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EFFECT OF GROWTH REGULATOR SPRAYS ON GROWTH, YIELD AND QUALITY OF GUAVA UNDER MALWA PLATEAU CONDITIONS

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ABSTRACT

The experiment was conducted at the Department of Fruit Science, K.N.K. College of Horticulture, Mandsaur (M.P.) on seven years old guava trees cv. Allahabad safeda during 2012-13. Results revealed that foliar spray of NAA 100 ppm proved best to increase the plant height (0.63 m), canopy spread E-W (0.81 m) and N-S (0.85 m) and canopy height (0.57 m). In case of reproductive parameters, minimum fruit drop per cent (42.96) and maximum fruit retention per cent (51.40) was recorded with the application of GA_3 150 ppm. Maximum fruit volume (174.6 ml), fruit length (6.54 cm) and diameter (5.74 cm) at harvest, number of fruit/plant (251.1), average fruit weight (223.37 g) and yield/tree (56.10 kg) were recorded with foliar spray of NAA 100 ppm. Maximum TSS (12.6 ^{0}Brix), acidity (0.35%), total sugars (10.42%), reducing sugar (5.82%), non reducing sugar (4.60%) were recorded with foliar spray of GA_3 150 ppm. Maximum ascorbic acid and pectin content were recorded with foliar spray of NAA 100 ppm.

Key words: Foliar feeding, growth regulators, quality, yield, guava

INTRODUCTION

Guava (*Psidium guajava* L.) is one of the most popular fruit grown in tropical and sub-tropical regions of India, which belongs to the family Myrtaceae. Plant hormones play a key role in guava production by influencing directly or indirectly various plant processes like germination, rooting, growth and productivity of guava. These also can influence size, appearance and quality parameters of fruits by indirectly affecting the crop growth and development or directly by synchronizing flowering, improving fruit set and decreasing fruit drop. By the application of plant growth regulators the physical (size, diameter and shape), chemical (T.S.S. and ascorbic acid), reproductive (fruit set and fruit retention) and yield (average fruit weight, fruits/tree and yield/tree) parameters are improved. The application of GA_3 improves the size, shape and weight of the fruits. GA_3 increases fruit set and fruit retention of the tree. By the application of NAA, T.S.S. and Ascorbic- acid content of fruits are increased and acidity is reduced. NAA reduces the number of seed of the fruits. It also induces heavier fruiting and promotes flowering. Plant growth regulators like auxins, Gibberellins and Cycocel have been extensively used for improving the quality of various fruits. Auxins as well as GA_3 have been found to accelerate the translocation of metabolites from other parts of the plant towards developing fruits. Ethrel was found to be accelerated the ripening process while, GA_3 and NAA were found to be accelerated cell elongation and increase fruit size. Auxin was to be used for controlling factor in the abscission of plant organ and it possibly acts through Ethylene production. Through the foliar application of growth regulators the size, volume and yield of the fruit are increased (Yadav, 2000). Therefore, an experiment was conducted to study the effect of growth regulators on yield and quality of guava.

MATERIAL AND METHODS

The experiment was conducted at the K.N.K. College of Horticulture, Mandsaur (M.P.) on six years old guava tree cv. Chittidar during 2012-13. The experiment was laid out in randomized block design with 10 treatments consisting of foliar sprays of NAA, GA_3, Ethrel, Cycoceal and control. First foliar spray of growth regulators on crop was done on 20 August 2012 and same spray is repeated after 30 days. The details of treatments were T_0 - Control , T_1- NAA 5 0ppm, T_2- NAA 100 ppm, T_3- GA_3 100 ppm,T_4- GA_3 200 ppm, T_5- Ethrel 200 ppm, T_6- Ethrel 400 ppm, T_7- Ethrel 600 ppm, T_8- CCC 400ppm, T_9- CCC 800 ppm and T_{10}- CCC 1200 ppm. For recording reproductive parameters of guava *viz*. fruit drop and fruit retention per cent, four branches are randomly selected and tagged on the plant and the number of flowers counted at full bloom separately on each branch after that number of fruits are counted. The fruit setting per cent is calculated with following formula:

