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Research Article

Effect of Pre Harvest Sprays of Plant Growth Regulators and Micronutrients on Fruit Set, Fruit Drop and Fruit Retention of Guava (*Psidium guajava* L.) cv. Lucknow-49

N. U. Vani[1*], A. Bhagwan[2], A. Kiran Kumar[3], M. Sreedhar[4] and S.R. Sharath[5]

[1]Ph.D. Scholar, Department of Horticulture with Specialization in Fruit Science, College of Horticulture, Rajendranagar

[2]Director of Research, Senior Scientist (Hort.) & Head, Fruit Research Station, Sangareddy

[3]Associate Dean, College of Horticulture, Rajendranagar

[4]Principal Scientist& Head, Dept. of Genetics and Plant breeding,

[5]MFPI Quality Control Laboratory, PJTSAU, Rajendranagar, Hyderabad

*Corresponding Author E-mail: nuvani26@gmail.com

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ABSTRACT

An experiment was conducted on the effects of plant growth regulators (SA@100ppm, GA_3@100ppm, NAA@200ppm) and micronutrients ($ZnSO_4$ + Boric acid, $ZnSO_4$ + Boric acid + $CuSO_4$, $ZnSO_4$ + Boric acid +$MgSO_4$, $ZnSO_4$ + Boric acid + $CuSO_4$ + $MgSO_4$ each at 0.4%) on fruit set, fruit drop and fruit retention in fifteen year old guava cv. L-49 under randomized block design with factorial concept was conducted at Fruit research station, Sangareddy, SKLTSHU, Telangana. Yield attributing parameters like fruit set (%), fruit retention (%) and fruit drop (%) were recorded. Among PGRs, NAA@200ppm has recorded significantly highest fruit set (71.08%), fruit retention (75.01%) and lowest fruit drop (25.16%). Among micronutrients, $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% + $CuSO_4$ @0.4% + $MgSO_4$ @0.4% has recorded significantly highest fruit set (68.06%), fruit retention(71.79%) and lowest fruit drop (33.62%). In interaction effects, NAA@200ppm and $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% + $CuSO_4$ @0.4% + $MgSO_4$ @0.4% has recorded significantly maximum fruit set (76.15%), fruit retention (78.25%). Minimum fruit drop percentage (21.75%) was recorded in the same treatment. NAA@200ppm and $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% + $CuSO_4$ @0.4% + $MgSO_4$ @0.4% was superior in improving the flowering parameters of guava cv. Lucknow-49.

Keywords: *PGRs, Fruit set, Fruit drop, Fruit retention, Micronutrients.*

INTRODUCTION

Guava (*Psidium guajava* L.) the apple of the tropics, is one of the most popular fruits grown in tropical, sub-tropical and some parts of arid regions of India. The fruit belongs to the family Myrtaceae. Guava is a prolific bearer and highly remunerative even without much care.

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Therefore, it is an ideal fruit crop in terms of yield, nutritional security as well as in economic boost. It is a rich and cheap source of vitamin C and pectin (Agnihotri et al., 1962). It is also a good source of vitamin A, phosphorous, calcium and iron as well as thiamin and niacin. Further, guava fruit has effective antioxidant properties due to presence of vitamin C and phytonutrients such as carotenoids, isoflavonoids and polyphenols.

Plant growth regulators like Auxins, Gibberellins and Salicylic acid 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. SA induces flowering in plant (Raskin, 1992a and b). It has been found to play a key role in the regulation of plant growth, development and enhance plant vigor under biotic and abiotic stresses (Hayat et al., 2010).

Micronutrients are key elements in plant growth and development. These elements play very important role in various enzymatic activities and synthesis. These micronutrients also 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 (Das, 2003).

The foliar application of micronutrients and plant growth regulators improves the fruit quality individually. However, the experimental effect of plant growth regulators and micronutrients was not studied systematically and research is meagre in guava so the present investigation was formulated.

MATERIALS AND METHODS

An experiment was conducted to study the effect of pre harvest sprays of plant growth regulators and micronutrients on fruit set, fruit drop and fruit retention during July, 2018 to January, 2019 (Hasta bahar crop) at Fruit Research Station (FRS), Sangareddy, SKLTSHU, Telangana. The study was carried out with 16 different treatments involving different combinations of PGRs and micronutrients. The experiment was laid out in a randomized block design with factorial concept (FRBD) replicated thrice.

