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Foliar Application of Growth Regulators and Nutrients for Better Quality Aspects of Guava Cv Lalit

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ABSTRACT

The guava has tendency to bears flowers and fruits throughout the years but quality of fruits is highly influenced improper crop management practices and bahar season. The fruits of ambe bahar is poor in quality due to lack of nutrients availability and irregular orchard management practices. To carry out this new strategy to sustain the quality of guava through combination of nutrients and growth regulators, the present study was carried out during 2018-19 in 20-years-old orchard on mrig bahar season using foliar application of zinc sulphate (0.5%), borax (0.5%), GA_3 (50 ppm), and NAA (40 ppm) either alone or in combinations, comprised of 9 treatments and 3 replications under Randomized Block Design. The results revealed that plants treated with 0.5% Borax along with 50 ppm GA_3 significantly increased the leaf nutrient composition (1.09% leaf N, 0.014 % leaf P, 0.89% leaf K, 28.50 ppm Zn and 23.70 ppm B). The qualitative parameters of guava fruits also increased by borax and GA_3, over untreated control.

Keywords Borax, Foliar application, Fruit quality, Orchard, Total soluble solids.

INTRODUCTION

Consumer preference of guava (*Psidium guajava* L.) has increased just after the pandemic because of its high nutritional benefits and excellent vitamin C content. Although in India guava ranks 4th position in fruit crops with regard to area (2.87 mha) and production (43.04 MT ha^{-1}) but the productivity of this crops lacks behind due to improper orchard management (Anonymous 2020). So it is a prior objective to improve the quality production of guava with easy to use techniques, environmentally friendly and cost-effective. Out of which application of bio-stimulants is a way sustainable approach to enhance the qualitative production of guava. Bio-stimulants are defined as any compounds or microorganisms that can stimulate plant growth and development by influencing numerous metabolic processes, accumulate nutrients in leaves leading to biomass production and protect plants from biotic and abiotic stress (Abd El-Samad *et al.* 2019). Apart from the organic plant bio-stimulants (plant growth-promoting rhizobacteria, humic and fulvic substances amino acids, seaweed extracts, yeast, and chitosan), inorganic bio-stimulants (essential elements, plant growth regulators, antioxidant, inorganic salts and phenolic compounds) are gaining popularity in the horticulture sector (Abd El-Samad *et al.* 2019). Application of growth regulators also

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increases total soluble solids, reducing sugars, total sugars, vitamin-C and decreases tannin and fruit acidity (Priyadarshi *et al.* 2018).

Guava prefers to grow in alkaline soil, where the micronutrients like boron and zinc decreases as the pH increases leading to reduce yield and quality (Preet *et al*. 2021). Foliar application of micronutrients and plant growth regulators has been shown to be effective in limiting fruit quality (Arora and Singh 2019). Involvement of zinc in metabolism of carbohydrate and protein through various enzymatic reactions makes it an important micronutrient among all the essential elements (Das *et al.* 2019). The developmental activity of plants due to zinc is only possible, as it structurally holds up many enzymes or regulates the enzymatic process as a metal component (Gurjar *et al*. 2018). Similarly, the role of boron in reproductive growth especially in pollen tube formation and its elongation inside the style (Singh *et al.* 2022) is well known, however, other activity such as translocation of sugar like mannitol and sorbitol, active salt absorption, hormonal regulation was confirmed by Davis *et al*. (2003). The role of boron in the dry matter accumulation through cell wall maintenance by forming B-pectin complex was well established by Lo´pez-lefebre *et al*. (2002). Despite all these benefits of bio-stimulants either in form of nutrients or plant growth regulators, literature regarding their combined use is limited (Suman *et al*. 2022) and the farmers from Uttar Pradesh are still unaware to use it in guava orchards to fetch a maximum return. Based on the context, this experiment was executed to assess the influence of plant growth regulators and micro nutrients on qualitative aspects of guava during winter season.

