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Ritu Kumari
Department of Horticulture Vegetable and Floriculture, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

Sangeeta Shree
Department of Horticulture Vegetable and Floriculture, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

Vijay Kumar Singh
Department of Horticulture Vegetable and Floriculture, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

Sanjay Sahay
Department of Horticulture Vegetable and Floriculture, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

Corresponding Author:
Sangeeta Shree
Department of Horticulture Vegetable and Floriculture, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

Effect of plant growth regulators and fresh fruit picking on growth and seed yield of okra

Ritu Kumari, Sangeeta Shree, Vijay Kumar Singh and Sanjay Sahay

Abstract
Present investigation was framed with Sixty (60) treatments consisting of 10 PGR's level, P0 (distilled water), GA_3 (100 ppm, 150 ppm and 200 ppm), NAA (100 ppm, 150 ppm and 200 ppm), IAA (30 ppm, 60 ppm and 90 ppm), 2 Stage of plant for spraying of PGRs, S1 (4 leaf stage), S2 (4 leaf stage + Flower initiation) and 3 pickings of fruits, H1 (3 Pickings of fresh fruits + rest fruits left for seed production), H2 (6 Pickings of fresh fruits + rest fruits left for seed production), H3 (No pickings of fresh fruits + all fruits left for seed production) were laid out in randomized block design (factorial) with three replications to find out the most suitable PGR's level and stage of plant for spray as well as fresh fruit pickings to increase the seed yield of okra. It was observed that the different levels of treatments affected the growth and yield attributes of the crops. Among the treatments, P2S1H1 treatment was recorded maximum plant height (119.50 cm), days taken to 50% flowering (38.17 days), days taken to 1st harvest (25.83 days), number of fruits/ plant (15.25), number of seeds per pod (54.75), 100 seed weight (6.60), Seed yield/ plant (32.64g), seed yield/ha (12.95). Therefore, it may be concluded that P2S1H1 treatment was superior among all treatments. Similar trend was also observed under the treatment P1S1H1.

Keywords: Okra, plant growth regulators, fruit picking, GA3

Introduction
Okra (*Abelmoschus esculentus* (Moench) L.) an annual, often cross-pollinated crop belonging to the family Malvaceae (Naveed *et al*., 2009) [20]. It is an economically important vegetable crop grown in tropical and sub-tropical parts of the world (Saifullah & Rabbani, 2009) [25]. The quality seed is basic input for increasing the crop productivity. Prolonged flowering and maturity of fruit in okra necessitates the picking of fruits at different stages. The seed qualities are changed in fruits harvested at different picking due to differential supply of nutrient by mother plant. Growth regulators help in enhancement for efficient accumulation as well as stimulate physiological processes going on in plant system. They are known to regulate and modify various physiological processes within the plant. Thereby, they influence on plant's morphological characters and yield. The fruit as well as seed yield of okra can be improved with the adoption of scientific cultivation technology including the use of growth regulators. GA_3 has been reported to be beneficial in okra because it is involved in the regulation of growth and development of the crop (Sachs, 1965) [24]. NAA is also being used in many vegetables crops at various stages of development for increasing growth and yield by way of cell elongation, enlargement, division and differentiation. Foliar spray of growth regulator has been found effective in increasing vegetative growth, early fruiting, total yield and quality of fruits in many vegetables (Ramu and Muthuswamy, 1964). [23]

Materials and Methods
The present investigation was carried out at Vegetable Research farm, Bihar Agricultural College, BAU, Sabour, Bhagalpur (Bihar) during two consecutive years of 2018-19 and 2019-20. The design of the experiment was RBD (Factorial), replicated thrice. Seeds were sown and covered with thin layer of soil mixed with FYM. The soil and the weather condition prevailing during the period of investigation was close to normal for the place and could be termed congenial for growth and development of okra.
The treatment comprised Sixty (60) treatments consisting of 10 PGR's level, P0 (distilled water), GA_3 (100 ppm, 150 ppm and 200 ppm), NAA (100 ppm, 150 ppm and 200 ppm), IAA (30 ppm, 60 ppm and 90 ppm), 2 Stage of plant for spraying of PGRs, S1 (4 leaf stage), S2 (4 leaf stage + Flower initiation) and 3 pickings of fruits, H1 (3 Pickings of fresh fruits + rest

