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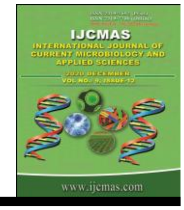

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Effect of Different Crop Regulation Methods and Chemicals on Growth, Flowering and Yield of Guava cv. Arka Mridula

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A B S T R A C T

A field experiment was conducted during 2016-17 and 2017-18 at Instructional Farm, Krishi Vigyan Kendra, Jharsuguda in Guava (*Psidium guajava* L.)” with an objective to evaluate the effect of plant growth regulation practices (both cultural and chemical methods) on vegetative growth, flowering and yield. The soil of the experimental orchard is red laterite and the climatic condition of the region is sub-tropical dry climate having hot and dry summer and mild winter. The experiment consisted of 8 treatments (T_1:Control,T_2: Shoot bending; T_3: 10 cm pruning with complete removal of old leaves, in March-April; T_4: 50 % fruit thinning randomly by hand at an average fruit weight 15 -20 g in March-April; T_5: Foliar spray of Naphthalene Acetamide (NAD) @ 50 ppm twice at 15 days interval during March-April; T_6: Foliar spray of (2, 4-D) @ 60 ppm, twice at 15 days interval in the during March-April, T_7: Foliar spray of urea @ 15%, twice at 15 days interval during March-April and T_8: Foliar spray of Dinitro Ortho Cresol (DNOC) @ 10ppm, twice at 10 days during March-April). These 8 treatments were evaluated in randomized block design with three replications. From the experiment, it was found that untreated treatment (Control i.e. T_1) resulted tallest plant while minimum plant height was recorded in Bending (T_2). The canopy spread in East-West and North-South were recorded highest in T_3 (10 cm pruning). Number of days required for emergence of new shoot was recorded minimum of (18.00 & 19.2 days) shoot bending (T_2) and 10 cm pruning (T_3) respectively while it was highest (35.8 days) in the untreated control (T_1). Shoot bending (T_2) treatment took minimum days (43.5 days) while control plants (T_1) took maximum days (50.5days) for initiation of flowers in the new shoots. The period required for fruit maturity varied from 126.7 days in bending (T_2) to 134.5 days in control plants (T_1). Shoot bending (T_2) recorded highest number of fruits per plant during both the years and were significantly different from other treatments. Heaviest fruit (125.3g) was obtained in T_5 (50 ppm NAD) followed by 124.2g in T_3 (10cm pruning) and 123.7g inT_6 (60 ppm 2, 4-D) whereas lowest fruit weight was obtained in control (108.4g). Similarly, 50 ppm NAD (T_5) gave highest fruit yield (8.3 kg/plant) followed by T_2 (8.1 kg/plant) whereas it was recorded lowest in control (6.3 kg/plant).

