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Influence of Foliar Application of NAA and Zinc on Yield and Quality Attributes of Guava (*Psidium guajava* L.) cv. L-49

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

An experiment was carried out at Department of Fruit Science, Sardar Vallabhbhai Patel University of Agriculture & Technology Meerut (U.P), India during two consecutive years i.e., 2021-22 and 2022-23 to assess the Influence of foliar Spray of NAA and Zinc on growth, flowering, fruiting, yield and quality of Guava (*Psidium guajava* L.) cv. L-49 under western U.P. conditions. The foliar spray of micronutrients along with plant growth regulators play an important role in manipulating many physiological phenomena, improving the yield and quality and enhanced the productivity of plants by fulfilling the nutritional needs of fruit crops. Twelve treatments *viz*., three level of NAA (0, 50, and 75 ppm) and four level of Zinc (0, 0.4, 0.6, and 0.8 %) with their combinations were used, which were replicated in factorial Randomized Block Design. Results showed NAA @75 ppm (N_2) individually registered yield of 53.75 and 53.06 kg/plant the application of Zinc at 0.8 % (Zn_3) concentration recorded yield of 53.86 and 53.17 kg/plant. Interactive effect of naphthalene acetic acid and Zinc (N_2Zn_3) treatments registered yield of 59.56 and 58.81 kg/plant while quality parameter pectin was in the range of 0.79 and 0.80 % with treatment naphthalene acetic acid @75 ppm (N_2) and Zinc at 0.8 % (Zn_3) individually recorded 0.80 and 0.82 % outperformed the other treatments. The combination could be ideal and recommended for the production of guava in the Indo-Gangetic plains in western India.

Keywords: Guava; zinc; NAA; yield; pectin.

1. INTRODUCTION

The guava, often known as the Apple of the Tropics (*Psidium guajava* L.), is India's sixth most popular fruit crop after papaya, mango, banana, and citrus fruits. It is a member of the myrtaceae family and is native to tropical America, spanning from Mexico to Peru [1]. The trees were cultivated more than 2000 years ago, and soon after the discovery of the new world by the Spanish and Portuguese, they spread quickly across the globe's tropics. It is now present in tropical and subtropical regions of many nations, Thailand, New Zealand, Philippines, China, Malaysia, Cuba, Sri Lanka, Venezuela, Australia, Burma, Myanmar, Israel, Pakistan, and Bangladesh. Guava is mostly produced in India. In India, there are 6967 thousand hectares of land used for fruit farming, and 102924 thousand metric tonnes of fruit are produced annually. India is the leading producer of guava in the world. The total area under guava cultivation and production in India is about 287 thousand hectares and 4304 thousand MT respectively (NHB, 2019-20). The major guava-producing states of India are Uttar Pradesh, Maharashtra, Bihar, Andhra Pradesh, Gujarat, Madhya Pradesh, Karnataka, Punjab, and Orissa. Uttar Pradesh produces the best quality guava, and Allahabad has a distinct reputation for growing the best guava in the country as well as in the world. Mature fruits of guava are rich in nutrition. Its composition varies in different cultivars, seasons and not only within the cultivar from place to place but also at one location owing to changes in yearly climatic conditions and cultural practices followed. The fruit (berry) is an excellent source of vitamin C (210-305 mg/100 g fruit pulp) and pectin (0.5-1.8%) but has low energy (66cal. /100 g). The ripe fruits contain 12.3-26.3% dry matter, 77.9-86.9% moisture, 0.51-1.02% ash, 0.10-0.70% crude fat, 0.82-1.45% crude protein and 2.0-7.2% crude fibre. The fruits are also rich in minerals like phosphorus (22.5-40.0 mg/100g pulp), calcium (10.0-30.0 mg/100g pulp) and iron (0.60-1.39 mg/100g pulp) as well as vitamins like niacin (0.20-2.32 mg/100g pulp), pantothenic acid, thiamine (0.03-0.07 mg/100 g pulp), riboflavin (0.02-0.04 mg/100g pulp) and vitamin- "A" [2]. It has an astringent property due to which its mature leaves, fruits, roots and bark are used in medicines to treat gastroenteritis, diarrhoea and dysentery [3]. Most of the guava varieties produce medium to small inferior quality fruits research work has been done in the country on various aspects such as varieties, propagation, irrigation, training and pruning, etc., to increase the yield and quality of guava fruits. The production of poor-quality fruits is a matter of common experience; it would be, therefore, worthwhile to improve the yield and quality of fruit crops by use of micronutrients and plant growth regulators. The importance of micronutrients and synthetic plant growth regulators in achieving higher yields and better quality of fruit crops have been well recognized in recent time. Micronutrients help in the uptake of major nutrients and play an active role in the plant metabolism process starting from cell wall development to respiration, photosynthesis, chlorophyll formation, enzyme (activity) hormone synthesis, nitrogen fixation and reduction [4]. The experiment aims to assess the "Influence of foliar spray of NAA & Zinc on growth, flowering, fruiting, yield and quality of Guava under Western U.P. conditions.