MATERIALS AND METHODS

The experiment was conducted in 20-years-old orchards during the year 2018-19 at Horticultural Research Farm of Babasaheb Bhimrao Ambedkar University, Lucknow, Uttar Pradesh. The experimental site covers subtropical climate region with temperatures ranging from 12-42°C, annual rainfall of 700–1000 mm and relative humidity of 50–77% in different seasons of the year. The soil texture of the experimental site was clay loam which is well drained and well aerated with a pH of 8.0 and plant available $KMnO_4$- 171.5 mg/kg, Olsen-P- 12.50 mg/kg, and NH_4OAc-K- 180.9 mg/kg. Twenty-year-old uniform guava (cv Lalit) plants spaced 6x6 m apart were chosen for study. The experiment had nine treatments consisting of two nutrients $ZnSO_4$ (0.5%) and borax (0.5%) and two hormones NAA (40 ppm) and GA_3 (50 ppm) and their combinations (0.5% $ZnSO_4$ + 40 ppm NAA, 0.5% Borax + 40 ppm NAA, 0.5% $ZnSO_4$ + 50 ppm GA_3 and 0.5% Borax + 50 ppm GA_3), with three replications and was set up in a Randomized Block Design. The crop received its initial foliar spray of micronutrients and plant growth regulators in the first week of August, which coincided with fruit set, then the same treatment in the second week of September during fruit development stage. During the experimental study, the crops were fed with the recommended dose of fertilizers i.e., 600 g N, 300 g P_2O_5 and 300 g K_2O.

Total soluble solids were measured by using hand refractometer (ATAGO Pocket 3810, PAL-1), titratable acidity as mallic acid were determined according to (AOAC 1990). The reducing sugars, non-reducing sugars, total sugars and ascorbic acid were determined as method suggested by Rangana (2010). The leaf nutrient analysis was carried out as per method suggested by Jackson (1973). Leaf B content was determined using the Azomethine-H colorimetric method, whereas leaf Zn content was evaluated using a tri–acid mixture (HNO_3: H_2SO_4: $HClO_4$: 9:1:4) digestion method.

Statistical analysis

The experiment was laid out as per Randomized Block Design and data were analyzed using statistical software SAS 9.4. The interaction means was subjected to analysis of variance and pairwise comparison using LSD ($p \leq 0.05$) where found significant.

RESULTS AND DISCUSSION

Effect of phyto bio-stimulants on qualitative aspect of guava cv Lalit

The data highlighted through Table 1 clearly depict that maximum TSS (12.59 °Brix), ascorbic acid

Table 1. Effect of phyto bio-stimulants on qualitative aspect of guava cv Lalit. *Means with the same letter are not significantly different at ($p \leq 0.05$).