Introduction

Guava is a popular fruit tree of tropical and sub-tropical climate and is native to the Tropical America. It is contributing 4.1% to the total fruit production in India. The crop covers about 2.60 lakh hectare area of the country with an annual production of 38.26 lakh tonnes with an average productivity of 14.75 metric tonnes per hectare (Anon, 2017).It is the third richest source of Vitamin C (299 mg/100g) after Barbados cherry (1000-4000 mg/100 g pulp) and aonla (600 mg/100g of pulp) contains 2 to 5 times more vitamin C than oranges and 10 times more than tomato Gupta (2014). Guava bears fruit on current season's shoot and flowers appear in solitary or in cymes of two or three in the axil of leaves.Crop regulation in guava can be adopted successfully by various cultural and chemical methods. In general, guava flowers twice in a year, i.e., in April–May and August–September, of which fruits ripen in rainy and winter season, respectively. The fruits produced in rainy season are insipid and watery and do not keep well. Fruits of winter season crop are superior in all respect as compared to rainy season fruits (Sahoo and Tarai, 2018). Therefore there is need to regulate guava crop in such a way that only quality fruits are harvested in winter season (Gorakh and Reddy, 1997). The basic theory of crop regulation is to manipulate the natural flowering and fruiting of guava plant in desired season of the year that put in to better fruit yield, quality, profitability and sustainability of the environment by reducing the use of the frequency of the pesticides. This concept is based on the fact that guava flowers are borne only on new, succulent, vigorously emerging vegetative growths. Crop regulation in guava can be adopted successfully by various cultural and chemical methods. Most of the research were already carried out in guava with an objective to reduce rainy season crop and to get more winter season crop by means of root exposure and root pruning, shoot pruning, mechanical flower thinning and chemical thinning by the use of Urea, growth substances like naphthalene acetic acid (NAA), naphthalene acetamide (NAD), 2,4-dichlorophenoxy acetic acid (2,4-D), dinitro-ortho-cresol (DNOC) etc. (Dubey *et al.,* 2002 and Tiwari and Lal, 2007). The objective of crop regulation is to manipulate the natural flowering of the guava plant in desired season that can put in to increased fruit yield, quality and profitability. Currently, specific PGRs are used to modify crop growth rate and growth pattern during the various stages of development. In order to have a winter harvest, fruit thinning is advisable. According to Sing *et al.,* (1996), flower thinning from guava plants during summer, improved fruit quality and increase yield during next winter. The percentage of flowering and fruiting, poor yield and quality fruits are of major concern of the fruit growers. The natural flowering and fruiting behaviour of guava are needed to be regulated, towards the production of heavy crop load during winter season to make guava cultivation highly profitable and market oriented. However, no such work has been reported under the hot and moist sub humid conditions of Western Central Table Land zone of Odisha in Eastern part of India. Keeping this in view, an investigation was carried out to evaluate the effect of different crop regulation methods and chemicals on growth, flowering and yield of Guava cv. Arka Mridula.

Materials and Methods

The study was conducted at Instructional Farm, Krishi Vigyan Kendra, Jharsuguda in Guava (*Psidium guajava* L.) cv. Arka Mridula during 2016-17 and 2017-18. The soil of the experimental orchard is red laterite and the climatic condition of the region is hot and moist sub humid conditions of Western Central Table Land zone of Odisha. The guava plants were procured from Central Horticultural Experiment Station, Bhubaneswar. The experiment consisted of 8 treatments (T_1: Control, T_2: Shoot bending during March-April at 90^0 angle with the help of piece of rope, keeping 10-12 inch of terminal of growth and rest leaves are to be removed; T_3: 10 cm pruning with complete removal of old leaves, in March-April; T_4: 50

% fruit thinning randomly by hand at an average fruit weight 15 -20 g in March-April; T_5: Foliar spray of Naphthalene Acetamide (NAD) @ 50 ppm twice at 15 days interval during March-April; T_6: Foliar spray of (2, 4-D) @ 60 ppm, twice at 15 days interval in the during March-April, T_7: Foliar spray of urea @ 15%, twice at 15 days interval during March-April and T_8: Foliar spray of Dinitro Ortho Cresol (DNOC) @ 10ppm, twice at 10 days during March-April). Healthy and disease free lateral shoots were selected for shoot bending with utmost care. Shoot bending was done in such a way that the bent branch did not broken down after bending. Shoots were bent at 90° angle with the help of a piece of rope. Before shoot bending 3-5 leaves were kept at the upper portion of the branch to continue its photosynthesis and respiration process and rest leaves were removed off.