Fruit setting (%) = Number of set fruits / number of flowers x100

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The fruit drop per cent was calculated with following formula

$$\text{Fruit drop\%} = \frac{\text{Total number of fruit set - Total number of fruits at harvest time}}{\text{Total number of fruit set}} \times 100$$

The fruit retention (at maturity) is calculated with following formula:

Fruit retention (%) = Number of fruits at harvest/ initial number of fruit set x100

Four healthy fruits were selected randomly from each tree at full maturity to determine of chemical parameters. Hand refractometer was used for determination of T.S.S. in ^{0}Brix. Acidity was estimated by simple acid–alkali titration method as described in A.O.A.C. (1970). Sugars in fruit juice were estimated by the method as suggested by Nelson (1944). Assay method of ascorbic acid was followed for vitamin C (Ranganna, 1977). The estimation of pectin was done as per method of Kertesz (1951).

RESULTS AND DISCUSSION

Morphological parameters

The individual spray of growth regulators (NAA, GA_3, Ethrel and CCC) increased the morphological and reproductive parameters significantly over control (Table 1). But maximum values of plant height (0.63 m), canopy spread in N-S direction (0.85 m) and in E-W direction (0.81 m) were found by the spray of NAA 100 ppm followed by NAA 50 ppm treatment. There is notable improvement with respect to growth parameters with the use of plant growth regulators. The length of terminal shoot, number of leaves and flower buds per shoot increased significantly with plant growth regulators. NAA proved most effective in increasing vegetative characters followed by GA_3. NAA increased shoot growth at relatively higher concentration and root growth at a very low concentration. NAA stimulates cell division, cell enlargement and cell elongation in the apical region. The elongation of cell is due to increasing osmotic pressure and permeability of cytoplasm to water. It may also be due to decreasing cell wall pressure and increasing cell- wall elasticity. NAA increases amylase activity, membrane permeability, formation of energy rich phosphate and cell wall plasticity. The results are in accordance with the findings of Iqbal *et al.* (2009) in guava.

Table 1: Effect of plant growth regulator sprays morphological and reproductive parameters of Guava

Treatment	Plant Height (m)	Canopy spread (m)		Canopy height (m)	Fruit drop (%)	Fruit retention (%)
		N-S	E-W			
Control	0.44	0.34	0.32	0.38	53.8	39.3
NAA 50 ppm	0.61	0.80	0.80	0.56	48.4	47.4
NAA 100 ppm	0.63	0.85	0.81	0.57	47.3	47.4
GA_3 1 00 ppm	0.54	0.65	0.70	0.48	45.2	48.7
GA_3 150 ppm	0.55	0.79	0.76	0.49	42.9	51.4
Ethrel 200 ppm	0.51	0.63	0.64	0.46	48.6	46.7
Ethrel 400 ppm	0.52	0.65	0.69	0.47	48.6	44.4
Ethrel 600 ppm	0.51	0.63	0.61	0.45	51.1	44.3
CCC 400 ppm	0.50	0.60	0.56	0.44	51.1	42.4
CCC 800 ppm	0.49	0.56	0.56	0.43	51.2	41.5
CCC 1200 ppm	0.46	0.43	0.42	0.41	52.2	40.7
S.Em ±	0.01	0.03	0.011	0.01	0.77	1.40
CD (p=0.05) at 5%	0.04	0.07	0.04	0.03	2.28	4.06

(The data given for plant height, canopy spread and canopy height are the increment during the investigation period)

The minimum fruit drop percentage (42.96) and maximum fruit retention (51.40%) was recorded with spray of GA_3 150 ppm. The maximum fruit drop (53.82%) and minimum fruit retention (39.34%) were recorded under control. The higher fruit set in response to higher concentration of growth substances like GA_3 application may probably due to translocation of hormones, food substances and other factors stimulating fruit formation to the tissue of ovary in greater amount. These results are similar to the findings of Yadav *et al.* (2011) in guava. The primitive

effect of growth substances in greater retention of fruit may be attributed to reduction in fruit drop. There is correlation between fruit drop and endogenous hormonal status, and existence of high level of internal auxin that prevent fruit drop. Since high level of endogenous hormones might help in building up endogenous hormone at appropriate level, potent to enough reduce the fruit drop. By the foliar application of growth regulators synthesis to sink and increased pollen viability and fertilization. These results are in accordance with the finding of Ram *at al.* (2005) and Yadav *et al.* (2011) in guava.