The treatments are *viz.*, SA @ 100 ppm+ $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% **(**T_1**),** SA @ 100 ppm+ $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% + $CuSO_4$ @0.4% **(**T_2**),** SA @ 100 ppm+ $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% +$MgSO_4$ @0.4% **(**T_3**),** SA @ 100 ppm+ $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% + $CuSO_4$ @0.4% + $MgSO_4$ @0.4% **(**T_4**),** GA_3 @ 100 ppm + $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% **(**T_5**),** GA_3 @ 100 ppm + $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% + $CuSO_4$ @0.4% **(**T_6**),** GA_3 @ 100 ppm + $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% +$MgSO_4$ @0.4% **(**T_7**),** GA_3 @ 100 ppm +$ZnSO_4$ @ 0.4% + Boric acid @ 0.4% + $CuSO_4$ @0.4% +$MgSO_4$ @0.4% **(**T_8**),** NAA @ 200 ppm + $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% **(**T_9**),** NAA @ 200 ppm + $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% + $CuSO_4$ @0.4% **(**T_{10}**),** NAA @ 200 ppm + $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% + $MgSO_4$ @0.4% **(**T_{11}**),** NAA @ 200 ppm+ $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% + $CuSO_4$ @0.4% + $MgSO_4$ @0.4% **(**T_{12}**),** $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% **(**T_{13}), $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% + $CuSO_4$ @0.4% **(**T_{14}**),** $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% + $MgSO_4$ @0.4% **(**T_{15}**),** $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% + $CuSO_4$ @0.4% + $MgSO_4$ @0.4% **(**T_{16}).

Fifteen years old, well grown, uniform statured trees of guava cv. Lucknow-49 were selected for the experiment. The trees were spaced at 5m and planted in square system. Treatmental trees were selected by random numbers (Oliver, 1965). The fruits were harvested based on their maturity indices viz., change in colour of the fruit from dark green to yellowish green.

Aqueous solutions of the plant growth regulators were prepared. Naphthalene acetic acid 200 ppm stock solution was prepared by weighing 2g of NAA into a beaker, Dissolve it completely by addition of small quantity of 1N NaOH, then made the volume up to 10 litres

by addition of distilled water. Gibberellic acid and salicylic acid 100 ppm stock solutions were prepared by taking 1g each of gibberellic acid and salicylic acid separately into a beaker by dissolving completely with little quantity of alcohol and the volume was made up to ten litres by adding distilled water. The boron, zinc, magnesium and copper solutions at 0.4% concentrations were prepared by weighing 40gm of boric acid, zinc sulphate, magnesium sulphate and copper sulphate and dissolving them in little quantity of distilled water, then diluted to ten litre respectively. Plant growth regulators and micronutrients were sprayed a month before flowering (July) using hand sprayer.

STATISTICAL ANALYSIS

The data recorded were tabulated and statistically analysed by adopting randomised block design with Factorial concept as suggested by Panse and Sukhatme (1978). The differences among the treatmental means were tested for significance by F value at 5% level. The critical difference values were calculated at 0.05 levels wherever the treatmental mean differences were found to be significant.

RESULTS AND DISCUSSION

The data furnished in tables clearly indicate that treated plants with plant growth regulators and micronutrients foliar spray performed significantly far better than control plants where only water spray was done.

Fruit set (%):

Among PGRs, maximum fruit set (71.08) was recorded in NAA@200ppm followed by SA@100ppm (68.16). Minimum per cent fruit set (54.94) was recorded in control.

Maximum fruit set (68.06) was recorded in $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% + $CuSO_4$ @0.4% + $MgSO_4$ @0.4% followed by $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% + $MgSO_4$ @0.4% (65.08). Minimum fruit set (62.78) was recorded in $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% + $CuSO_4$ @0.4% (62.78).

Among interaction effect, maximum per cent fruit set (76.14) was recorded in T_{12} which was statistically on par with T_{11} (75.56) and also with T_1 (74.07). Minimum per cent fruit set (51.66) was recorded in T_{15}.

Maximum fruit set by NAA spray was due to profuse flowering. It might have increased the fruit set either by improving pollen germination or by helping its receptivity or the style becomes non-functional (Mandal et al., 2016). In the present investigation, micronutrients increased fruit set percentage which might be due to the reason that these nutrients play an important role in translocation of carbohydrates and in auxin synthesis to the sink and increase pollen viability and fertilization (Yadav et al., 2014). These results are in accordance to the findings of Raj Kumar et al. (2010) Rajput et al. (2015) in guava and Chaudhari et al. (2016) in custard apple.

