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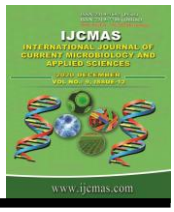

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Effect of Growth Regulators and Pruning on Growth and Flowering of Okra (*Abelmoschus esculentus* L. Moench)

Manikanta R. Rajappa[1*], M. Padma[2], B. Neeraja Prabhakar[3] and D. Saidanaik[4]

[1]Department of Vegetable Science, College of Horticulture (SKLTSHU), Rajendranagar, Hyderabad, India
[2]Controller of examinations, Sri Konda Laxman Telangana State Horticultural University (SKLTSHU), Hyderabad, India
[3]Department of Horticulture, [4]Department of Crop Physiology, College of agriculture (PJTSAU), Hyderabad, India

**Corresponding author*

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A B S T R A C T

The present research entitled "Effect of growth regulators and pruning on growth, yield and quality of okra (*Abelmoschus esculentus* L. Moench)." was carried out at the PG research block of the Department of Vegetable Science, College of Horticulture, Rajendranagar, during *Kharif*- 2019. The experiment was laid in factorial completely randomized block design with three replications. Results revealed that growth regulators (NAA 150ppm, IAA 100 ppm and GA_3 150 ppm), pruning and its combinations significantly improved the plant growth and flowering parameters. GA_3 significantly recorded maximum Plant height (102.38 cm), internodal length (6.56 cm), leaf area (959.19 cm^2) and no. of flowers per plant (17.15). GA_3 treated plants also took least number of nodes to first flowering (7.09) and number of days to first flowering (44.26). Among different level of pruning, Pinching of apical buds of main stem only showed significantly maximum number of leaves per plant (21.38) and leaf area (1124.87 cm^2). Number of nodes per plant (26.10) and number of branches per plant (3.33) were recorded maximum in severe pruning (Pinching of apical buds of main stem, lower and upper branches). The interaction between growth regulators and pruning has shown significant results, maximum plant height (117.07 cm) and least number of days to first flowering (38.67) and Days to 50% flowering (44.80) was observed in GA_3 150 ppm in combination with Control (no Pinching).

Introduction

Okra (*Abelmoschus esculentus* L. Moench) is also known as Bhendi and lady's finger. Okra is one of the important member of Malvaceae family having a higher chromosome number 2n=130. The cultivated species *A. esculentus* is believed to be originated in the Hindustani centre, *i.e.*, India, according to the taxonomic classification of Zeven and Zhukovsky (1975). Okra has been an often cross-pollinated crop, outcrossing range was from 11.80 to 60.00 per cent (Martin, 1979).

Plant growth regulators affect the physiological efficiency of plants including growth, photosynthesis and accumulation of assimilates. The productivity of crops is increased by stimulating the translocation of photo-assimilates (Solaimalai *et al.,* 2001). Among plant growth regulator GA_3, NAA and IAA are very promising and it is being used on a large scale in a number of fruit vegetable crops in developed countries. Pruning which involves the removal of apical buds will in-turn increase the number of fruiting branches per plant. Therefore, the combination of pruning and plant growth regulators is essential to improve yield and quality of okra. Keeping in view of the above information, the present investigation was planned to evaluate the effect of growth regulators and pruning on growth and flowering of okra (*Abelmoschus esculentus* L. moench)

Materials and Methods

The present experiment was conducted to find out the effect of growth regulators and pruning on growth and flowering of okra at PG research block of the Department of Vegetable Science,, College of Horticulture, Rajendranagar, Hyderabad comes under sub-tropical zone and is situated at a latitude of $17^0$33' N, longitude of $78^0$42' E and altitude of 542.3 m above mean sea level. The experiment was laid out in Factorial Randomized Block Design replicated thrice.