Physico-yield parameters of fruits

The results revealed that various physical parameters (fruit volume, fruit diameter, fruit length at harvest) of fruit were significantly affected by application of different plant growth regulators. Maximum fruit volume (174.6 ml), fruit length (6.54 cm) and diameter (5.74 cm) at harvest was recorded with foliar spray of NAA 100 ppm followed by NAA 50 ppm and GA_3 150 ppm. The increase in fruit size due to accelerated rate of cell division and cell enlargement and more intercellular space with the application of higher concentration of growth substances like NAA. Increase in fruit size was recorded with NAA in guava (Jain and Dashora, 2010). Endogenous auxin is responsible for increasing fruit size in guava. The rapid growth of the fruit synchronized with the maximum amount of auxin present therein. The increase in length and diameter of guava fruit may be due to higher concentration of plant growth regulators (NAA) that appears to have indirect role in hastening the process of cell division and cell elongation due to which size and weight of fruits would have improved. The results were in conformity with those of Yadav (2002).

Table 2: Effect of growth regulator sprays on physical and yield parameters of guava

Treatment	fruit volume (ml)	Fruit length (cm)	Fruit diameter (cm)	Fruits per tree	Fruit weight (g)	Yield per tree (kg)
Control	174.6	5.79	5.10	190.5	170.00	32.38
NAA 50 ppm	214.6	6.33	5.66	249.6	210.67	50.95
NAA 100 ppm	220.6	6.54	5.74	251.1	223.37	56.10
GA_3 1 00 ppm	205.6	6.15	5.48	227.3	203.00	47.87
GA_3 150 ppm	207.3	6.25	5.63	235.8	204.10	47.89
Ethrel 200 ppm	204.6	6.12	5.36	223.3	200.63	44.80
Ethrel 400 ppm	205.6	6.14	5.43	214.1	203.00	43.47
Ethrel 600 ppm	203.6	6.05	5.31	209.5	198.00	41.48
CCC 400 ppm	194.6	6.00	5.27	195.6	196.00	38.35
CCC 800 ppm	200.6	6.02	5.29	204.5	194.60	39.79
CCC 1200 ppm	177.6	5.85	5.18	191.1	194.00	37.08
S.Em.±	2.43	0.14	0.13	8.46	1.51	0.43
CD (P=0.05)	7.16	0.40	0.38	24.99	4.45	1 .27

It is evident from Table 2 that number of fruits per tree, average fruit weight and yield per tree was significantly affected by different treatments. The maximum fruits per tree (251.10), average fruit weight (223.37 g) and yield per tree (56.17) were recorded with the foliar spray of NAA 100 ppm followed by NAA 50 ppm and GA_3 150 ppm. Increase in fruit weight may be attributed to the strengthening of middle lamella and consequently cell wall, which later may have increase the free passage of solutes to the fruits. Desai *et al.* (1993) confirmed the effective role of NAA in increasing fruit weight. Ultimately these produced more number of leaves and flowers/buds. This might have lead to more length and diameter of fruit and also larger weight of individual fruit. There was a positive and significant correlation between the length and weight of fruit and the diameter and weight of

fruit. Increase in the fruit size has been recorded with the help of NAA in different fruits like guava (Katiyar *et al.,* 2009 and Iqbal *et al.* 2009). Endogenous auxin is responsible for increasing fruit size of guava. The rapid growth of the fruit synchronized with the maximum amount of auxin present therein. The terminal shoot was highly correlated with the other characters, such as number of leaves, number of flower buds and yield per tree. It indicated that yield of fruit, number of leaves and number of flower buds increased with increase in the length of shoots. Number of leaves per shoots was highly correlated with yield of fruit which indicated that yield increased with increased number of leaves per shoots this might be due to the fact that leaves accelerate the physiological processes which result in increase in the yield of the fruit. Ultimately these produced more number of leaves and flowers buds. This might have lead to more length and diameter of fruit and also larger weight of individual fruit.