The interaction effect led to higher fruit set in response to higher concentration of growth substances application, is probably due to translocation of hormones, food substances and creation of congenial conditions for pollination and fertilization of flowers (Ram et al., 2014) through an involvement of endogenous (auxin) and exogenous factors stimulating fruit formation to the tissue of ovary in greater amount (Rajput et al., 2015). These results are similar to the findings of Narayan et al. (2013) and Yadav et al. (2014) in guava.

Fruit retention percentage (%)

Among PGRs, maximum per cent fruit retention (75.01) was recorded in NAA@200ppm followed by GA_3@100ppm (71.67). Minimum per cent fruit retention (61.74) was recorded in control.

Among micronutrients, maximum fruit retention (71.79) was recorded in $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% + $CuSO_4$ @ 0.4% + $MgSO_4$ @0.4% followed by $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% + $MgSO_4$ @ 0.4% (69.31). Minimum fruit retention (68.07) was recorded in $ZnSO_4$ @ 0.4% + Boric acid @ 0.4%.

Significant differences were observed in interaction effect between plant growth regulators and micronutrients on fruit retention percentage in guava. Maximum per cent fruit

retention (78.25) was recorded in T_{12} which was statistically on par with T_{11} (76.22) and also with T_8 (75.29). Minimum fruit retention percentage (59.81) was recorded in T_{15}.

In the present investigation, all the plant growth regulators tested significantly improved the per cent fruit retention when compared to control. NAA@ 200 ppm has significantly increased fruit retention percentage in guava cv. L-49 by increasing internal auxin content or antagonizing adverse effects of endogenous hormones like ethylene and ABA (Mahaveer et al., 2017). Similar results with NAA treatments were reported by Ghosh et al. (2009) in ber and Ramezani and Shekafandeh (2010) in olive.

Zinc and Boron which proved helpful in maintaining better nutritional status of plants which ultimately led to beneficial effect in hastening fruit retention. These results are in accordance to the findings of Raj Kumar et al. (2010) in guava cv. Pant prabhat, Gaur et al. (2014) and Yadav et al. (2011) in guava cv. L-49.

In the present investigation, interaction effect of plant growth regulators and micronutrients had significantly increased the fruit retention in guava cv. L-49. By the foliar application of boron the fruit drop was reduced because boron plays an important role in translocation of carbohydrate and auxin synthesis to sink and increased pollen viability and fertilization (Mahaveer et al., 2017). When these both components applied in combination, their synergistic effect enhanced the fruit retention as compared to alone applications. These results are in accordance with the findings of Raj Kumar et al. (2010), Subhash et al. (2017) and Shreekant et al. (2017) in guava.

Fruit drop (%)

All the plant growth regulators tested significantly decreased the per cent fruit drop when compared to control. Minimum per cent fruit drop (25.16) was recorded in NAA@200ppm followed by GA_3@100ppm (34.58). Maximum per cent fruit drop (47.45) was recorded in control.

Micronutrients had significant influence on fruit drop per cent in guava. Minimum per cent fruit drop (33.62) was recorded in $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% + $CuSO_4$ @0.4% + $MgSO_4$ @0.4% followed by $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% + $CuSO_4$ @0.4% (37.25) which was statistically on par with $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% + $MgSO_4$ @0.4% (37.48) and also with $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% (37.60).

Significant differences were observed in interaction effect of plant growth regulators and micronutrients on fruit drop percentage in guava. Minimum per cent fruit drop (21.75) was recorded in T_{12} which was statistically on par with T_{11} (23.78) followed by T_{10} (26.28) was statistically on par with T_9 (28.82). Maximum fruit drop percentage (50.43) was recorded in T_{13}.

NAA@ 200 ppm has significantly decreased the per cent fruit drop in guava cv. L-49 as it helped in fruit retention because auxin prevents the abscission and facilitated the ovary to remain attached with the shoot as antagonic effects on endogenous hormones like ethylene and ABA resulting in lesser fruit drop (Yadav et al., 2010). The action of GA_3 might have raised auxin level leading to diminished drop rate and attributed to its reduction in fruit drop which prevents the formation of abscission layer as reported by Addicot (1970) in apple. These results are in confirmity with the findings of Yadav et al. (2010) in aonla and Lal et al. (2013) in guava.

In the present investigation, micronutrients has significantly influenced fruit drop percentage in guava cv. L-49. Further the present results revealed that the zinc has helped in decreasing fruit drop because zinc stimulates the synthesis of endogenous auxins and auxin prevents the abscission and facilitated the ovary to remain attached with the shoot, resulting in lower fruit drop (Kachave & Bhosale, 2007). By the foliar application of boron, the fruit drop was reduced because boron plays an important role in translocation of carbohydrate and auxin synthesis which lowers the fruit drop (Yadav et al., 2011). These results are in conformity with the findings of Raj Kumar et al. (2010) in guava.