Treatment details

Factor 1: Plant growth regulators

NAA 150 ppm
IAA 100 ppm
GA_3 150 ppm

Factor 2: Pruning

Pinching of apical buds of main stem only
Pinching of apical buds of lower branches
Pinching of apical buds of upper branches
Pinching of apical buds of lower branches and upper branches
Pinching of apical buds of main stem, lower and upper branches
Control (no Pinching)

Treatment combinations

T_1	**:**	**NAA 150 ppm + Pinching of apical buds of main stem only**
T_2	:	NAA 150 ppm + Pinching of apical buds of lower branches only
T_3	:	NAA 150 ppm + Pinching of apical buds of upper branches only
T_4	:	NAA 150 ppm+ Pinching of apical buds of lower and upper branches
T_5	:	NAA 150 ppm+ Pinching of apical buds of main stem, lower and upper branches
T_6	:	NAA 150 ppm + control (no Pinching)
T_7	:	IAA 100 ppm + Pinching of apical buds of main stem only
T_8	:	IAA 100 ppm + Pinching of apical buds of lower branches only
T_9	:	IAA 100 ppm + Pinching of apical buds of upper branches only
T_{10}	:	IAA 100 ppm + Pinching of apical buds of lower and upper branches
T_{11}	:	IAA 100 ppm + Pinching of apical buds of main stem, lower and upper branches
T_{12}	:	IAA 100 ppm + control (no Pinching)
T_{13}	:	GA_3 150 ppm + Pinching of apical buds of main stem only
T_{14}	:	GA_3 150 ppm + Pinching of apical buds of lower branches only
T_{15}	:	GA_3 150 ppm + Pinching of apical buds of upper branches only
T_{16}	:	GA_3 150 ppm + Pinching of apical buds of lower and upper branches
T_{17}	:	GA_3 150 ppm + Pinching of apical buds of main stem, lower and upper branches
T_{18}	:	GA_3 150 ppm + control (no Pinching)

Note: - Treatments of foliar sprays are imposed twice at 30 and 50 days after sowing
Apical bud Pinching on main stem is done 25-30 days after sowing
Apical bud Pinching on branches is done 40 days after sowing

Main field preparation and sowing

The main field was ploughed thrice and FYM was applied at the time of last ploughing and incorporated well into the soil. Ridges and furrows were formed at a spacing of 45 cm. The recommended basal dose of fertilizer at the rate of 25 kg Nitrogen, 50 kg Phosphorus and 50 kg Potash per hectare was applied in the form of urea, single super phosphate and muriate of potash and mixed with soil. The seeds of Arka Abhay were dibbled on one side of ridges at a spacing of 30 cm at the rate of two seeds per hill in a plot size of 3m × 2.1m in the first week of July. Gap filling was done a week after sowing. After establishment, the seedlings were thinned out to one plant per hill. Thirty days after sowing, 25 kg of Nitrogen per hectare was applied as a top dressing. Other cultural operations including need-based plant protection measures were done regularly.

Observations recorded

Data on the following characters were recorded on five randomly selected labelled plants from the plot in each treatment and in each replication.

Growth parameters

Plant height (cm)

The height of the plant was measured from the first cotyledonary node to the tip of the growing point at selected intervals (40, 60, 80 days and at final harvest) of growth and expressed in centimetre.

Number of branches per plant

The number of branches arising from the main stem was counted at selected intervals (40, 60, 80 days and at final harvest) of growth and expressed in number.

Internodal length (cm): Length of the internode between third and fourth node from the tip of the plant was measured at selected intervals (40, 60, 80 days and at final harvest) of growth and expressed in centimetres

Number of nodes per plant: The number of nodes on the plant was recorded at selected intervals (40, 60, 80 days and at final harvest) of growth and means were computed.

Number of leaves per plant: The number of leaves on the plant was recorded at selected intervals (40, 60, 80 days and at final harvest) of growth and means were computed.

Leaf area: Leaf area was computed at the final harvest by using LI-COR LT-3000 portable leaf area meter with a transparent belt conveyor with an electronic digital display and is expressed in cm^2.

Flowering parameters

Node to first flowering: The number of nodes taken for first flower appearance was recorded and means were computed.

Days to first flowering: The number of days taken from sowing to first flower opening in each treatment was recorded and expressed in days.

Days to 50% flowering: Number of days taken from the date of sowing to 50% flowering in each treatment was recorded and expressed in days.

Number of flowers per plant: The number of flowers on the plant was recorded after the final harvest and means were computed.