These 8 treatments were imposed on 4-5 years old guava plants of cultivars Arka Mridula which were maintained at a spacing of 5 m x 5 m. Each treatment was replicated thrice with two plants per replication. During both the years, the experimental plants were applied with 20 kg FYM along with 500, 200, 300 g of N, P_2O_5 and K_2O. A full dose of FYM and P_2O_5 was applied at the time of imposition of treatment. Nitrogen and K_20 were applied in 2 split doses. The first dose of N and K_2O was applied along with FYM + P_2O_5 and the second was applied during the second week of September. The plant protection and other cultural operations were uniformly given as and when required. Observations were recorded on vegetative growth parameters like plant height, canopy spread in East-West and North-South direction, number of days required for initiation of vegetative buds, number of new shootlets / pruned shoot and other parameters like number of days required for initiation of flowers on newly emerged shoots and days required for attainment of fruit maturity, fruit weight (g), number of fruits / plant and fruit yield per plant (Kg) etc. The data on the above parameters were subjected to analysis of variance (Panse and Sukhatme, 1989).

Results and Discussion

Growth and vigour of the trees were recorded in terms of plant height, spread in East-West and North-South direction. The growth characters of the tree were significantly influenced by different treatments.

Plant height (m)

The effect of different crop regulation intervention had a significant influence on the plant height during both years of 2016-17 and 2017-18 (Table 1). The height of guava plants after crop regulation intervention varied between 1.89 m to 3.18 m. The maximum height of the plants was recorded in control (3.18 m) i.e. in T_1 while the minimum plant height (1.89 m) was recorded in T_2 (shoot bending) followed by (2 m) in T_7 (15 % urea). During second year (2017-18) maximum plant height was recorded in T_1 i.e. control (4.12 m) followed by in 50 % fruit thinning (4.02 m) treatment (T_4) whereas the shortest plant height was recorded in T_2 i.e. in shoot bending (2.01 m) followed by (3.17 m) in T_8 i.e. with application of 10 ppm DNOC. However, according to Prajapati and Singh (2018) NAA (200 ppm) increased the growth parameters of guava such as plant height (4.13 m) followed by GA_3 under Allahabad condition.From the pooled data it was established that untreated treatment (Control i.e. T_1) resulted maximum plant height while it was recorded minimum in Bending i.e. $T_{2.}$ Thus, the vegetative growth of guava seems to respond to variation in different crop regulation methods (like bending, shoot pruning, fruit thining and use of chemicals). Under pruning treatments, it might shift the allocation of metabolites from rainy season crop in favour of increased vegetative growth due to flower and fruitlet removal as a result of pruning. Branch bending opens up the canopy and improves leaf photosynthesis by change in leaf exposure to sunlight (Li and Lakso, 2004).

Canopy spread (m) in East-West direction

The data depicted in the Table 1, indicated that during both the year the canopy spread in East-West direction varied significantly. During 1st year the maximum canopy spread (3.43 m) in East-West direction was recorded in T_3 (10 cm pruning) followed by T_2 i.e. under shoot bending (2.73 m). The minimum E-W canopy spread was recorded in 50 % fruit thinning (1.77 m) followed by 50 ppm NAD (2.01 m). In second year canopy spread varied between 2.93 m to 4.54 m. The maximum total increase in plant spread was recorded in shoot bending (4.54 m) which was very closely followed by 10 cm pruning (4.21m), while lowest E-W plant spread was recorded in untreated plant (2.93 m), followed by 50 % fruit thinning (3.33 m). From the pooled data, it was found highest in T_3 followed by T_2 and T_5.

Canopy spread (m) in East-West direction

The guava plant under study showed significant variations among themselves with regards to canopy spread in North-South direction during rainy season and winter season crop of guava (Table 1). The spread of guava plants after treatments varied between 2.15 to 2.43 m. During first year, mmaximum canopy spread in the North-South direction was recorded in the 10 cm pruning(2.43 m) followed by (2.36m) under T_6 i.e., (60 ppm 2,4-D) whereas it was recorded minimum (2.15 m) in T_1 (Control) followed by T_8 i.e. 10 ppm DNOC (2.20 m). During second year highest canopy spread in North-South direction was observed in 10 cm pruning (3.03 m) followed by 50 ppm NAD (2.98m) with minimum in control (2.35 m) followed by T_6(2.42 m) i.e. with 60 ppm 2,4-D.