In the present investigation, interaction effect of plant growth regulators and micronutrients had significantly influenced fruit drop percentage in guava cv. L-49. There is correlation between fruit drop and endogenous NAA status and existence of high level of internal auxin that prevent fruit drop (Jawed et al., 2017). When these both components applied in combination, their synergistic effect reduced the fruit drop percentage as compared to alone applications. These results are in accordance with the findings of Lal et al. (2013) in guava and Kachave and Bhosale (2007) in kagzi lime.

Table 1: Effect of pre harvest spray of plant growth regulators and micro nutrients on fruit set (%) of guava (*Psidium guajava* L.) cv. Lucknow-49.

Treatments	Micronutrients				
PGRs	**M_1**	**M_2**	**M_3**	**M_4**	**Mean**
Salicylic acid @ 100ppm	74.07	63.24	66.79	68.53	**68.16^{A}**
GA_3 @100 ppm	60.52	62.97	66.31	71.82	**65.40^{B}**
NAA @ 200ppm	62.83	69.79	75.56	76.15	**71.08^{D}**
Control	53.68	58.67	51.66	55.74	**54.94^{A}**
Mean	**62.78^{a}**	**63.67^{a}**	**65.08^{b}**	**68.06^{c}**	

	F test	SE (m) ±	CD at 5%
PGRs (P)	*	0.81	2.35
Micronutrients(M)	*	0.81	2.35
P × M	*	1.62	4.70

Table 2: Effect of pre harvest spray of plant growth regulators and micro nutrients on fruit retention (%) of guava (*Psidium guajava* L.) cv. L-49.

Treatments	Micronutrients				
PGRs	**M_1**	**M_2**	**M_3**	**M_4**	**Mean**
Salicylic acid @ 100ppm	68.65	64.01	69.81	70.48	**68.24^{B}**
GA_3 @100 ppm	69.55	70.44	71.40	75.29	**71.67^{C}**
NAA @ 200ppm	72.18	73.39	76.22	78.25	**75.01^{D}**
Control	61.91	62.05	59.81	63.17	**61.74^{A}**
Mean	**68.07^{a}**	**67.47^{a}**	**69.31^{b}**	**71.79^{c}**	

	F test	SE (m) ±	CD at 5%
PGRs (P)	*	0.58	1.66
Micronutrients (M)	*	0.58	1.66
P × M	*	1.15	3.33

Table 3: Effect of pre harvest spray of plant growth regulators and micro nutrients on fruit drop (%) of guava (*Psidium guajava* L.) cv. Lucknow-49.

Treatments	Micronutrients				
PGRs	**M_1**	**M_2**	**M_3**	**M_4**	**Mean**
Salicylic acid @ 100ppm	40.68	38.32	43.53	32.52	**38.76^{C}**
GA_3 @100 ppm	30.45	37.73	35.44	34.71	**34.58^{B}**
NAA @ 200ppm	28.82	26.28	23.78	21.75	**25.16^{A}**
Control	50.43	46.68	47.19	45.50	**47.45^{D}**
Mean	**37.60^{b}**	**37.25^{b}**	**37.48^{b}**	**33.62^{a}**	

	F test	SE (m) ±	CD at 5%
PGRs (P)	*	0.70	2.01
Micronutrients (M)	*	0.70	2.01
P × M	*	1.39	4.02

Significant at (0.05 –p LOS), NS- Non- Significant. Means with similar alphabets did not differed significantly.
Values are compared with respective C.D values.

M_1- $ZnSO_4$ @ 0.4% + Boric acid @ 0.4%
M_2- $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% + $CuSO_4$ @0.4%
M_3- $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% +$MgSO_4$ @0.4%
M_4- $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% + $CuSO_4$ @0.4% + $MgSO_4$ @0.4%