fruits left for seed production), H2 (6 Pickings of fresh fruits + rest fruits left for seed production), H3 (No pickings of fresh fruits + all fruits left for seed production). Half of nitrogen as per treatment and full of phosphorus and potassium as a common dose were applied as basal at the time of transplanting and remaining half of nitrogen as per treatments was applied at 30 days after planting of crop. Five plants in each treatment combination and each replication were randomly selected and tagged properly for recording various observations. The observation recorded for the aforesaid five plants were worked out to give mean in respect of all the characters, *viz*. plant height (cm), Number of days to 50% flowering, Number of fruits per plant, Number of seeds/pod, Average fruit length (cm), Days to first harvest, 100 seed weight (g), Seed yield/plant (g), Seed yield/ha. The statistical analysis of the data recorded in all observations was carried out by the method of "Analysis of the variance" prescribed by Fisher and Yates (1963) [6]. Comparison of treatment was made with the help of critical difference (C.D.).

Results and Discussion

The significantly maximum plant height (119.50 cm) was associated with plant growth regulators P2 (GA_3-150 ppm), the maximum plant height (107.35cm) was recorded in S2 (4 leaf stage + flower initiation) and the maximum plant height (108.71cm) was associated with six fresh fruit picking + rest of fruits were left for seed production (H2). The pooled interaction effects of plant growth regulators, stage of plant for spray and fresh fruit pickings significantly affected the plant height. The maximum plant height (120.86 cm) was recorded with the application of GA3-150 ppm at the 4 leaf stage (S1) and six fresh fruit picking + rest fruits for seed production i.e. P2S1H2. The growth regulator GA_3 is recognized as a growth promoter which stimulates the rapid cell elongation in the meristamatic zone of vegetative plant organs. Similar findings were reported by Chandiniraj *et al*. (2016) [3], Bhagure and Tambe (2011) [2], Patil and Patel (2010) [21], Mukesh *et al*. (2009) [15], Kumar and Sen (2000) [11] Natesh *et al*. (2005) [18], Patil *et al*. (2014) [22], Kokare *et al*. (2006) [8] and Marie *et al*. (2007) [13] in Okra. The increase in plant height is due to the diversion of photosynthates to growing tips rather than their utilization for seed development and maturity of fruit. These results are in agreement with those of Tyagi and Khandelwal (1977) [28], Velumani and Ramaswamy (1980) [29], and Ashtaputre (1987) [1] in okra.

Days taken to 50% flowering and days to 1st harvest

The significantly minimum number of days taken to 50% flowering (38.17 days) was associated with plant growth regulators P2 (GA_3-150 ppm). The least number of days taken to 50% flowering (48.17 days) was recorded in S1 (4 leaf stage). The minimum number of days taken to 50% flowering (48.41 days) was associated with six picking of fresh fruit + rest fruits were left for seed production (H2) and The minimum number of days taken to 1st harvest (25.83 days) was recorded in P2 (GA_3-150 ppm). The minimum number of days taken to 1st harvest (28.67 days) was observed in S1 (4 leaf stage). The minimum number of days taken to 1st harvest (28.51days) was associated with three picking of fresh fruit + rest fruit for seed production (H1).

The pooled interaction effects between plant growth regulators, stage of plant for spray and fresh fruit picking were found to be significant for earliness in flowering. The minimum number of days to 50% flowering (37.00) was taken by the application of plant growth regulators P2 (GA_3-150 ppm) with six pickings of fresh fruits + rest fruits left for seed production (H2) in stage S1 (4 leaf stage), The minimum days taken to 1st harvest after anthesis (24.75) was observed in the application of plant growth regulators P2 (GA3-150 ppm) with three picking fresh fruits + rest fruits left for seed production (H1) in stage S1 (4 leaf stage). This might be due to an increase in the endogenous gibberellin level in the plant. The growth regulators might have influenced the physiological regulation of flower formation in the plants, possibly influencing the timing of anthesis mechanism (Das and Prusty, 1969) [4]. When plant sprayed with GA3 remained physiologically more active to build up sufficient food reserve for developing flowers and seed. Similar results have been confirmed by Natesh *et al*. (2005) [18] in chilli. It is due to the fact that the plant, on account of its rapid and increased vegetative growth, built up suitable carbohydrate content. This accumulation of accelerated photosynthates in the plant is more than that required. This increase in the number of flowers might also have been due to the induction of internodes after successive picking. The picking of edible fruits at each picking results in diverting the reserved food material for vegetative growth, which ultimately leads to a greater number of flowers. The pronounced effect in terms of all the above mentioned growth parameters has also been reported by Talab *et al*. (2014) [27], Muhmmad *et al*. (2013) [14], Dhage *et al*. (2011) [5], Patil *et al*. (2008) [20], Zagdani *et al*., 2002 [30].