Statistical analysis

The experimental data on all yield and quality parameters were tabulated and subjected to

analysis of variance (ANOVA) using the module of ICAR CCARI WASP for Factorial Randomized Block Design (FRBD). Whenever 'F' test was found significant, for comparing the means of two treatments, critical difference (CD at 5%) was used to analyse and results were presented accordingly.

Results and Discussion

Growth parameters

Plant height (cm)

The maximum (Table 1) plant height (102.38cm) was recorded in GA_3 150 ppm (A_3) followed by (A_1) NAA 150ppm (88.04 cm) which was on par with (A_2) IAA 100 ppm (86.98 cm). The significant increasing effect of GA_3 was observed on the plant height might be due to its rapid cell elongation in meristematic zone of vegetative plant organs. The cytological basis of GA-mediated regulation of plant height and organ size involves the promotion of both cell elongation and cell division (Achard 2009). Similar results were reported by Rani *et al.*, (2013) and Sanodiya *et al.*, (2017) in okra.

Different levels of pruning had significant effect on plant height. The treatment, B_6Control (no pinching) recorded maximum plant height (101.83 cm) which was on par with B_4 (97.71 cm), B_3 (93.14 cm), B_2 (93.14 cm). However, minimum plant height (83.42 cm) was recorded in B_1 pinching of apical buds of main stem. Pruning significantly reduces plant height due to the action of apical debudding when compared with the control plants. The above results are in line with the findings of Bhat (1994), Firoz *et al.*, (2010) and Aikins *et al.*, (2017) in okra.

Among interactions significantly maximum plant height (117.07 cm) was recorded in (A_3B_6) GA_3 150 ppm in combination with Control (no pinching) which was on par with A_3B_4 (108.67) and A_3B_5 (99.93) and minimum plant height (75.93 cm) was recorded in (A_2B_1) IAA 100 ppm in combination with pinching of apical buds of main stem only.

Number of nodes per plant

The different levels of pruning (Table 2) had significant effect on number of nodes. The treatment B_5pinching of apical buds of main stem, lower and upper branches resulted in the maximum number of nodes (26.10) which was on par with B_1 (25.09) followed by B_6 (22.40) which was on par with B_3 (22.29) and B_2 (22.11). Treatment B_4 pinching of apical buds of lower branches and upper branch recorded minimum number of nodes (20.96).Development of more nodes was significantly encouraged by the removal of the apical bud. Similar results were obtained by Aikins *et al.*, (2017) in okra, Nayak *et al.*, (2018) in cucumber.

Internodal length (cm)

The data (Table 3) regarding the internodal length of okra at final harvest significantly affected by growth regulators. The maximum internodal length (6.56 cm) was recorded in (A_3) GA_3 150 ppm followed by (A_1) NAA 150 ppm (5.66 cm). Minimum internodal length was recorded in IAA 100ppm (5.54 cm). It might be due to its involvement in many aspects of plant growth and development, such as cell enlargement, internodal elongation, stimulated RNA and protein synthesis thereby leading to enhanced growth and development (Yamaguchi and Kamiya 2000). Similar results were reported by Dhage *et al.*, (2011) in okra, Kof *et al.*, (1998) and Brumbaugh and Stewen (2008) in pea

Table.1 Effect of growth regulators and pruning on plant height (cm) of okra at final harvest

Treatments	Pruning (B)						
PGR (A)	**B_1**	**B_2**	**B_3**	**B_4**	**B_5**	**B_6**	**MEAN**
A_1	79.53	93.38	88.67	93.67	76.13	96.87	**88.04^{B}**
A_2	75.93	89.27	93.70	90.80	80.63	91.55	**86.98^{B}**
A_3	94.80	96.77	97.07	108.67	99.93	117.07	**102.38^{A}**
MEAN	**83.42^{c}**	**93.14^{b}**	**93.14^{b}**	**97.7^{ab}**	**85.57^{c}**	**101.83^{a}**	
		Factor (A)		**Factor (B)**		**A × B**	
F test		*		*		*	
SE (m) ±		1.34		1.90		3.28	
CD at 5%		3.85		5.45		9.44	