Table 3: Effect of growth regulator sprays on chemical parameters of guava

Treatment	Acidity (%)	TSS (^{0}Brix)	Total Sugars (%)	Reducing Sugars (%)	Non-reducing	Ascorbic acid (mg/100g pulp)	Pectin (%)
Control	0.39	9.6	9.03	5.51	3.52	170.0	0.79
NAA 50 ppm	0.27	11.4	9.61	5.66	3.95	178.9	1.29
NAA 100 ppm	0.25	11.6	9.94	5.70	4.25	180.1	1.61
GA_3 1 00 ppm	0.30	12.0	10.02	5.75	3.27	176.2	1.15
GA_3 150 ppm	0.35	12.6	10.42	5.82	4.60	177.9	1.20
Ethrel 200 ppm	0.32	11.3	9.49	5.65	3.84	175.6	0.94
Ethrel 400 ppm	0.31	11.2	9.35	5.63	3.72	174.4	0.90
Ethrel 600 ppm	0.32	11.0	9.33	5.62	3.72	173.4	0.88
CCC 400 ppm	0.33	10.6	9.22	5.57	3.66	173.2	0.87
CCC 800 ppm	0.33	9.8	9.21	5.57	3.64	172.3	0.84
CCC 1200 ppm	0.34	9.6	9.11	5.55	3.57	172.2	0.83
S.Em±	0.02	0.65	0.11	0.02	0.09	0.41	0.02
CD (p=0.05)	0.05	1.89	0.33	0.08	0.27	1.20	0.06

Chemical parameters of fruits

Maximum T.S.S. (12.67 ^{0}Brix), total sugars (10.42), reducing sugar (5.82) and non reducing sugar (4.60) was noticed by foliar spray of GA_3 150 ppm followed by T_3 (GA_3 100 ppm) and T_2 (NAA 100 ppm) (Table 3). GA_3 at higher concentration augmented TSS content of the fruit. This has been reported to divert more solids towards developing fruits and might also enhance the conversion of complex polysaccharide into simple sugars. Increase in sugar content may be due to the higher concentration of GA_3 which promotes hydrolysis of starch into sugar. The higher percentage of total sugar, reducing and non-reducing sugar pectin might have been due to efficient translocation of photosynthates to the fruits by regulation of GA_3. These results are in conformity with the findings of Ram *et al.* (2005) in ber. Acidity of fruits was reduced by application of all the treatments, however maximum reduction was noted with foliar spray of NAA 100 ppm followed by T_1 (NAA 50 ppm). It appears that acid under the influence of higher concentration of growth regulators might has either fastly been converted into sugar and their derivatives by reactions involving reverse glycolytic pathways or might have been used in respiration or both. These results are in accordance with the findings of Brahmachari *et al.* (1997) in guava where they reported minimum acidity with foliar application of NAA. Acidity is also reduced by the foliar application of NAA because it helps in preventing excessive polymerization of sugar and accumulation of more sugar in the cells of plant. This result is in close conformity with the finding of Barar *et al.*

(2012) in guava. Foliar spray of NAA 100 ppm increased in maximum pectin content (1.61) and ascorbic acid content (180.11 mg) during the study followed by NAA 50 ppm and GA_3 150 ppm. This might be due to higher concentration of plant growth regulators (NAA etc), which are responsible for solubilizing the pectin substances from middle lamella with rise in pectin. Kumar *et al.* (2010) also observed that the application of NAA in guava proved effective in increasing pectin content. The higher concentrations of plant regulators increase the ascorbic acid content of fruit. It may due to the possible catalytic influence of these growth regulators on biosynthesis of ascorbic acid from sugars or inhibition of oxidative enzymes or both. These results are in conformity with the findings of Brahmachari *et al.* (1997).

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