2. MATERIALS AND METHODS

The present investigation was carried out in the Old Campus, Horticulture Garden Department of Fruit Science, College of horticulture, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut during two subsequent years 2021-22 and 2022- 23.

2.1 Experimental Design and Treatments

Lucknow-49 guava cultivar trees that were uniformly, and healthy well established were chosen for the experiment's goal the tress, Fertilizer doses and other horticultural practices. The experiment was laid out in Factorial Randomized Design with three replications and Twelve treatments. Three level of NAA (0, 50 and 75 ppm), and four level of Zinc (0, 0.4, 0.6 and 0.8 %) and these combinations were taken the treatments were follows-

Table 1. Treatments details

Treatments	Treatment Description
T_1	Water Spray
T_2	Zinc 0.4%
T_3	Zinc 0.6%
T_4	Zinc 0.8%
T_5	NAA 50 ppm
T_6	NAA 50 ppm+ Zinc 0.4%
T_7	NAA 50 ppm + Zinc 0.6%
T_8	NAA 50 ppm + Zinc 0.9 0.8%
T_9	NAA 75 ppm
T_{10}	NAA 75 ppm + Zinc 0.4%
T_{11}	NAA 75 ppm + Zinc 0.6%
T_{12}	NAA 75 ppm + Zinc 0.8%

NAA (water spray), NAA (50 ppm), NAA (75 ppm) are denoted as (N_0, N_1, N_2,) respectively, Zinc (water spray), Zinc 0.4 % , Zinc 0.6 % , Zinc 0.8 % are denoted as (Zn_0, Zn_1, Zn_2, Zn_3) respectively. The micronutrient (Zinc) and Plant growth regulator (NAA) were sprayed on the guava trees. Five newly initiated shoot on the current season's growth were randomly selected and tagged for taking the observation pertaining to Yield (kg/plant) and Pectin (%). These parameters were carefully recorded using prescribed standard methodology. The micronutrient (zinc) and Plant growth regulator (NAA) were sprayed on the tree. Five newly initiated shoot on the current season's growth were randomly selected and tagged for taking the observation, the observation pertaining to Yield (kg/plant), Pectin (%).

2.2 Parameters of Study

2.2.1 Yield (kg/Plant)

The weight of fruits was recorded at every harvesting under each treatment and total yield per plant was calculated at the final harvesting.

2.2.2 Pectin (%)

The fruits of each treatment were crushed by means of pestle and mortar. About 100 (g) of the crushed sample was taken and 200 ml of water was added to it and boiled for half an hour. The process was repeated twice and the extract was made up to 250 ml. The sample was then tested for starch content with 0.1 (per cent) iodine solution, which was negligible. Again 100 ml of the extract was centrifuged to get a clear solution and 50 ml of this solution was taken out for estimation of pectin according to the method of Kertesz [5].

2.3 Statistical Analysis

The observations recorded during the course of the investigation were subjected to statistical analysis by adopting appropriate model analysis of variance (ANOVA) According to the procedure described by Panse and Sukhantme [6]. Critical differences (CD) within the treatment were calculated to compare the treatment at (1 percent 5 percent level) of significance only:

(1) $\mathrm{C.F} = \frac{\mathrm{GT}^2}{\mathrm{N}}$
(2) T.S.S = ($X^2_1 + X^2_2 + X^2_3$--------------- X^2_n) - C.F.
(3) S.S. for error = TSS – Tr.S.S.
(4) Table for analysis of variance

3. RESULTS AND DISCUSSION

3.1 Results

Yield (kg/ Plant): The Table 2 indicated that the applied NAA and Zinc as foliar spray It was observed that among all NAA treatment were significant during the experimental trial and it was found that treatment T_9 NAA 75 ppm has showed the maximum yield (kg/plant) (45.89 kg/plant) and followed by treatment T_5 NAA 50 ppm (45.57 kg/plant), while under control treatment (N_0) water Spray has showed the minimum yield (kg/plant) (36.75 kg/plant) and Zinc has showed the significant result during the experiment. It was found that the treatment T_4 Zinc 0.8% has showed the maximum yield (kg/plant) (45.74 kg/plant) and followed by T_3 Zinc 0.6 % (42.16 kg/plant) and T_2 Zinc 0.4% (39.70 kg/plant) while the minimum yield (kg/plant) under the control treatment (Zn_0) water spray (37.23 kg/plant) and second year data (2022-2023) data were recorded all NAA and Zinc treatment were significant during the experimental trial and it was found that treatment T_9 NAA 75 ppm has showed the maximum yield (kg/plant) (45.89 kg/plant) and followed by treatment T_5 NAA 50 ppm (45.57 kg/plant), while under control treatment (water spray) has showed the minimum yield (kg/Plant) (36.75 kg/plant) and all the treatment of Zinc has showed the significant result during the experiment. It was found that the treatment T_4 Zinc 0.8% has showed the maximum yield (kg/plant) (45.15 kg/plant) and followed by T_3 Zinc 0.6 % (42.62 kg/plant) and T_2 Zinc 0.4% (39.18 kg/plant) while the minimum yield (kg/plant) under the control treatment water spray (36.75 kg/plant).