Number of fruit per plant and number of seed per pod

The maximum number of fruit per plant (15.25) was observed under P2 (GA_3-150 ppm) treatment, which was significantly superior to others plant growth regulators. Maximum number of fruits per plant (12.23) was recorded in S1 (4 leaf stage). The maximum number of fruits per plant (12.25) was associated with 3 picking of fresh fruits + rest fruits for seed production (H1).

The maximum number of seeds per pod (54.75) was recorded in P2 (GA_3-150 ppm), which was significantly higher than others plant growth regulators. Maximum number of seeds per plant (49.58) was observed in S2 (4 leaf stage + flower initiation). The maximum number of seeds per pod (50.20) was associated with 3 picking of fresh fruits + rest of fruits for seed production (H1).

The interaction effects of plant growth regulators, stage of plant for spray and fresh fruit picking on the number of fruits per plant and seeds per pod were significant. The application of plant growth regulators P2 (GA3-150 ppm) with three pickings of fresh fruits + rest fruits left for seed production (H1) in stage S1 (4 leaf stage) resulted in the highest number of fruits per plant (16.00) and number of seeds per pod (56.00). The results obtained may be explained on the basis that the treated plants remained physiologically more active, resulting in a greater number of flowers, more fruits, and a greater number of seeds per pod. The present findings are in agreement with those reported by Munda *et al*. (2000) [16], Naruka and Paliwal (2000) [17], Talab *et al*. (2014) [27], Muhmmad *et al*. (2013) [14]. The physiological role of gibberellins in increasing cell division and elongation and stimulating the complete growth of plants is revealed in better fruit and pod setting. GA3 allows water and dissolved materials to enter the cells of fruits, which leads naturally to

increased fruit size by increasing the permeability of a fruit cell wall, which ultimately increases the yield.

100 Seed weight (g)

The maximum 100 seed weight (6.60g) was recorded in P2 (GA_3-150 ppm). Maximum 100 seed weight (6.04g) was observed in S2 (4 leaf stage + flower initiation). The maximum 100 seed weight (6.05g) was associated with three picking of fresh fruit + rest fruit for seed production (H1).

The pooled interaction effects of plant growth regulators, stage of plant for spray and fresh fruit picking significantly affected the 100 seed weight (g). With the application of plant growth regulators P2 (GA3-150 ppm) with three pickings of fresh fruits + rest fruits left for seed production (H1) in stage S2 (4 leaf stage + flower initiation), the maximum 100 seed weight (6.70g) was observed. The increase in 100 seed weight caused by GA_3 is most likely due to an increase in carbohydrate metabolism, carbohydrate accumulation and enhanced metabolic activity, which resulted in higher metabolite translocation from source to sink, resulting in improved seed development. This could be because of the heavier buildup of sufficient food reserves diversified towards the developing pods and seeds due to spraying of growth regulators this might have favoured increased supply of photosynthates and mobilization efficiency in plants, giving rise to more developed seeds in the pods. The results are in agreement with the findings of Mahorkar *et al*. (2008) [12] and Mukesh *et al*. (2009) [15] in okra.

Seed yield per plant and seed yield per hectare

The maximum seed yield per plant (32.64g) was recorded in P2 (GA_3-150 ppm). The maximum seed yield per plant (28.79g) was observed in S1 (4 leaf stage). The maximum seed yield per plant (30.39g) was associated with three picking of fresh fruit + rest fruit for seed production (H1).

The maximum seed yield/ha (12.95) was recorded in P2 (GA_3-150 ppm). The maximum seed yield/ha (10.59) was observed in S2 (4 leaf stage + flower initiation). The maximum seed yield/ha (11.82) was associated with three picking of fresh fruit + rest fruit left for seed production (H1).