Table.2 Effect of growth regulators and pruning on number of nodes per plant of okra at final harvest

Treatments	Pruning (B)						
PGR (A)	**B_1**	**B_2**	**B_3**	**B_4**	**B_5**	**B_6**	**MEAN**
A_1	25.99	22.26	23.93	21.73	26.29	23.20	**23.90**
A_2	28.23	21.40	21.30	20.59	24.50	20.97	**22.83**
A_3	21.06	22.68	21.64	20.57	27.51	23.04	**22.75**
MEAN	**25.09^{a}**	**22.11^{b}**	**22.29^{b}**	**20.96^{b}**	**26.10^{a}**	**22.40^{b}**	
		Factor (A)		**Factor (B)**		**A × B**	
F test		NS		*		NS	
SE (m) ±		0.59		0.83		1.44	
CD at 5%		-		2.39		-	

Note:A_1- NAA 150ppm,A_2 – IAA 100 ppm,A_3 - GA_3 150 ppmB_1 - Pinching of apical buds of main stem only, B_2 - Pinching of apical buds of lower branches, B_3 - Pinching of apical buds of upper branches,B_4 - Pinching of apical buds of lower and upper branches,B_5 - Pinching of apical buds of main stem, lower and upper branches,B_6 - Control (no Pinching)

Table.3 Effect of growth regulators and pruning on internodal length (cm) of okra at final harvest

Treatments	Pruning (B)						
PGR (A)	**B_1**	**B_2**	**B_3**	**B_4**	**B_5**	**B_6**	**MEAN**
A_1	5.86	5.53	5.65	5.33	5.77	5.79	**5.66^{B}**
A_2	5.81	5.73	5.37	5.29	5.77	5.24	**5.54^{B}**
A_3	6.59	5.41	6.57	6.77	6.75	7.30	**6.56^{A}**
MEAN	**6.09**	**5.56**	**5.86**	**5.80**	**6.10**	**6.11**	
		Factor (A)		**Factor (B)**		**A × B**	
F test		*		NS		NS	
SE (m) ±		0.15		0.21		0.37	
CD at 5%		0.44		-		-	

Table.4 Effect of growth regulators and pruning on number of leaves per plant of okra at final harvest

Treatments	Pruning (B)						
PGR (A)	**B_1**	**B_2**	**B_3**	**B_4**	**B_5**	**B_6**	**MEAN**
A_1	20.87	17.00	18.47	17.00	21.40	17.67	**18.73**
A_2	21.50	15.93	16.33	15.73	19.00	16.00	**17.42**
A_3	21.77	17.80	16.20	15.47	15.93	17.23	**17.40**
MEAN	**21.38^a**	**16.91^a**	**17.00^a**	**16.07^a**	**18.78^a**	**16.97^a**	
		Factor (A)		**Factor (B)**		**A × B**	
F test		NS		*		NS	
SE (m) ±		0.59		0.83		1.44	
CD at 5%		-		2.39		-	

Note:A_1- NAA 150ppm,A_2 – IAA 100 ppm,A_3 - GA_3 150 ppmB_1 - Pinching of apical buds of main stem only, B_2 - Pinching of apical buds of lower branches, B_3 - Pinching of apical buds of upper branches,B_4 - Pinching of apical buds of lower and upper branches,B_5 - Pinching of apical buds of main stem, lower and upper branches,B_6 - Control (no Pinching)

Table.5 Effect of growth regulators and pruning on number of branches per plant of okra at final harvest

Treatments	Pruning (B)						
PGR (A)	**B_1**	**B_2**	**B_3**	**B_4**	**B_5**	**B_6**	**MEAN**
A_1	2.63	2.13	2.10	2.03	3.70	2.33	**2.49**
A_2	3.10	2.67	1.97	1.73	3.33	2.10	**2.48**
A_3	3.17	2.00	1.90	1.80	2.97	2.43	**2.38**
MEAN	**2.97^a**	**2.27^b**	**1.99^{bc}**	**1.86^c**	**3.33^a**	**2.29^b**	
		Factor (A)		**Factor (B)**		**A × B**	
F test		NS		*		NS	
SE (m) ±		0.10		0.14		0.24	
CD at 5%		-		0.40		-	