The interaction between NAA and Zinc treatment on the yield (kg/plant) of guava cause significant variation during experiment trial. It was observed that treatment T_{12} NAA 75 ppm + Zinc 0.8% has showed the maximum yield (kg/plant) (59.56 kg/plant) and followed by treatment T_{11} NAA 75 ppm + Zinc 0.6% (57.63 kg/plant) and T_8 NAA 50 ppm + Zinc 0.8% (56.28 kg/plant) and while the minimum yield (kg/plant) was observed in control treatment (N_0Zn_o) (37.23 kg/plant) and followed T_6 NAA 50 ppm+ Zinc 0.4% (49.84 kg/Plant) and T_{10} NAA 75 ppm + Zinc 0.4% (51.31 kg/plant) and final year 2022-23 data were recorded NAA and Zinc treatment on the yield (kg/plant) of guava cause significant variation during experiment trial. It was observed that treatment T_{12} NAA 75 ppm + Zinc 0.8% has showed the maximum yield (kg/plant) (58.81 kg/plant) and followed by treatment T_{11} NAA 75 ppm + Zinc 0.6% (56.90 kg/plant) and T_8 NAA 50 ppm + Zinc 0.8% (55.56 kg/plant) and while the minimum yield (kg/plant) was observed in control treatment (N_0Zn_o) (36.75 kg/plant) and followed T_6 NAA 50 ppm+ Zinc 0.4% (49.21 kg/plant) and T_{10} NAA 75 ppm + Zinc 0.4% (50.65 kg/plant).

Pectin %: NAA treatment were significant during the experimental trial and it was found Table 3 that treatment T_9 NAA 75 ppm has showed the maximum Pectin content (0.68%) and followed by treatment T_5 NAA 50 ppm (0.66%), while under control treatment (water spray) has showed the minimum Pectin content (0.64%) and Zinc treatment has showed the significant result during the experiment. It was found that the treatment T_4 Zinc 0.8% has showed the maximum Pectin content (0.69%) and followed by T_3 Zinc 0.6 % (0.68%) and T_2 Zinc 0.4% (0.65%) while the minimum Pectin content under the control treatment (water spray) (0.64%) and Second year data (2022-2023) data was recorded among all NAA and Zinc treatment were significant during the experimental trial and it was found that treatment T_9 NAA 75 ppm has showed the maximum Pectin content (0.69%) and followed by treatment T_5 NAA 50 ppm (0.67%), while under control treatment (Water Spray) has showed the minimum Pectin content (0.66%).

The interaction between NAA and Zinc treatment on the Pectin content of guava caused significant variation during experiment trial. It was observed that treatment T_{12} NAA 75 ppm + Zinc 0.8% has showed the maximum Pectin content (0.87%) and followed by treatment T_8 NAA 50 ppm + Zinc 0.8% (0.85%) and T_{11} NAA 75 ppm + Zinc 0.6% (0.83%) while the minimum Pectin content was observed in control treatment T_1 N_0Zn_o (0.64%) and followed T_6 NAA 50 ppm+ Zinc 0.4% (0.75%) and T_{10} NAA 75 ppm + Zinc 0.4% (0.77%) second year data was recorded 2022-2023 The interaction between NAA and Zinc treatment on the Pectin content of guava caused significant variation during experiment trial. It was observed that treatment T_{12} NAA 75 ppm + Zinc 0.8% has showed the maximum Pectin content (0.89%) and followed by treatment T_8 NAA 50 ppm + Zinc 0.8% (0.86%) and T_{11} NAA 75 ppm + Zinc 0.6% (0.85%) while the minimum Pectin content was observed in control treatment T_1 N_0Zn_o (0.66%) and followed T_6 NAA 50 ppm+ Zinc 0.4% (0.76%) and T_{10} NAA 75 ppm + Zinc 0.4% (0.78%).