The interaction effects (pooled) of plant growth regulators, stage of plant for spray and fresh fruit picking significantly affected the seed yield per plant and seed yield per hectare. The application of plant growth regulators P2 (GA3-150 ppm) with three pickings of fresh fruits + rest fruits left for seed production (H1) in stage S1 (4 leaf stage) resulted in the highest seed yield per plant (35.66g) and seed yield/ha (14.88 q/ha). Increased seed yield per plant and seed yield per hectare were obviously due to the increased number of fruits per plant and the number of seeds per fruit due to treatment of plant growth regulators. Similar results were reported by Krishnaveni *et al*. (2016) [9], Shahid *et al*. (2013) [26] and Kumar *et al*. (2014) [10] in okra. The fruit yield depends on the accumulation of photo assimilates and partitioning in different plant parts. The yield in okra was found to be strongly influenced by the application of different growth regulators, thus indicating the importance of these compounds in increasing the yield potential through their effect on various growth and yield parameters. GA3 increased the permeability of the cell wall, which allowed a greater amount of water and dissolved materials to enter the cell, and this would naturally increase the weight of the pod, which was reflected in the greatest pod/plant. The present findings are in agreement with those reported by Talab *et al*. (2014) [27], Muhmmad *et al*. (2013) [14],Dhage *et al*. (2011) [5], Patil and Patel (2010) [21], Hussaini and Babu (2004) [7], Zaghdani *et al*. (2002) [30], Naruka and Paliwal (1999) [17],. The picking of green fruits for some period prior to allowing the plants to mature the fruits for seed production significantly affected the size, number of dry fruits, seeds per fruit, seed yield per fruit, per plant and ultimately affected the seed yield per plot, per hectare basis. With the advancement of green fruit pickings, the size and weight of dry fruits were significantly reduced. There was a linear decrease in weight and size of dry fruit with the successive number of pickings of green fruits. The results are in accordance with those of Tyagi and Khandelwal (1985) [28] and Ashtaputre (1987) [1] in okra. The seed yield per plant, per plot, and per hectare was highest in three green fruit pickings; it was 14% more than control or without application of growth regulators. With the advancement of pickings, there was a successive increase in seed yield up to three pickings. Similar results were obtained by Ashtaputre (1987) [1] in okra.

Table 1: Effect of plant growth regulators, stage of plant for spray and number of fresh fruit picking on plant height (cm) of okra *cv.* Super Green

	S1	**S2**	**Mean**	**H1**	**H2**	**H3**
P0	83.86	91.23	87.55	76.36	88.18	98.10
P1	116.00	115.38	115.69	115.18	116.97	114.92
P2	119.29	119.71	119.50	120.02	120.50	117.98
P3	110.71	108.49	109.60	108.76	110.66	109.37
P4	113.35	113.02	113.18	112.45	114.92	112.18
P5	112.60	111.16	111.88	110.73	114.00	110.90
P6	107.23	105.91	106.57	104.75	108.22	106.73
P7	99.96	100.11	100.04	98.80	101.28	100.04
P8	105.09	104.91	105.00	103.51	106.74	104.75
P9	104.81	103.58	104.20	102.50	105.68	104.41
Mean	107.29	107.35		105.31	108.71	107.94
H1	105.76	104.85	105.31			
H2	108.66	108.77	108.71			
H3	107.45	108.42	107.94			
	S.Em±	CD (P = 0.05)		S.Em±	CD (P = 0.05)	
P	1.162	3.26	P*S	1.644	4.60	
S	0.520	NS	P*H	2.013	5.64	
H	0.637	1.78	H*S	0.900	2.52	

Table 2: Interaction effect of plant growth regulators, stage of plant for spray and number of fresh fruit picking on plant height (cm) of okra *cv.* Super Green

Treatments		H1	H2	H3
S1	P0	78.74	83.41	89.44
	P1	115.67	117.17	115.15
	P2	120.38	120.86	116.64
	P3	111.29	111.62	109.21
	P4	113.19	114.69	112.18
	P5	112.25	112.95	112.60
	P6	105.74	108.73	107.23
	P7	97.31	101.78	100.79
	P8	102.77	107.74	104.76
	P9	100.29	107.61	106.54
S2	P0	73.98	92.95	106.77
	P1	114.69	116.77	114.68
	P2	119.67	120.14	119.33
	P3	106.24	109.70	109.53
	P4	111.70	115.16	112.19
	P5	109.22	115.04	109.21
	P6	103.77	107.72	106.24
	P7	100.28	100.78	99.29
	P8	104.25	105.74	104.75
	P9	104.72	103.75	102.27
S.Em±		2.847		
CD (P=0.05%)		7.97		