Table.6 Effect of growth regulators and pruning on leaf area (cm^2) of okra at final harvest

Treatments	Pruning (B)						
PGR (A)	**B_1**	**B_2**	**B_3**	**B_4**	**B_5**	**B_6**	**MEAN**
A_1	1082.66	934.40	947.90	842.60	1188.68	645.80	**940.34^A**
A_2	1020.10	732.81	870.32	720.14	851.22	616.00	**801.77^B**
A_3	1271.84	869.99	773.87	692.45	1261.98	885.01	**959.19^A**
MEAN	**1124.87^a**	**845.73^b**	**864.03^b**	**751.73^c**	**1100.63^a**	**715.61^c**	
		Factor (A)		**Factor (B)**		**A × B**	
F test		*		*		*	
SE (m) ±		21.67		30.64		53.08	
CD at 5%		62.28		88.07		152.54	

Note:A_1- NAA 150ppm,A_2 – IAA 100 ppm,A_3 - GA_3 150 ppmB_1 - Pinching of apical buds of main stem only, B_2 - Pinching of apical buds of lower branches, B_3 - Pinching of apical buds of upper branches,B_4 - Pinching of apical buds of lower and upper branches,B_5 - Pinching of apical buds of main stem, lower and upper branches,B_6 - Control (no Pinching)

Table.7 Effect of growth regulators and pruning on days to first flowering on okra plant

Treatments	Pruning (B)						
PGR (A)	**B_1**	**B_2**	**B_3**	**B_4**	**B_5**	**B_6**	**MEAN**
A_1	50.40	41.20	40.33	40.07	56.27	39.93	**44.70^{AB}**
A_2	51.27	41.20	40.53	39.43	57.07	39.90	**44.90^{A}**
A_3	51.47	39.07	39.13	39.03	58.20	38.67	**44.26^{B}**
MEAN	**51.04^{b}**	**40.49^{d}**	**40.00^{cd}**	**39.51^{a}**	**57.18^{a}**	**39.50^{d}**	
		Factor (A)		**Factor (B)**		**A × B**	
F test		*		*		*	
SE (m) ±		0.17		0.24		0.42	
CD at 5%		0.49		0.69		1.20	

Table.8 Effect of growth regulators and pruning on node to first Flowering of okra

Treatments	Pruning (B)						
PGR (A)	**B_1**	**B_2**	**B_3**	**B_4**	**B_5**	**B_6**	**MEAN**
A_1	8.63	5.47	5.37	5.47	12.60	5.27	**7.13^{AB}**
A_2	8.80	5.40	5.53	5.57	12.73	5.47	**7.25^{A}**
A_3	8.60	5.33	5.43	5.43	12.53	5.23	**7.09^{B}**
MEAN	**8.68^{b}**	**5.40^{c}**	**5.44^{c}**	**5.49^{c}**	**12.62^{a}**	**5.32^{c}**	
		Factor (A)		**Factor (B)**		**A × B**	
F test		*		*		NS	
SE (m) ±		0.04		0.06		0.10	
CD at 5%		0.12		0.17		-	

Note: A_1- NAA 150ppm,A_2 – IAA 100 ppm, A_3 - GA_3 150 ppm B_1 - Pinching of apical buds of main stem only, B_2 - Pinching of apical buds of lower branches, B_3 - Pinching of apical buds of upper branches,B_4 - Pinching of apical buds of lower and upper branches, B_5 - Pinching of apical buds of main stem, lower and upper branches,B_6 - Control (no Pinching)

