolli *et al*., (2009) [5] in tomato, Kumari *et al.* (2013) [7] and Bhat and Singh (1996) in okra.

Seed density, shoot length, root length, total seedling length, seedling dry weight, test weight, seed vigour index-I, II and speed of germination exhibited significant differences due to positions of fruit (Table-5, 6 and 7). Among the fruit positions, the P_1 (Collection of seeds from 1-3 nodes) fruit position recorded significantly maximum seed density (18.63 g/cc), root length (14.87 cm), shoot length (20.18 cm), total seedling length (35.06 cm) seedling dry weight (0.264 g), speed of germination (19.35), test weight (72.21 g), seed vigour index-I (2936.72) and seed vigour index –II (22.18) (Table-5, 6 and 7). It may be attributed to the reason that lower position fruits remained on the plant for longer period of time and thus absorbed more nutrients and minerals which go on decreasing towards the top of the plant, there by resulting in lower seed weight, reduced vigour and viability in seeds of upper position fruits. Similar results were also recorded by Yadav and Dhankhar (2001) [13] in okra, and Rao *et al*. (2004) in okra.

Conclusions

Thus, it is concluded that treatment combination, R_1P_1 (Retention of fruits borne on 1-3 nodes for seed purpose and harvesting remaining fruits for vegetable purpose) was found to be superior for most of the yield contributing traits, green fruit yield and seed quality parameters whereas, R_1P_6 (Retention of all fruits for seed purpose) was found to be best for seed yield. Finally, for harvesting the vigorous seed, the treatment combination R_1P_1 and for getting the highest seed yield, the treatment combination R_1P_6 may be adopted.

Table 1: Weekly weather parameters recorded during crop growth of okra in *Kharif* season, 2017

Standard week	Temperature (^{0}C)		Relative Humidity (%)	Rainfall (mm)
	Max.	Min.		
22 – 28 July	30.7	24.7	82.4	38.7
29 July- 4 Aug	32.6	27.1	78	4.4
5 – 11	33.8	26.3	82	106.1
12 – 18	32.5	25.6	74	2.4
19 – 25	32.2	26.3	81	73.8
26 Aug- 01 Sep	34.1	25.7	79.6	3.1
2 – 8	35.8	26.1	81.2	0
9 – 15	36.9	26.6	51.31	1.3
16 – 22	32.3	24.9	81.17	23.2
23 – 29	35.1	24.6	69	0
30 Sep – 06 Oct	35.7	25.1	65.26	0
7 – 13	36.3	24.4	64.41	0
14 – 20	36.6	20.7	69.23	0
21 – 27	35.3	14.6	51.44	0

Source: Meteorological observatory, CSA University of Agriculture & Technology, Kanpur (Uttar Pradesh), India

Table 2: Influence of fruit positions and fruit retention loads on growth parameters of okra

Treatments	Days to flower initiation			Fruit length(cm)		
	R_1	R_2	Mean	R_1	R_2	Mean
P_1	40.87	40.55	40.71	11.86	10.73	11.29
P_2	41.19	41.44	41.31	10.29	9.97	10.13
P_3	42.13	42.47	42.30	8.67	8.21	8.44
P_4	40.89	40.72	40.80	10.21	9.48	9.84
P_5	42.78	42.89	42.83	9.77	8.91	9.34
P_6	40.85	40.92	40.88	9.31	8.83	9.07
Mean	41.45	41.49	41.47	10.01	9.35	9.68
Comparing	*P*< 0.05		S.E. (d)	*P*< 0.05		S.E. (d)
R	N.S.		0.29	0.48		0.23
P	1.06		0.51	0.83		0.40

Treatments	Number of fruits /plant			Number of seeds/ fruit		
	R_1	R_2	Mean	R_1	R_2	Mean
P_1	33.66	14.00	23.83	60.21	57.23	58.72
P_2	26.00	13.00	19.50	56.35	55.01	55.68
P_3	27.66	12.00	19.83	44.22	39.15	41.68
P_4	23.00	14.00	18.50	54.72	52.67	53.69
P_5	19.33	12.00	15.66	50.96	47.09	49.02
P_6	13.33	13.00	13.16	49.02	48.30	48.66
Mean	23.83	13.00	18.41	52.58	49.90	51.24
Comparing	*P*< 0.05		S.E. (d)	*P*< 0.05		S.E. (d)
R	3.67		1.81	0.79		0.38
P	2.26		1.12	1.36		0.66

Table 3: Influence of fruit positions and fruit retention loads on yield parameters of okra

Treatments	Green fruit yield (Kg/ha.)			Seed yield (Kg/ha.)		
	R_1	R_2	Mean	R_1	R_2	Mean
P_1	3624.00	0.00*	3624.00	197.00	182.00	189.50
P_2	3113.00	0.00	3113.00	456.00	425.00	440.50
P_3	2446.00	0.00	2446.00	174.00	154.00	164.00
P_4	1723.00	0.00	1723.00	652.00	603.00	627.50
P_5	906.00	0.00	906.00	338.00	309.00	323.50
P_6	0.00*	0.00	0.00*	791.00	768.00	779.50
Mean	2362.40	0.00	2362.40	434.66	406.83	420.74
Comparing	*P*< 0.05		S.E. (d)	*P*< 0.05		S.E. (d)
R	---------		---------	11.87		5.72
P	485.20		234.04	20.55		9.91