From the pooled data, the canopy spread in East-West and North-South were recorded highest in T_3 (10 cm pruning). The results of pruning and thinning treatment is in line with the findings of Tiwari and Lal (1984) and Singh, (1986) who reported that pruning the current season's growth of spring flush could avoid the rainy season crop for getting a subsequent good winter crop.

The results pertaining to plant height, canopy spread (East-West and North-South direction) were in close proximity with the findings of Singh *et al*., (1992) and Brar (2010) who reported maximum increment in plant height, canopy spread in East-West and North-South direction with foliar application of growth regulators like 60 ppm of 2,4-D. It might be due to immediate absorption of auxins, which increased the endogenous auxin level that resulted in cell elongation and enhanced vegetative growth.

Number of days required for emergence of new shoots

The number of days taken emergence of new shoots of guava cv. Arka Mridula was significantly influenced by different crop regulation treatments. It was quite apparent from the data depicted in the Table 2, that crop regulation treatments had profuse effect on the emergency of new shoots. It was found that except the treatments control (T_1) and (T_4) i.e. 50 % fruit thinning, all other treatments caused early emergence of new shoots. During first year, a minimum of 16.3 & 18 days were required for emergency of new shoots in bending (T_2) and 10 cm pruning (T_3) respectively which were followed by the treatment (T_7) i.e. application of 15 % urea (21.7) and T_5 i.e. with application of 50 ppm NAD (27) while (T_1) control and (T_4) 50 % thinning took maximum days for the emergence of new shoot, i.e.37.7 and 35.3 days respectively. During second year the treatments the same trend was obtained with minimum of (19.67 & 20.33 days) were required for emergence of new shoots in shoot bending (T_2) and 10 cm pruning (T_3) respectively while it took more days (34 days) in the untreated control (T1) and 32 days in (T_4). The same trend was also obtained from the pooled data with minimum of (18.00 & 19.2 days) in shoot bending (T_2) and 10 cm pruning (T_3) respectively while it took more days (35.8 days) for emergence of new shoots in the untreated control (T_1) followed by 33.7 days in (T_4). Similar effects of pruning and branch bending on shoot emergence have also been reported earlier by Sherif, (2012) in Pear. This result was also found to be in close proximity with the finding of Nandi *et al.,* (2017) who opined that bending in summer months (March to June) resulted early emergence of new shoot (15.0 to 19.3 days) and Ghosh and Sukul (2003) who reported that summer season bending is more responsive in early emergence of new shootlets in profuse number.

Number of shootlets per branch

The number of shootlets varied significantly among different treatments with higher number in bending treatments as compared to control (Table 2). During 1st year the maximum number of shoots per branch (14.25) was found in T_2 (shoot bending) followed by (12.92) in T_3 (with 10 cm pruning) and (12.52) in T_5 (50 ppm NAD). The minimum number of shoots per branch (9.58) was observed in T_1 (control) followed by 50 % thinning of fruits (T_4). During second year, it was recorded maximum with bending i.e. T_2 (33.49) followed by T_5 (29.42) and minimum in untreated control i.e.T_1 (22.51). From the pooled data, it was recorded maximum in T_2 (23.9) closely followed by T_3 (21.6), T_5 (21.0) and T_6 (20.2) and minimum in T_1 (16.0) followed by T_4 (16.8). Similar findings were obtained by Lakhpati and Rajkumar (2018) who recorded the minimum number of new shoot per pruned shoot (2.96) in control plants (untreated) than all other treatments.