Table.9 Effect of growth regulators and pruning on Days to 50% flowering in okra

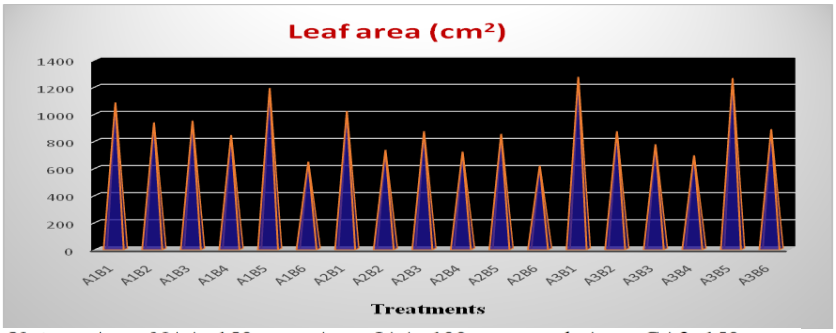
Treatments	Pruning (B)						
PGR (A)	**B_1**	**B_2**	**B_3**	**B_4**	**B_5**	**B_6**	**MEAN**
A_1	56.39	47.15	46.21	46.15	62.86	45.92	**50.78**
A_2	57.60	46.59	46.65	45.45	63.32	45.90	**50.92**
A_3	57.38	45.40	45.26	44.91	63.91	44.83	**50.28**
MEAN	**57.12^{b}**	**46.38^{c}**	**46.04^{c}**	**45.50^{c}**	**63.36^{a}**	**45.55^{c}**	
		Factor (A)		**Factor (B)**		**A × B**	
F test		NS		*		NS	
SE (m) ±		0.23		0.32		0.56	
CD at 5%		-		0.92		-	

Table.10 Effect of growth regulators and pruning on number of flowers per plant of okra at final harvest

Treatments	Pruning (B)						
PGR (A)	**B_1**	**B_2**	**B_3**	**B_4**	**B_5**	**B_6**	**MEAN**
A_1	16.85	14.86	15.93	14.70	16.27	16.18	**15.80^{B}**
A_2	15.96	13.87	15.94	13.91	15.08	16.86	**15.27^{B}**
A_3	17.85	17.46	17.46	15.92	16.75	17.45	**17.15^{A}**
MEAN	**16.89^{a}**	**15.40^{bc}**	**16.44^{ab}**	**14.84^{c}**	**16.03^{abc}**	**16.83^{a}**	
		Factor (A)		**Factors (B)**		**A × B**	
F test		S		S		NS	
SE (m) ±		0.34		0.48		0.83	
CD at 5%		0.97		1.38		2.38	

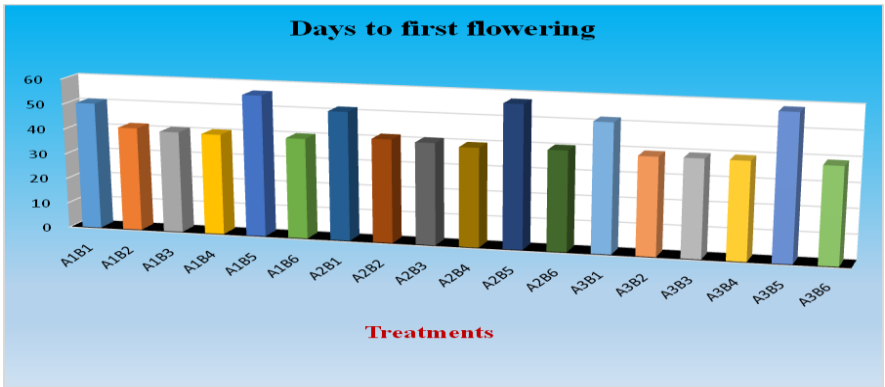
Note: A_1- NAA 150ppm,A_2 – IAA 100 ppm,A_3 - GA_3 150 ppm B_1 - Pinching of apical buds of main stem only, B_2 - Pinching of apical buds of lower branches, B_3 - Pinching of apical buds of upper branches, B_4 - Pinching of apical buds of lower and upper branches, B_5 - Pinching of apical buds of main stem, lower and upper branches, B_6 - Control (no Pinching)

Fig.1 Effect of growth regulators and pruning on leaf area (cm^2) of okra at final harvest



Note : A_1 - NAA 150ppm, A_2 – IAA 100 ppm and A_3 - GA3 150 ppm B_1 - Pinching of apical buds of main stem only, B_2 - Pinching of apical buds of lower branches, B_3 - Pinching of apical buds of upper branches, B_4 - Pinching of apical buds of lower and upper branch, B_5 - Pinching of apical buds of main stem, lower and upper branches and B_6 - Control (no Pinching).