Table 3: Effect of plant growth regulators, stage of plant for spray and number of fresh fruit picking on days taken to 50% flowering of okra *cv.* Super Green

	S1	S2	Mean	H1	H2	H3
P0	44.17	45.67	44.92	45.50	44.50	44.75
P1	40.00	39.50	39.75	40.00	39.00	40.25
P2	38.17	38.17	38.17	38.75	37.00	38.75
P3	41.67	41.17	41.42	42.00	40.75	41.50
P4	41.83	41.50	41.67	41.50	41.25	42.25
P5	42.33	42.67	42.50	43.00	41.75	42.75
P6	42.33	42.17	42.25	41.75	42.50	42.50
P7	42.67	43.50	43.08	42.25	43.00	44.00
P8	42.67	42.50	42.58	42.50	42.25	43.00
P9	42.83	44.00	43.42	43.25	42.75	44.25
Mean	41.87	42.08		42.05	41.48	42.40
H1	41.50	42.60	42.05			
H2	41.30	41.65	41.48			
H3	42.80	42.00	42.40			
	S.Em±	CD (P = 0.05)		S.Em±		CD (P = 0.05)
P	0.343	0.96	P*S	0.485		1.36
S	0.153	NS	P*H	0.594		1.67
H	0.188	NS	H*S	0.266		NS

Table 4: Interaction effect of plant growth regulators, stage of plant for spray and number of fresh fruit picking on days taken to 50% flowering of okra *cv.* Super Green

Treatments		H1	H2	H3
S1	P0	46.00	43.50	43.00
	P1	39.50	39.50	41.00
	P2	38.00	37.00	39.50
	P3	42.50	41.00	41.50
	P4	40.50	42.00	43.00
	P5	42.50	41.50	43.00
	P6	40.50	43.50	43.00
	P7	41.00	41.00	46.00
	P8	42.00	42.00	44.00
	P9	42.50	42.00	44.00
S2	P0	45.00	45.50	46.50
	P1	40.50	38.50	39.50
	P2	39.50	37.50	38.00
	P3	41.50	40.50	41.50

	P4	42.50	40.50	41.50
	P5	43.50	42.00	42.50
	P6	43.00	41.50	42.00
	P7	43.50	45.00	42.00
	P8	43.00	42.50	42.00
	P9	44.00	43.50	44.50
S.Em±	0.840			
CD (P=0.05%)	2.35			

Table 5: Effect of plant growth regulators, stage of plant for spray and number of fresh fruit picking on number of fruit per plant of okra *cv.* Super Green

	S1	**S2**	**Mean**	**H1**	**H2**	**H3**
P0	10.83	10.67	10.75	11.25	9.75	11.25
P1	14.17	13.33	13.75	13.75	13.75	13.75
P2	15.33	15.17	15.25	15.50	15.00	15.25
P3	11.33	10.67	11.00	11.00	11.25	10.75
P4	13.00	12.50	12.75	13.00	12.50	12.75
P5	12.00	11.83	11.92	12.00	12.00	11.75
P6	11.33	10.83	11.08	11.75	11.00	10.50
P7	10.83	10.33	10.58	10.25	10.00	11.50
P8	12.00	11.83	11.92	12.50	12.25	11.00
P9	11.50	11.00	11.25	11.50	11.25	11.00
Mean	12.23	11.82		12.25	11.88	11.95
H1	12.65	11.85	12.25			
H2	12.20	11.55	11.88			
H3	11.85	12.05	11.95			

	S.Em±	CD (P = 0.05)		S.Em±	CD (P = 0.05)
P	0.191	0.53	P*S	0.270	0.76
S	0.085	NS	P*H	0.330	0.93
H	0.104	NS	H*S	0.148	0.42

Table 6: Interaction effect of plant growth regulators, stage of plant for spray and number of fresh fruit picking on number of fruit per plant of okra *cv.* Super Green

Treatments		**H1**	**H2**	**H3**
S1	P0	10.00	11.50	11.00
	P1	14.50	14.00	13.50
	P2	16.00	12.00	15.00
	P3	11.50	11.50	11.00
	P4	13.50	13.00	12.50
	P5	12.50	12.00	11.50
	P6	11.50	12.50	10.00
	P7	10.50	11.00	12.00
	P8	12.50	12.50	11.00
	P9	12.00	11.50	11.00
S2	P0	9.50	11.00	11.50
	P1	13.50	12.50	14.00
	P2	15.50	13.00	15.00
	P3	11.00	10.50	10.50
	P4	11.50	13.00	13.00
	P5	11.50	12.00	12.00
	P6	10.50	11.00	11.00
	P7	10.50	9.50	11.40
	P8	12.00	12.50	11.20
	P9	10.50	11.50	11.00
S.Em±	0.467			
CD (P=0.05%)	1.30			