Duration for initiation of flowers in new shootlet

The data pertaining to duration for initiation of flowers in new shootlet in different crop regulation treatment in guava during both the year were presented in the Table 3. The data revealed that during first year, the shoot bending treatment (T_2) recorded early initiation of flowers (42 days) in new shootlets followed by T_3 i.e. with 10 cm pruning (44.7 days) , whereas delayed initiation of flowers (49 days) was found in untreated control (T_1) plants in the new shootlet. During second year, it ranged between 45 days in (T_2) and 52 days in control plants (T_1). From the pooled data, it was confirmed that shoot bending (T_2) took minimum days (43.5 days) followed by T_3 (45.8 days) while control plants (T_1) took maximum days (50.5 days) for initiation of flowers in the new shoots. In case of bending of branch wood pressure of branch is increased and phloem formation decreased. As a result photosynthetic product goes by slowly from the shoots of twisted branches as to the other parts, maintaining higher C: N ratio and induce more flowering and fruit set. Bending forced dormant reproductive buds into growth. The above results are in consonance with findings of Ghosh (2003) who reported that bending of shoots increases number of flowers per plant during off-season that also supports the present experimental results.

Table.1 Effect of different crop regulation methods and chemicals on vegetative characters of Guava cv. Arka Mridula

Treatments	Plant height (m)			Canopy spread E-W (m)			Canopy spread N-S (m)		
	1st year	2nd year	Pooled	1st year	2nd year	Pooled	1st year	2nd year	Pooled
Control	3.18	4.12	3.65	2.19	2.93	2.4	2.15	2.35	2.3
Shoot bending	1.89	2.01	1.95	2.73	4.54	3.3	2.33	2.62	2.5
10cm pruning	2.49	3.74	3.12	3.43	4.21	3.7	2.43	3.03	2.7
50% fruit thinning	2.53	4.02	3.28	1.77	3.33	2.3	2.30	2.60	2.4
50 ppm NAD	2.45	3.21	2.83	2.01	4.15	3.1	2.24	2.98	2.6
60 ppm 2, 4-D	2.13	3.19	2.66	2.65	3.46	2.4	2.36	2.42	2.4
15% Urea	2.00	3.19	2.59	2.21	3.56	2.6	2.32	2.57	2.4
10ppm DNOC	2.03	3.17	2.60	2.23	3.38	2.6	2.20	2.55	2.4
S.E (m) +	0.33	0.37	0.20	0.21	0.21	0.12	0.09	0.09	0.05
CD at (5 %)	1.00	1.11	0.60	0.64	0.64	0.37	0.27	0.28	0.16

Table.2 Effect of different crop regulation methods and chemicals on days required for emergence of new shoots and number of new shootlets/ pruned shoot of Guava cv. Arka Mridula

Treatments	Number of days required for emergence of new shoots			Nos. of new shootlets /pruned shoot		
	1st year	2nd year	Pooled	1st year	2nd year	Pooled
Control	37.67	34.00	35.8	9.58	22.51	16.0
Shoot bending	16.33	19.67	18.0	14.25	33.49	23.9
10cm pruning	18.00	20.33	19.2	12.92	30.36	21.6
50% fruit thinning	35.33	32.00	33.7	10.02	23.55	16.8
50 ppm NAD	27.00	30.33	28.7	12.52	29.42	21.0
60 ppm 2, 4-D	29.00	29.00	29.0	12.05	28.32	20.2
15% Urea	21.67	24.33	23.0	11.85	27.85	19.8
10ppm DNOC	31.33	31.33	31.3	10.39	24.42	17.4
S.E (m) +	1.28	1.24	0.73	0.04	0.15	0.06
CD at (5 %)	3.89	3.75	2.18	0.12	0.45	0.19

Table.3 Effect of different crop regulation methods and chemicals on days required for initiation of flowers and days required for fruit maturity in Guava cv. Arka Mridula