Treatments	TSS (˚Brix)	Titratable acidity (%)	Ascorbic acid mg/100 g fruit pulp	Reducing sugar (%)	Non- reducing sugar (%)	Total sugars (%)
T_1: Control	7.85 ± 0.09^{c}	0.48 ± 0.00^{a}	147.64 ± 1.68^{d}	3.17 ± 0.03^{f}	2.51 ± 0.02^{e}	5.68 ± 0.06^{f}
T_2: $ZnSO_4$ 0.5 %	8.03 ± 0.09^{c}	0.43 ± 0.00^{bc}	158.13 ± 1.80^{c}	3.28 ± 0.03^{ef}	2.74 ± 0.02^{d}	6.02 ± 0.06^{ef}
T_3: Borax 0.5 %	12.20 ± 0.15^{a}	0.29 ± 0.00^{e}	173.79 ± 1.97^{ab}	3.76 ± 0.04^{ab}	3.42 ± 0.03^{ab}	7.19 ± 0.08^{ab}
T_4: NAA @ 40 ppm	10.91 ± 0.13^{b}	0.44 ± 0.00^{b}	168.04 ± 1.91^{b}	3.37 ± 0.03^{de}	2.93 ± 0.02^{c}	6.31 ± 0.06^{de}
T_5: GA_3 @ 50 ppm	11.27 ± 0.13^{b}	0.39 ± 0.00^{d}	173.18 ± 1.96^{ab}	3.65 ± 0.04^{bc}	3.34 ± 0.03^{ab}	6.97 ± 0.07^{bc}
T_6: $ZnSO_4$ 0.5 % + NAA @ 40 ppm	10.81 ± 0.13^{b}	0.42 ± 0.00^{bc}	173.89 ± 1.98^{ab}	3.47 ± 0.03^{cd}	3.27 ± 0.03^{b}	6.75 ± 0.07^{c}
T_7: Borax 0.5 % + NAA @ 40 ppm	12.01 ± 0.14^{a}	0.41 ± 0.00^{cd}	169.16 ± 1.92^{ab}	3.38 ± 0.03^{de}	3.27 ± 0.03^{b}	6.65 ± 0.07^{cd}
T_8: $ZnSO_4$ 0.5 % + GA_3 @ 50 ppm	12.06 ± 0.14^{a}	0.30 ± 0.00^{e}	170.83 ± 1.94^{ab}	3.53 ± 0.03^{cd}	3.33 ± 0.03^{ab}	6.86 ± 0.07^{bc}
T_9: Borax 0.5 % + GA_3 @ 50 ppm	12.59 ± 0.15^{a}	0.23 ± 0.00^{f}	177.72 ± 2.02^{a}	3.87 ± 0.04^{a}	3.48 ± 0.03^{a}	7.34 ± 0.08^{a}
Tukey HSD ($p \leq 0.05$)	**0.66**	**0.02**	**9.48**	**0.18**	**0.16**	**0.36**

(177.72 mg/100 g fruit pulp), reducing sugar (3.87 %), non-reducing sugar (3.48%) and total sugars (7.34 %) and lowest titratable acidity (0.23 %) were recorded with the foliar feeding of Borax 0.5 % + GA_3 50 ppm (T_9) followed by borax 0.5 % (T_3) while the minimum were observed with control. Among the two different micronutrients ($ZnSO_4$ and Borax), use of borax either in solely or combination performed better compare to zinc sulfate. Similarly, performance of GA_3 excelled the performance of NAA, either in solo or combined formula. However, the combined effect of micronutrient and growth regulators is far superior over the solo application of any of these.

This increase in TSS and total sugars with GA_3 and boron application could be due to the fact that these plant bio-regulators and nutrients aid in the photosynthesis process, resulting in higher levels of oligosaccharides and polysaccharides. They also regulate enzymatic activity and metabolize carbohydrates into simple sugars (Nazir *et al*. 2018), which translated into reduced acidity in fruits. The rise in ascorbic acid content could be attributed to ascorbic acid production from sugar, inhibition of oxidative enzymes, or both, as a result of positive metabolic activity involving specific enzymes and metabolic ions under the effect of plant growth regulators and

Table 2. Effect of phyto bio-stimulants on leaf nutrient composition of guava cv Lalit. *Means with the same letter are not significantly different at ($p \leq 0.05$).