Table 7: Effect of plant growth regulators, stage of plant for spray and number of fresh fruit picking on number of seed per pod of okra *cv.* Super Green

	S1	S2	Mean	H1	H2	H3
P0	43.00	45.17	44.08	44.50	43.00	44.75
P1	53.00	53.50	53.25	54.50	51.75	53.50
P2	55.17	54.33	54.75	56.75	52.50	55.00
P3	49.83	50.33	50.08	51.75	49.25	49.25
P4	51.33	50.83	51.08	51.75	51.00	50.50
P5	49.83	50.33	50.08	50.25	50.00	50.00
P6	47.83	49.50	48.67	50.25	47.75	48.00
P7	44.67	46.17	45.42	46.50	44.50	45.25
P8	46.83	48.33	47.58	47.75	47.50	47.50
P9	48.17	47.33	47.75	48.00	47.50	47.75
Mean	48.97	49.58		50.20	48.48	49.15
H1	49.75	50.65	50.20			
H2	48.50	48.45	48.48			
H3	48.65	49.65	49.15			
	S.Em±	CD (P = 0.05)			S.Em±	CD (P = 0.05)
P	0.621	1.74	P*S		0.878	2.46
S	0.278	NS	P*H		1.076	3.01
H	0.340	NS	H*S		0.481	NS

Table 8: Interaction effect of plant growth regulators, stage of plant for spray and number of fresh fruit picking on number of seed per pod of okra cv. Super Green

Treatments		H1	H2	H3
S1	P0	43.00	45.50	40.50
	P1	53.00	53.00	53.00
	P2	56.00	54.50	55.00
	P3	49.50	50.50	49.50
	P4	49.50	52.50	52.00
	P5	50.00	49.50	50.00
	P6	47.50	47.00	49.00
	P7	43.00	47.00	44.00
	P8	47.00	46.50	47.00
	P9	49.50	50.00	45.00
S2	P0	46.50	43.50	45.50
	P1	54.00	52.00	50.50
	P2	55.50	51.50	50.00
	P3	49.00	53.00	49.00
	P4	51.50	51.00	50.00
	P5	50.00	51.00	50.00
	P6	48.50	53.50	46.50
	P7	47.50	46.00	45.00
	P8	48.00	49.00	48.00
	P9	46.00	46.00	50.00
S.Em±		1.521		
CD (P=0.05%)		4.26		

Table 9: Effect of plant growth regulators, stage of plant for spray and number of fresh fruit picking on days to 1st harvest of okra *cv.* Super Green

	S1	S2	Mean	H1	H2	H3
P0	32.00	33.17	32.58	32.50	32.25	33.00
P1	27.83	29.17	28.50	28.25	28.25	29.00
P2	25.33	26.33	25.83	25.00	26.23	26.25
P3	29.50	29.67	29.58	29.25	29.75	29.75
P4	28.17	28.17	28.17	28.00	28.75	27.75
P5	28.50	28.50	28.50	28.00	27.50	30.00
P6	27.83	28.67	28.25	28.50	27.75	28.50
P7	29.83	30.83	30.33	29.50	30.00	31.50
P8	29.33	29.33	29.33	29.00	29.25	29.75
P9	28.33	28.83	28.58	27.75	28.50	29.50
Mean	28.67	29.27		28.58	28.83	29.50
H1	28.00	29.15	28.58			
H2	28.65	29.00	28.83			
H3	29.35	29.65	29.50			
	S.Em±	CD (P = 0.05)			S.Em±	CD (P = 0.05)

P	0.374	1.05	P*S	0.528	1.48
S	0.167	0.47	P*H	0.647	1.81
H	0.205	NS	H*S	0.289	NS

Table 10: Interaction effect of plant growth regulators, stage of plant for spray and number of fresh fruit picking on days to 1st harvest of okra *cv.* Super Green