Treatments	Number of days required for initiation of flowers on newly emerged shoots			Number of days required for attainment of fruit maturity		
	1st year	2nd year	Pooled	1st year	2nd year	Pooled
Control	49.00	52.00	50.5	134.33	134.67	134.5
Shoot bending	42.00	45.00	43.5	126.00	127.33	126.7
10cm pruning	44.67	47.00	45.8	127.00	127.67	127.3
50% fruit thinning	48.00	49.33	48.7	133.00	133.67	133.3
50 ppm NAD	47.00	50.00	48.5	131.33	131.33	131.3
60 ppm 2, 4-D	46.00	49.00	47.5	134.00	132.67	133.3
15% Urea	45.00	47.67	46.3	129.00	129.00	129.0
10ppm DNOC	48.33	50.00	49.2	132.00	133.00	132.5
S.E (m) +	0.92	0.82	0.50	1.02	0.91	0.56
CD at (5 %)	2.79	2.50	1.51	3.10	2.75	1.67

Table.4 Effect of different crop regulation methods and chemicals on number of fruits/tree, fruit weight and yield of Guava cv. Arka Mridula

Treatments	No. of fruits/tree			Average fruit weight (g)			Yield /tree (Kg)			Yield per hectare (q/ha)		
	1st year	2nd year	Pooled	1st year	2nd year	Pooled	1st year	2nd year	Pooled	1st year	2nd year	Pooled
Control	56.16	60.21	58.2	104.91	82.36	108.4	5.89	6.74	6.3	23.57	26.96	25.3
Shoot bending	64.50	71.91	68.2	115.24	100.69	118.7	7.43	8.79	8.1	29.74	35.16	32.5
10cm pruning	58.00	66.00	62.0	120.67	132.65	124.2	7.00	8.43	7.7	28.00	33.71	30.9
50% fruit thinning	56.33	58.35	57.3	118.96	127.01	122.5	6.69	7.36	7.0	26.76	29.42	28.1
50 ppm NAD	63.19	69.36	66.3	121.80	126.88	125.3	7.70	8.93	8.3	30.79	35.74	33.3
60 ppm 2, 4-D	59.58	65.87	62.7	120.20	142.79	123.7	7.16	8.38	7.8	28.65	33.52	31.1
15% Urea	58.00	59.75	58.9	114.78	109.45	118.3	6.65	7.28	7.0	26.62	29.10	27.9
10ppm DNOC	56.17	58.14	57.2	113.02	85.58	116.5	6.35	6.98	6.7	25.39	27.90	26.6
S.E (m) +	1.59	0.83	0.73	1.50	1.42	0.86	0.17	0.15	0.09	0.69	0.61	0.38
CD at (5 %)	4.83	2.53	2.20	4.54	4.31	2.59	0.53	0.46	0.28	2.10	1.85	1.13

The upright branch produces fewer flowers and fruits than the bent branch (Ito *et al.*, 1999). Among the chemicals, the treatment T_7 (15% Urea) took minimum days (46.3) for initiation for flowering followed by 47.5 days in T_6 (60 ppm 2, 4-D) and 48.5 days in T_5 (50 ppm NAD). This result corroborated with the finding of Maji *et al.*, (2015) who concluded that summer deblossoming with NAD (60 ppm) was the most effective crop regulating treatment followed by NAA @ 500 ppm and Kumar and Hoda (1977) who reported that NAD (50 ppm) and 2, 4-D (30 ppm) were the most effective chemicals for deblossoming of summer flowers. By deblossoming or thinning of ambe bahar flowers, the trees produced abundant flowers in June- July and fruits were ready for harvesting in the month of October-November.

Number of days required for fruit maturity

From the data presented in the Table 3, it indicated that the treated guava showed significant variations regarding period required from flowering to fruit maturity. Shoot bending (T_2) and 10 cm pruning (T_3) treatment took minimum duration for fruit maturity i.e. (126 days and 127 days during first year) and (127.3 days and 127.67 days during second year) respectively. Maximum duration from flowering to fruit maturity was recorded in untreated (T_1) i.e. control plants (134.33 days and 134.67 days) during first and second year respectively. From the pooled data, it was found that the period required for fruit maturity varied from 126.7 days in bending (T_2) to 134.5 days in control plants (T_1). Further, it is inferred that among cultural methods, T_3 (10 cm pruning) and T_1 (control) recorded minimum (127.3) and maximum (134.5) days respectively for attainment of fruit maturity. Among chemicals, the treatment T_7 (15% Urea) recorded minimum days (129) followed by 131.3days in T_5 (50 ppm NAD application).