Graphs

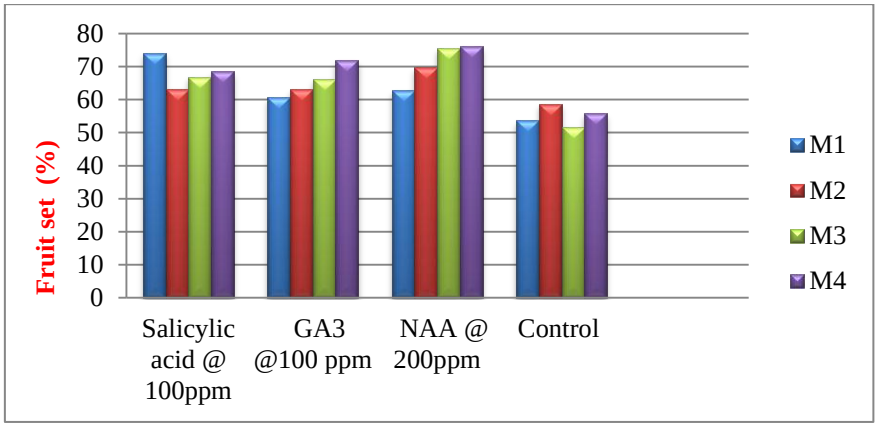

Fig. 1: Effect of plant growth regulators and micronutrients on Fruit set (%) in guava cv. Lucknow-49

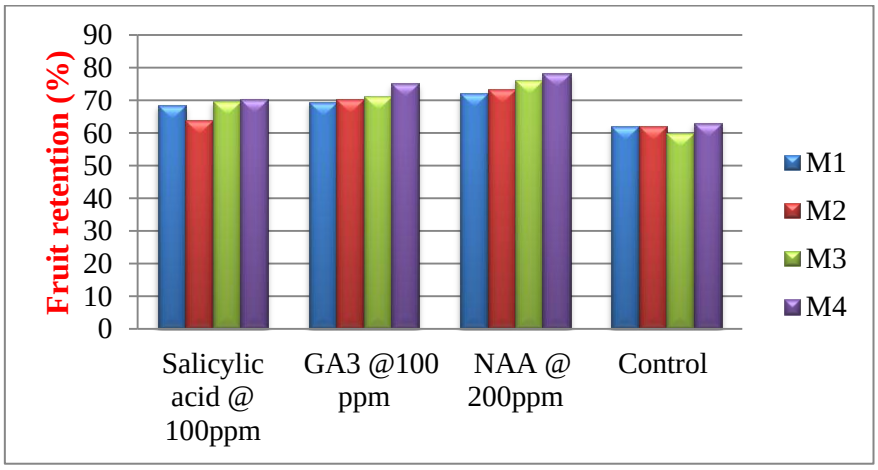

Fig. 2: Effect of plant growth regulators and micronutrients on Fruit retention (%) in guava cv. Lucknow-49

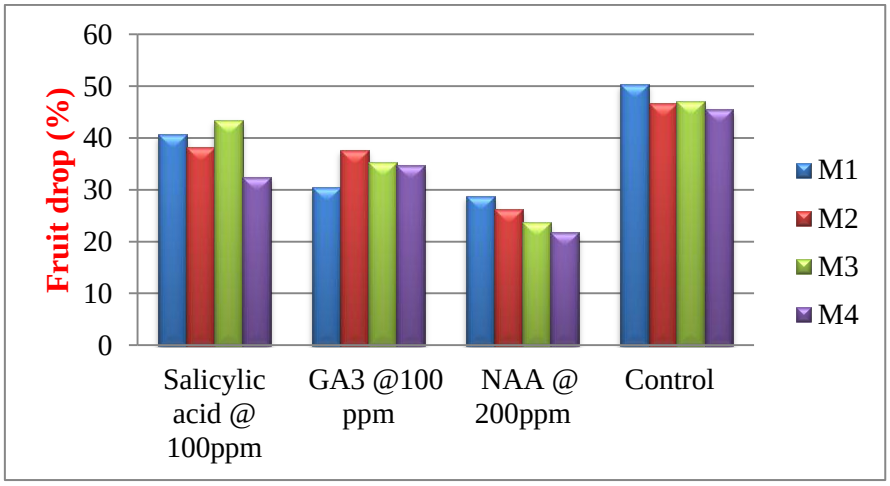

Fig. 3: Effect of plant growth regulators and micronutrients on fruit drop (%) in guava cv. Lucknow-49

CONCLUSION

Keeping in view the results summarized above, T_{12}- NAA@200ppm and $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% + $CuSO_4$ @0.4% + $MgSO_4$ @0.4% has recorded significantly maximum fruit set and fruit retention. Minimum fruit drop percentage was recorded in the same treatment. It is concluded that the NAA@200ppm and $ZnSO_4$ @ 0.4% + Boric acid @ 0.4% + $CuSO_4$ @0.4% + $MgSO_4$ @0.4% is best treatment to improve the flowering parameters of guava cv. Lucknow-49.

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