Treatments		H1	H2	H3
S1	P0	31.00	32.50	32.50
	P1	27.50	27.50	28.50
	P2	24.75	26.00	25.50
	P3	29.00	29.50	30.00
	P4	28.00	28.50	28.00
	P5	28.50	27.00	30.00
	P6	28.50	27.00	28.00
	P7	27.50	30.50	31.50
	P8	28.00	29.50	30.50
	P9	27.00	28.50	29.50
S2	P0	34.00	32.00	33.50
	P1	29.00	29.00	29.50
	P2	25.00	26.50	27.50
	P3	29.50	30.00	29.50
	P4	28.00	29.00	27.50
	P5	27.50	28.00	30.00
	P6	28.50	28.50	29.00
	P7	31.50	29.50	31.50
	P8	30.00	29.00	29.00
	P9	28.50	28.50	29.50
S.Em±		0.915		
CD (P=0.05%)		2.56		

Table 11: Effect of plant growth regulators, stage of plant for spray and number of fresh fruit picking on 100 seed weight (g) *cv.* Super Green

	S1	S2	Mean	H1	H2	H3
P0	5.19	5.43	5.31	5.27	5.39	5.28
P1	6.29	6.35	6.32	6.45	6.16	6.42
P2	6.58	6.60	6.60	6.65	6.45	6.50
P3	6.20	6.11	6.15	6.17	6.11	6.18
P4	6.19	6.25	6.22	6.13	6.18	6.35
P5	6.03	6.18	6.11	6.41	6.02	6.10
P6	5.91	5.88	5.89	5.98	5.89	5.80
P7	5.78	5.69	5.73	5.52	5.83	5.80
P8	6.06	6.02	6.04	5.97	6.05	6.10
P9	6.01	5.86	5.94	5.95	5.97	5.93
Mean	6.03	6.04	6.03	6.05	6.01	6.04
H1	6.10	6.01	6.05			
H2	6.03	5.98	6.01			
H3	6.05	6.03	6.04			

	S.Em±	CD (P = 0.05)		S.Em±	CD (P = 0.05)
P	0.070	0.20	P*S	0.099	0.28
S	0.031	NS	P*H	0.121	0.34
H	0.038	NS	H*S	0.054	NS

Table 12: Interaction effect of plant growth regulators, stage of plant for spray and number of fresh fruit picking on 100 seed weight (g) of okra *cv.* Super Green

Treatments		H1	H2	H3
S1	P0	5.00	5.36	5.23
	P1	6.47	6.04	6.37
	P2	6.60	6.34	6.46
	P3	6.15	6.32	6.13
	P4	6.13	6.11	6.33
	P5	6.25	5.91	5.93
	P6	6.07	5.87	5.79
	P7	5.31	6.03	6.00
	P8	5.75	6.17	6.25
	P9	5.98	6.07	5.99
S2	P0	5.54	5.42	5.33

	P1	6.32	6.29	6.46
	P2	6.70	6.56	6.54
	P3	6.19	5.90	6.24
	P4	6.14	6.25	6.38
	P5	6.15	6.14	6.26
	P6	5.90	5.92	5.81
	P7	5.74	5.63	5.71
	P8	6.19	5.93	5.94
	P9	5.85	5.87	5.88
S.Em±	0.171			
CD (P=0.05%)	0.48			

Table 13: Effect of plant growth regulators, stage of plant for spray and number of fresh fruit picking on seed yield per plant (g) *cv.* Super Green

	S1	**S2**	**Mean**	**H1**	**H2**	**H3**
P0	23.36	25.02	24.19	25.68	21.90	25.00
P1	31.70	31.06	31.38	33.19	29.34	31.60
P2	33.09	32.19	32.64	34.72	30.40	32.80
P3	29.32	29.11	29.22	30.16	27.49	30.01
P4	30.23	29.31	29.77	31.37	27.57	30.36
P5	29.60	29.16	29.38	30.71	27.10	30.33
P6	28.69	28.43	28.56	29.76	26.36	29.57
P7	26.37	25.79	26.08	29.06	22.10	27.07
P8	28.25	28.33	28.29	29.93	25.44	29.48
P9	27.28	27.93	27.61	29.31	24.52	28.99
Mean	28.79	28.63		30.39	26.22	29.52
H1	30.37	30.41	30.39			
H2	26.39	26.05	26.22			
H3	29.60	29.44	29.52			
	S.Em±	CD (P = 0.05)			S.Em±	CD (P = 0.05)
P	0.360	1.01		P*S	0.509	1.43
S	0.161	NS		P*H	0.623	1.75
H	0.197	NS		H*S	0.279	0.78