*In R_2 and P_6, green fruits were not harvested for vegetable purpose

Table-4: Influence of fruit positions and fruit retention loads on standard germination % and hard seeds % of okra

Treatments	Standard germination %			Hard seeds %		
	R_1	R_2	Mean	R_1	R_2	Mean
P_1	85.40	82.13	83.76	4.91	6.83	5.87
P_2	82.69	79.39	81.04	5.14	7.26	6.20
P_3	68.77	65.71	67.24	9.26	11.49	10.37
P_4	81.51	79.68	80.59	5.72	7.87	6.79
P_5	78.96	75.09	77.02	6.89	9.04	7.96
P_6	77.43	74.84	76.13	6.62	8.77	7.69
Mean	79.11	76.14	77.62	6.42	8.54	7.48
Comparing	*P*< 0.05		S.E. (d)	*P*< 0.05		S.E. (d)
R	1.98		0.95	0.48		0.23
P	3.43		1.65	0.83		0.40

Table 5: Influence of fruit positions and fruit retention loads on seed density (g/cc), root length (cm) and shoot length (cm) of okra

Treatments	Seed density (g/cc)			Root length (cm)			Shoot length (cm)		
	R_1	R_2	Mean	R_1	R_2	Mean	R_1	R_2	Mean
P_1	19.20	18.07	18.63	15.19	14.56	14.87	21.11	19.26	20.18
P_2	15.72	14.93	15.32	14.67	13.91	14.29	20.23	19.13	19.68
P_3	13.33	12.75	13.04	12.45	11.63	12.04	17.85	17.02	17.43
P_4	16.02	14.11	15.06	14.04	11.98	13.01	19.33	18.82	19.07
P_5	14.05	13.39	13.72	13.26	12.26	12.76	18.46	17.59	18.02
P_6	13.89	13.22	13.55	13.82	12.31	13.06	18.37	17.63	18.00
Mean	15.36	14.41	14.88	13.90	12.77	13.33	19.22	18.24	18.73
Comparing	*P*< 0.05		S.E. (d)	*P*< 0.05		S.E. (d)	*P*< 0.05		S.E. (d)

R	0.67	0.33	0.53	0.25	0.56	0.27
P	1.16	0.57	0.92	0.44	0.97	0.47

Table 6: Influence of fruit positions and fruit retention loads on total seedling length (cm), seedling dry weight (g) and speed of germination of okra

Treatments	Total seedling length (cm)			Seedling dry weight (g)			Speed of germination		
	R_1	R_2	Mean	R_1	R_2	Mean	R_1	R_2	Mean
P_1	36.30	33.82	35.06	0.285	0.244	0.264	19.97	18.73	19.35
P_2	34.90	33.04	33.97	0.217	0.190	0.203	18.89	18.46	18.67
P_3	30.30	28.65	29.47	0.180	0.158	0.169	16.07	15.89	15.98
P_4	33.37	30.80	32.08	0.202	0.176	0.189	17.68	17.05	17.36
P_5	31.72	29.85	30.78	0.189	0.169	0.179	17.11	16.70	16.90
P_6	32.19	29.94	31.06	0.191	0.171	0.181	16.82	16.03	16.42
Mean	33.13	31.01	32.07	0.210	0.184	0.197	17.75	17.14	17.44
Comparing	$P < 0.05$		S.E. (d)	$P < 0.05$		S.E. (d)	$P < 0.05$		S.E. (d)
R	1.04		0.50	0.017		0.008	0.39		0.19
P	1.81		0.88	0.029		0.014	0.67		0.32

Table 7: Influence of fruit positions and fruit retention loads on test weight (g), seed vigour index-I and seed vigour index-II of okra

Treatments	Test weight (g)			Seed vigour index-I			Seed vigour index-II		
	R_1	R_2	Mean	R_1	R_2	Mean	R_1	R_2	Mean
P_1	73.32	71.11	72.21	3012.05	2861.40	2936.72	24.33	20.03	22.18
P_2	72.08	69.51	70.79	2849.49	2667.50	2758.49	17.94	15.08	16.51
P_3	48.11	45.36	46.73	2187.57	1991.01	2089.29	12.37	10.38	11.37
P_4	62.52	57.79	60.15	2764.00	2634.22	2699.11	16.46	14.02	15.24
P_5	59.13	56.27	57.70	2565.41	2343.55	2454.48	14.92	12.69	13.80
P_6	61.93	58.09	60.10	2517.24	2423.31	2470.27	14.78	12.79	13.78
Mean	62.84	59.68	61.26	2649.29	2486.83	2568.06	16.80	14.16	15.48
Comparing	$P < 0.05$		S.E. (d)	$P < 0.05$		S.E. (d)	$P < 0.05$		S.E. (d)
R	1.44		0.69	30.09		14.57	0.96		0.46
P	2.50		1.20	52.11		25.24	2.06		1.03

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