Number of fruits per plant

Data presented in Table 3, showed that the number of harvested fruits per plant varied significantly and during first year, it ranged between 56.16 and 64.50 among the treatments. The highest number of fruits (64.50) per plant were obtained by the treatment T_2 (Shoots bending) followed by T_5 (63.19) i.e. with 60 ppm NAD. The control plant (T_1) recorded the lowest number of fruits (56.16) per plant whereas the treatment T_4 (50 % thinning) was statistically at par with control (T_1). During 2nd year significant differences among the different treatment with respect to the number of fruits per plant was observed. The highest number of fruits per plant was observed in treatment T_2 (71.91) followed by T_5 (69.36). So with respect to the number of fruits per plant, shoot bending recorded highest number of fruits per plant during both the years and were significantly different from other treatments. Shoot bending (T_2) and 50 ppm NAD (T_5) recorded highest number of fruits per plant during 1st and 2nd year respectively and were significantly different from other treatments. Both the treatments were also found significantly superior over the control. The results are in line with the findings of Singh (1986) who reported NAD (50 ppm) application was very effective in reducing rainy season crop with subsequent increased fruit set and fruit number during winter and Kumar and Hoda (1977) who suggested for application of NAD (50 ppm) and 2,4-D (30 ppm) in thinning rainy season crop. Pruning also reduces tree crown area and improves number of fruits per plant in guava (Dalal *et al.*, 2000 and Brar *et al.*, 007)

Fruit weight (g)

The data presented in Table 4, showed that all the treatments varied significantly. All the treatment resulted higher fruit weight over the control (T_1).During first year,it was recorded highest (121.80 g) in T_5 (50 ppm NAD) followed by treatment with 10 cm pruning i.e. T_3 (120.67 g), T_6 (60 ppm 2, 4-D) (120.20), and 118.96 in T_4 (50% fruit thinning) and bending i.e.T_2 (115.24) whereas it was lowest (104.91 g) in control (T_1). However, during second year, the heaviest fruit (142.79 g) was found in T_6 (60 ppm 2, 4-D) followed by (132.65 g) in T_3 (10 cm pruning) while lowest fruit weight (82.36 g) was recorded in control (T_1). From the pooled data it was ascertained that heaviest fruit (125.3g) was found in T_5 (50 ppm NAD) followed by 124.2g in T_3 (10cm pruning) and 123.7g inT_6 (60 ppm 2, 4-D).Lowest fruit weight was obtained in control (108.4g). Application of growth substances like NAD (30 and 50 ppm) increased weight of fruit (Mitra *et al.*, 1982). The increased fruit weight could be attributed to an increase in the size of the cells and accumulation of food substances in the intercellular spaces in fruit.Fruit weight at harvest was negatively correlated with crop load, and fruit weight was greatest when there was minimum competition between fruit (Palmer *et al.*, 1997).

Yield per plant (Kg)

The fruit yield is an ultimate factor that decides the success and failure of any technology to the fruit growers. It was implied from the data presented in the Table 4, that the yield (kg / plant) varied significantly due to different treatments. During 1st year highest yield per plant was recorded in the 50 ppm NAD (7.70 kg) followed by shoot bending (7.43 kg), while the lowest yield per plant was recorded in control plant (5.89 kg) followed by treatment of 10 ppm DNOC (6.35 kg). Similarly during second year the highest yield per plant was recorded in 50 ppm NAD (8.93 kg) followed by shoot bending (8.79 kg). The treatment T_1 produces the lowest yield per plant (5.89 kg) which was followed by T_8(6.35 kg).From the pooled data, it was obvious that 50 ppm NAD (T_5) gave highest fruit yield (8.3 kg) followed by T_2 (8.1 kg/plant) whereas it was recorded lowest in control (6.3 kg/plant).So it was clear that with respect to the yield per plant the treatment were found superior to the check. However, according to Bagchi *et al.*, (2008), bending of shoots gave the highest yield per plant (48.6 kg/ plant), followed by 20 cm pruning (23 kg /plant).