Table 14: Interaction effect of plant growth regulators, stage of plant for spray and number of fresh fruit picking on seed yield per plant (g) of okra *cv.* Super Green

Treatments		**H1**	**H2**	**H3**
S1	P0	23.40	21.57	25.12
	P1	34.03	29.27	31.79
	P2	35.66	30.43	33.19
	P3	30.10	27.28	30.59
	P4	31.29	28.04	31.35
	P5	30.62	27.67	30.52
	P6	29.65	26.81	29.61
	P7	29.93	22.61	26.55
	P8	29.81	25.51	29.41
	P9	29.21	24.75	27.88
S2	P0	27.97	22.22	24.87
	P1	32.36	29.41	31.41
	P2	33.78	30.37	32.41
	P3	30.22	27.70	29.43
	P4	31.46	27.11	29.37
	P5	30.81	26.54	30.14
	P6	29.86	25.92	29.52
	P7	28.19	21.58	27.60
	P8	30.06	25.37	29.55
	P9	29.42	24.28	30.10
S.Em±	0.881			
CD (P=0.05%)	2.45			

Table 15: Effect of plant growth regulators, stage of plant for spray and number of fresh fruit picking on seed yield/ha (q/ha) *cv.* Super Green

	S1	**S2**	**Mean**	**H1**	**H2**	**H3**
P0	8.38	9.16	8.77	9.23	7.74	9.35
P1	12.15	11.98	12.06	13.83	10.54	11.83
P2	13.01	12.89	12.95	14.88	10.96	13.01
P3	10.39	10.55	10.47	11.00	10.02	10.40

P4	11.11	11.34	11.23	12.80	9.72	11.16
P5	10.51	10.79	10.65	12.34	9.24	10.37
P6	10.02	10.48	10.25	11.86	8.85	10.04
P7	8.94	8.93	8.94	9.90	7.77	9.14
P8	10.03	10.08	10.05	11.38	8.86	9.92
P9	9.75	9.69	9.72	11.03	8.51	9.62
Mean	10.43	10.59		11.82	9.22	10.48
H1	11.92	11.72	11.82			
H2	8.83	9.61	9.22			
H3	10.54	10.43	10.48			
	S.Em±	CD (P = 0.05)		S.Em±		CD (P = 0.05)
P	0.147	0.41	P*S	0.208		0.58
S	0.066	0.19	P*H	0.255		0.72
H	0.081	NS	H*S	0.114		0.32

Table 16: Interaction effect of plant growth regulators, stage of plant for spray and number of fresh fruit picking on seed yield/ha (q/ha) of okra *cv.* Super Green

Treatments		H1	H2	H3
S1	P0	8.85	7.55	8.74
	P1	14.18	10.33	11.95
	P2	14.88	10.65	13.51
	P3	10.75	9.85	10.58
	P4	13.05	9.10	11.19
	P5	12.45	8.79	10.30
	P6	12.05	8.23	9.78
	P7	9.93	7.18	9.73
	P8	11.60	8.55	9.94
	P9	11.48	8.13	9.65
S2	P0	9.60	7.93	9.95
	P1	13.48	10.75	11.71
	P2	14.80	11.28	12.51
	P3	11.25	10.19	10.23
	P4	12.55	10.34	11.13
	P5	12.23	9.70	10.45
	P6	11.68	9.48	10.30
	P7	9.88	8.37	8.55
	P8	11.15	9.18	9.90
	P9	10.58	8.90	9.59
S.Em±		0.361		
CD (P=0.05%)		1.01		

Note: Control (P0)- Distilled water, GA3-100 ppm (P1), GA3-150 ppm (P2), GA3- 200 ppm (P3), NAA-100 ppm (P4), NAA-150 ppm (P5), NAA- 200 ppm (P6), IAA -30 ppm (P7), IAA- 60 ppm (P8), IAA -90 ppm (P9) and 2 stage of plant for spray; 4 leaf stage (S1), 4 leaf stage + flower initiation (S2) as well as 3 pickings of fresh fruit; three picking of fresh fruits + rest of fruits for seed production (H1), Six picking of fresh fruits + rest of fruits for seed production (H2), No picking of fresh fruits +all fruits for seed production (H3).

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