Table 2. Effect of foliar sprays of NAA, Zinc and their interactions on yield (kg/plant) of guava cv L- 49

	2021-22					2022-23				
Treatments	**Control (Zn_0)**	**Zn_1 (0.4%)**	**Zn_2 (0.6%)**	**Zn_3 (0.8%)**	**Mean**	**Control (Zn_0)**	**Zn_1 (0.4%)**	**Zn_2 (0.6%)**	**Zn_3 (0.8%)**	**Mean**
Control NAA (N_0)	37.23	39.70	42.16	45.74	41.21	36.75	39.18	41.62	45.15	40.67
NAA 50 ppm (N_1)	46.16	49.84	54.17	56.28	51.61	45.57	49.21	53.48	55.56	50.95
NAA 75 ppm (N_2)	46.49	51.31	57.63	59.56	53.75	45.89	50.65	56.90	58.81	53.06
Mean	43.29	46.95	51.32	53.86		42.73	46.35	50.66	53.17	
	N	Z	NxZ				N	Z	NxZ	
C.D	**1.22**	**1.41**	**2.44**			C.D	**1.17**	**1.35**	**2.33**	
S.E.(d)	**0.59**	**0.68**	**1.18**			S.E.(d)	**0.58**	**0.67**	**1.16**	

Table 3. Effect of foliar sprays of NAA, Zinc and their interactions on Pectin (%) of guava cv L- 49

	2021-22					2022-23				
Treatments	**Control (Zn_0)**	**Zn_1 (0.4%)**	**Zn_2 (0.6%)**	**Zn_3 (0.8%)**	**Mean**	**Control (Zn_0)**	**Zn_1 (0.4%)**	**Zn_2 (0.6%)**	**Zn_3 (0.8%)**	**Mean**
Control NAA (N_0)	0.64	0.65	0.68	0.69	0.67	0.66	0.67	0.69	0.70	0.68
NAA 50 ppm (N_1)	0.66	0.75	0.81	0.85	0.77	0.67	0.76	0.83	0.86	0.78
NAA 75p pm (N_2)	0.68	0.77	0.83	0.87	0.79	0.69	0.78	0.85	0.89	0.80
Mean	0.66	0.72	0.78	0.80		0.67	0.74	0.79	0.82	
	N	Z	NxZ				N	Z	NxZ	
C.D	**0.05**	**0.05**	**NS**			C.D	**0.03**	**0.04**	**0.07**	
S.E.(d)	**0.02**	**0.03**	**0.05**			S.E.(d)	**0.02**	**0.02**	**0.03**	

3.2 Discussion

Increasing quantitative yields and improving the quality of collected items are two of every researcher's main goals. Foliar feeding of micronutrients or growth hormones is known to affect the metabolic activities of the plants, increasing yields and other potentialities of plants. Treatments with NAA and zinc had a substantial impact on the yield metrics of the plant in the current study. This rise in output may be brought about by bigger, heavier, and higher fruit sets. The greatest yield (kg/plant) values were recorded by NAA 75 ppm treatments during both research years, with values of 53.75 and 53.06 for the maximum value for each treatment (among all NAA treatments). Similar to how 0.8% Zinc exhibited the highest value for Yield (kg/plant) (53.86 and 53.17) finding of Dutta and Banik [7], Awasthi and Lal [8], Kumar et al. [9], Abbas et al. [10], Tirkey et al. [11], Bijay et al. (2023) in Pineapple. Bhoyar and Ramdevputra [12], Baidya et al., [13].

Different concentrations of NAA and Zinc, either alone or in combination, significantly impacted the quality metrics of the guava fruit among all NAA treatments, NAA 75 ppm recorded significantly higher pectin content (0.79 and 0.80%) during both the corresponding years i.e. 2021-22 and 2022-23 respectively. to how 0.8% zinc exhibited the highest value for pectin (%) (0.80 and 0.82 %) this finding Badal and Tripathi [14] in guava, Malik et al., [15] in kinnow, Balakrishnan [16], Kar et al. [17], El-Rahman [18] Zinc treatments may have sped up fruit ripening, which may have resulted in acid breakdown and prevented excessive sugar polymerization and build-up in plant cells. As a result, fruits' reduced acid content may have been caused by this process. Additionally, it seemed that when acidity decreases in tropical and subtropical fruits, total soluble solids rise. The acid that was affected by zinc may have been transformed into sugars and their derivatives through processes involving the reversal of the glycol tic pathway or may have been utilised in respiration. The higher concentrations of Zinc increased the ascorbic acid content of fruit which may be due to the possible influence of this micronutrient on the biosynthesis of ascorbic acid from sugars or inhibition of oxidative enzymes or both. Zinc is responsible for the improvement of fruit quality is in conformity with the findings by Kumar and Tripathi [19], Singh and Bal [20] and Dodiya et al. [21].

4. CONCLUSION

In conclusion guava plants treated with a mixture of 75 ppm NAA (naphthalene acetic acid) and 0.8% zinc will improve their vegetative development through blooming, fruiting, yield, and fruit quality. The combination could be ideal and recommended for the production of guava in the Indo-Gangetic plains in western India.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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