Fig.2 Effect of growth regulators and pruning on days to first flowering on okra plant



Number of leaves per plant

The different levels of pruning (Table 4) had significant effect on number of leaves. The treatment B_1pinching of apical buds of main stem only resulted in the maximum number of leaves (21.38) followed by B_5pinching of apical buds of main stem, lower and upper branches (18.78) which was on par with B_3 (17.00) and B_6 (16.97). Treatment B_4 pinching of apical buds of lower branches and upper branch recorded minimum number of leaves (16.07).

Many researchers studied the effect of pruning on growth parameters of plants and showed that pruning limits vegetative growth and allows more light penetration and increases photosynthetic efficiency and so improve vegetative growth of plants (Preece and Read 2005) and ultimately yield. These results are in line with the findings of Olasantan (1986), Olasantan and Salau (2008) and Aliyu *et al.,* (2015).

Number of branches per plant

The different levels of pruning (Table 5) had significant effect on number of branches. The treatment B_5pinching of apical buds of main stem, lower and upper branches resulted in the maximum number of branches (3.33) which was on par with B_1 (2.97) followed by B_6 (2.29) which was on par with B_2 (2.27) B_3 (1.99).

Treatment B_4 pinching of apical buds of lower branches and upper branch recorded minimum number of branches (1.86).Increase in number of branches may be due to suppression of vertical growth resulting in translocation of photosynthates to leaf axil thus encouraging the lateral branches (Thakral *et al.,* 1991). Similar opinions were expressed by Sajjan (2004), Olasantan and Salau (2008) and Firoz *et al*., (2010).

Leaf area (cm^2)

The highest (Table 6) (Fig 1) leaf area (959.19 cm^2) was recorded with GA_3 150 ppm (A_3) which was on par with (A_1) NAA 150ppm (940.34 cm^2). Minimum leaf area (801.77 cm^2) was recorded with IAA 100 ppm (A_2). This might be due to GA_3 which increased the rate of cell division and cell elongation and ultimately increased the better vegetative growth as stated by Wareing and Phillips (1976). These results are in accordance with the findings of Singh and Singh (1977), Kokare *et al.,* (2006)and Baraskar *et al.,* (2018) in okra.

The data regarding the leaf area of okra was significantly affected by pruning. The treatment pinching of apical buds of main stem only (B_1) recorded maximum leaf area of 1124.87 cm^2 which was on par with pinching of apical buds of main stem, lower and upper branches (B_5) (1100.63 cm^2) followed by pinching of apical buds of upper branches (B_3) (864.03 cm^2).

However, minimum leaf area (715.61 cm^2) was recorded in (B_6) Control (no pinching). Even though the leaves were small in case of pruned treatments the overall leaf area was recorded highest in case of pruned treatments only. Similar opinions were expressed by Ona *et al.,* (2015) and Dorajeerao and Mokashi (2012) in Chrysanthemum

The interaction between growth regulators and pruning was significant with respect to leaf area. Significantly maximum leaf area (1271.84 cm^2) was recorded in GA_3 150 ppm in combination with pinching of apical buds of main stem only (A_3B_1) which was on par with A_3B_5 (1261.98 cm^2) and A_1B_5(1188.68 cm^2). Minimum leaf area (616.00 cm^2) was recorded in IAA 100 ppm in combination with Control (no pinching) (A_2B_6).

Flowering parameters

Days to first flowering

Significantly (Table 7) (Fig 2) minimum number of days to first flowering (44.26) was recorded in GA_3 150 ppm (A_3) which was on par (44.70) with (A_1) NAA 150ppm. While maximum number of days to first flowering (44.90) was recorded in (A_2) IAA 100 ppm. GA_3 reduced the days required for flowering which ultimately led towards early flower production (Meena, 2017). These results were supported by Patil and Patel (2010) and Bhagure and Tambe (2013) in okra.