The result are close proximity with e research results of (Mamun *et al.*, 2012) who obtained highest fruit yield (13.50 kg/plant) in shoot bending treatment and the lowest fruit yield (7.19 kg/plant) was recorded in 100% fruit thinning treatment and (Sarker *et al.*, 2005), who reported that shoot bending increased the fruit yield per plant and quality fruit during off season.

Yield per hectare (q/ha)

Yield characteristics have been found significantly affected by various treatments. From the data depicted in the Table 4, the yield per hectare in 1st year varied from a minimum of 23.57 (q/ha) in control (T_1) to a maximum of 30.79 (q/ha) in T_5(50 ppm NAD). The highest yield (30.79 q/ha) was noticed in 50 ppm NAD (T_5) followed by (29.74 q/ha) in T_2(shoot bending), (28.65 q/ha) in T_6 (60 ppm 2,4-D) and (28 q/ha) in T_3 (10 cm pruning).The lowest yield (23.57 q/ha) was observed in control (T_1) followed by (25.39 q/ha) in T_8(10 ppm DNOC), (26.62 q/ha) in T_7(15 % urea) and (26.76 q/ha) in T_5(50 % fruit thinning). The yield per hectare during 2nd year was recorded highest (35.74q/ha) in T_5(50 ppm NAD) followed by shoot bending (35.16 q/ha), 10 cm pruning (33.71q/ha) and 60 ppm 2,4-D(33.52 q/ha), whereas the lowest in control (26.96 q/ha) followed by10 ppm DNOC (27.90 q/ha). From the pooled data, it was recorded highest

(33.3 q/ha) in T_5 followed by 32.5 q/ha in T_2(Bending), 31.1 q/ha in T_6(60 ppm 2, 4-D) and 30.9 q/ha in T_3 (10 cm pruning) and lowest (25.3 q/ha)in control (T_1). So with respect to the yield per hectare during both the years different treatments shown superiority over the control. A spray of NAA (80 or 100 ppm) was recommended by Rathore (1975) to reduce the rainy season yield so as to increase that in the winter NAD (50 ppm) followed by 2, 4-0 (30 ppm) gave better results (Kumar and Hoda, 1977). Similarly, Pandey *et al.*, (1980) obtained maximum yield in winter season by deblossoming with 800 ppm NAA followed by 600 ppm NAA.

In conclusion the normal flowering and fruiting behaviour of guava needed to be regulated, towards the production of heavy crop load during winter season to make guava cultivation highly profitable and market oriented. In general, all the crop regulation practices were found superior over the untreated control with respect to growth, flowering yield. If the guava tree is left unpruned, they tend to prolong the vegetative growth, reduce the bearing area, thus leading to decrease in fruit size, yield and quality. Hence, to get a good balance between the vegetative and reproductive growth, pruning becomes essential. Shifting of rainy season crop to winter months in guava with the help of crop regulation method was found to be efficient method of getting a good crop producing quality fruits free from pest and diseases. Hence, the above treatment may be effectively used for commercial exploitation of guava in winter months for getting remunerative price by producing more number of quality fruits. Among the cultural treatments, the treatment T_2 (Bending) was found superior to T_3 (10 cm pruning) and T_1 (control). Among chemical treatments, the treatment T_5 (50 ppm NAD) was found superior to others T_6 (60 ppm 2, 4-D) with respect to yield and other parameters studied.

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