Treatments	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Zinc (ppm)	Boron (ppm)
T_1: Control	1.59 ± 0.01^{e}	0.007 ± 0.00^{h}	0.69 ± 0.00^{g}	20.00 ± 0.23^{g}	15.00 ± 0.18^{g}
T_2: $ZnSO_4$ 0.5%	1.63 ± 0.01^{de}	0.008 ± 0.00^{g}	0.73 ± 0.00^{fg}	22.00 ± 0.25^{f}	17.33 ± 0.21^{f}
T_3: Borax 0.5%	1.78 ± 0.02^{b}	0.013 ± 0.00^{b}	0.87 ± 0.01^{ab}	27.50 ± 0.31^{ab}	22.50 ± 0.27^{ab}
T_4: NAA @ 40 ppm	1.65 ± 0.01^{cde}	0.009 ± 0.00^{f}	0.75 ± 0.00^{ef}	23.33 ± 0.26^{ef}	18.50 ± 0.22^{ef}
T_5: GA_3 @ 50 ppm	1.69 ± 0.02^{bcde}	0.010 ± 0.00^{e}	0.78 ± 0.00^{de}	24.50 ± 0.28^{de}	19.33 ± 0.23^{de}
T_6: $ZnSO_4$ 0.5 % + NAA @ 40 ppm	1.72 ± 0.02^{bcd}	0.011 ± 0.00^{d}	0.80 ± 0.00^{cd}	25.00 ± 0.28^{cd}	20.50 ± 0.24^{cd}
T_7: Borax 0.5 % + NAA @ 40 ppm	1.75 ± 0.02^{bc}	0.013 ± 0.00^{c}	0.83 ± 0.01^{bc}	25.33 ± 0.28^{cd}	21.33 ± 0.25^{bc}
T_8: $ZnSO_4$ 0.5 % + GA_3 @ 50 ppm	1.77 ± 0.02^{b}	0.012 ± 0.00^{c}	0.85 ± 0.01^{ab}	26.33 ± 0.30^{bc}	21.80 ± 0.26^{b}
T_9: Borax 0.5 % + GA_3 @ 50 ppm	1.89 ± 0.02^{a}	0.014 ± 0.00^{a}	0.89 ± 0.01^{a}	28.50 ± 0.32^{a}	23.70 ± 0.28^{a}
Tukey HSD ($p \leq 0.05$)	**0.10**	**0.001**	**0.04**	**1.43**	**1.21**

micronutrients (Dev *et al*. 2018). The positive effect of micronutrients on the conversion of polysaccharides to simple sugars is directly linked to an increase in reducing sugars. The enhanced translocation of polysaccharides in mature fruits was mostly responsible for the dual effect of micronutrients on per cent of non-reducing sugars. The considerable effect of micronutrients on the translocation of carbohydrates and photosynthates could explain the rise in total sugars in fruit (Arora and Singh 2019).

Effect of phyto bio-stimulants on leaf nutrient composition of guava cv Lalit

It is clearly illustrated that foliar application of plant growth regulators and micronutrients significantly affect leaf nutrient composition of guava leaves (Table 2). Maximum leaf N (1.89 %), leaf P (0.014 %), leaf K (0.89 %), leaf Zn (28.50 ppm) and leaf B (23.70 ppm) content were observed in plants treated with combined application of Borax 0.5 % + GA_3 @ 50 ppm (T_9), which was statistically at par with treatment T_3 (Borax 0.5%). However, the least amount leaf N, P, K, Zn and B were observed with untreated control. Among the two nutrients ($ZnSO_4$ and Borax), application of borax exceled in accumulating higher nutrients in guava leaves. Application of GA_3 proved to be superior over NAA. The combined effect of nutrient and growth regulators outsmarted the effect of sole application of either of two, suggesting integrated application of nutrients and growth regulators to achieve sustainable guava yield. The positive effect of boron with leaf nutrient composition can be attributed by the role of boron in biomass accumulation, protein and enzyme synthesis and indirect role of boron in promoting entrance of substrate through plasma membrane (Lo´pez-lefebre *et al.* 2002). Application of GA_3 leads to morpho-physiological growth of plants by cytogenesis and cell enlargement along with promoting DNA, RNA and protein synthesis. All these changes are possible as GA_3 act as sink for plant available nutrients (Hazarika *et al*. 2017).

CONCLUSION

Based on the findings of this study, we can conclude that foliar sprays of borax and GA_3 on the guava crop resulted in significant improvements total soluble solids, titratable acidity, reducing sugar, non-reducing sugar, total sugars and nutrients composition of guava leaves. It can be concluded that soil application of recommended dose of fertilizers along with foliar sprays of 0.5% borax and GA_3 @ 50 ppm is the most effective treatment to enhance qualitative parameters of guava in farmer's field.

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