Results revealed that among the different levels of pruning which had significant effect on number of days to first flowering. The treatment B_6 Control (no pinching) resulted in the minimum number of days to first flowering (39.5) which was on par with B_4 (39.51). B_3 (40.00) and B_2 (40.49) followed by B_1 (51.04). Treatment B_5 pinching of apical buds of main stem, lower and upper branches was found to be having maximum number of days to first flowering (57.18). This might be due to the fact that by removing apical portion, the plant enters vegetative phase and new shoots took longer time to be physiologically mature and thus resulted in delayed first flowering (Jindal *et al.,* 2018). Similar results were obtained by Gujar and Srivastava (1972), Nasir (2001) and Olasantan and Salau (2008) in okra.

The interaction of growth regulators and pruning showed significant variation. Significantly minimum number of days to first flowering (38.67) was recorded in GA_3 150 ppm in combination with Control (no pinching) (A_3B_6) which was on par with A_3B_4 (39.03) and A_3B_3 (39.13). Maximum number of days to first flowering (58.20) was recorded in GA_3 150 ppm in combination with pinching of apical buds of main stem, lower and upper branches (A_3B_5).

Node to first flowering

The least (Table 8) number of nodes to first flowering (7.09) was recorded with GA_3 150 ppm (A_3) which was on par wih (A_1) NAA 150 ppm (7.13) and maximum number of nodes to first flowering (7.25) was recorded in IAA 100ppm (A_2). As GA_3 reduced the number of days to first flowering it also reduced the number of nodes on which first flower appeared. These results are in accordance with Shingh *et al.,* (2012), UtpalMaity *et al.,* (2016) and Baraskar *et al.,* (2018) in okra.

Significant difference was recorded among the pruning treatments for number of nodes to first flowering. The treatment, B_6Control (no pinching) recorded minimum number of nodes to first flowering (5.32) which was on par with B_2 (5.40), B_3 (5.44) and B_4 (5.49) which is followed by B_1 (8.68). However, maximum number of nodes to first flowering (12.62) was recorded in B_5 pinching of apical buds of main stem, lower and upper branches.Due to the effect of pruning the number of branches on the plant increased, and within each branch the below 2-3 nodes did not produce any flowers due to which the number of nodes for first flower appearance increased hence on the control plants first flower appeared. These results are in line with the findings of Mir *et al.,* (2019) in cucumber.

Days to 50 percent flowering

The (Table 9) treatmentB_4pinching of apical buds of lower branches and upper branch resulted in the minimum number of days to 50 percent flowering (45.50) which was on par with B_6 (45.55), B_3 (46.04) and B_2 (46.38) followed by B_1 (57.12). Treatment B_5pinching of apical buds of main stem, lower and upper branches recorded maximum number of days to 50 percent flowering (63.36). Pruned okra took longer number of days to obtain 50% flowering when compared to the unpruned

ones which flowered earlier. This was a result of apical debuding that delayed the reproductive phase for some period before the development of new shoots. This might be the reason for maximum days taken for 50 per cent flowering under different pinching treatments and new shoots which emerged after pinching took more time to become physiologically mature to bear flowers (Sehrawat *et al.,* 2003).

Number of flowers per plant

The maximum (Table 10) number of flowers per plant (17.15) was recorded with GA_3 150 ppm (A_3) followed by (A_1) NAA 150 ppm (15.80) and minimum number of flowers per plant (15.27) was recorded in IAA 100ppm (A_2). This might be due to the presence of good vegetative growth in GA_3 treated plants which accumulated higher amount of assimilates and was ready to putforth higher number of flowers. Similar results were reported by Utpal Maity *et al.,* (2016) in okra and Sarkar *et al.,* (2002) in soyabean.

Significant difference was recorded among the pruning treatments for number of flowers per plant. The treatment, B_6Control (no pinching) recorded maximum number of flowers per plant (16.89) which was on par with B_6 (16.83) and B_3 (16.44). However, minimum number of flowers per plant (14.84) was recorded in B_4 pinching of apical buds of lower and upper branches. Pruning which intended towards increasing the number of branches which is the potential flowering area in case of okra crop, resulted in producing more number of flowers when compared to control. These results are in accordance with Eve *et al.,* (2016) in butternut (*Cucurbita moschata*).

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