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Effect of Novel Organic Liquid Fertilizer and Plant Growth Regulators on Quality of Guava cv. Lucknow 49

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ABSTRACT: An experiment was conducted to study the effect of novel organic liquid fertilizer and plant growth regulators on quality of guava cv. Lucknow 49, during the year 2021 and 2022. Eleven treatments were imposed in Complete Randomized Design (CRD) with three repetitions and among the different treatments, GA_3 150 mgl^{-1} (T_8) noted higher total soluble solids, ascorbic acid, total sugar, reducing sugar, non-reducing sugar and minimum acidity during both the years and in pooled data. While, maximum shelf life was observed with salicylic acid 150 mgl^{-1} (T_6) during both the years and in pooled data.

Keywords: Novel organic liquid fertilizer, plant growth regulators, quality and guava.

INTRODUCTION

Guava (*Psidium guajava* L.), known as the "apple of the tropics," is one of the most popular fruits found in tropical, subtropical, and some desert areas of India. Guava is one of the most important fruit crops of India next to mango and banana. It is a member of the Myrtaceae family and native to tropical America. Portuguese introduced it to India in the early 17th century (Hayes, 1974). It is pleasantly sweet and refreshingly acidic in flavor and emits a sweet aroma. Guava fruits are used to make a variety of delectable preserved goods, including jam, jelly, cheese, puree, ice cream, canned fruit and sherbat.

The agricultural sector is currently dealing with the simultaneous difficulties of boosting production to feed the expanding global population and increasing resource use efficiency, while lowering the environmental impact on ecosystems and human health. Novel organic liquid fertilizer and PGR's are a promising approach for achieving sustainable agriculture since they are often regarded as a renewable source of plant nutrients, promote crop production. Novel organic liquid fertilizer and plant growth regulators play a key role in guava production by influencing various plant processes like germination, rooting, growth and productivity of guava. The use of novel organic liquid fertilizer and plant growth regulators has assumed

an integral part of modern crop husbandry for increasing production of quality fruits. The findings of this study can have implications not only for guava cultivation but also for the broader field of organic and sustainable agriculture, which is of global importance.

Brassinosteroids (BRs), a class of steroidal plant hormones, are essential to the typical growth and development of plants. The presence of BRs in rape (*Brassica napus* L.) pollen was initially discovered by Mitchell *et al.* (1970). While the primary effects of brassinosteroids are on cell expansion, they also influence cell division and cell elongation to control the growth (Clouse and Sasse 1998). According to Aly *et al.* (2021) in custard apple. application of brassinosteroids improved quality attributes.

Triacontanol has been shown to regulate plant development in lucerne (*Medicago sativa* L.), according to research by Ries *et al.* (1977). Triacontanol (TRIA) is a natural plant growth regulator found in epicuticular waxes. Triacontanol is reported to accelerate the rate of cell division, photosynthesis, transpiration, stomatal conductance and uptake of water and nutrients and other metabolic activities in plants (Ries and Houtz 1983). Scientific evidences have also suggested that triacontanol enhanced quality parameters of fruit crops. (Zubair *et al*., 2017 in apple and Sood *et al*., 2018 in strawberry).

Salicylic acid has also been reported to cause plants to develop SAR (Systemic Acquired Resistance). Itis also known as 'natural plant defender'. It has been discovered to play a crucial role in the regulation of plant growth, development and vigour under biotic and abiotic stresses. Salicylic acid influenced physiological or biochemical processes including ion uptake, membrane permeability, enzymes activity, heat production, growth and development. Due to its stimulatory influence on plant growth, flowering, fruiting, and yield, salicylic acid is regarded as an endogenous plant growth regulator (Hayat *et al.*, 2010). Lokesh *et al.* (2020); Chourasia (2021) in mango recorded highest

quality attribute with the application of salicylic acid.

Gibberellic acid was initially discovered in Japan in 1926 as a metabolic byproduct of the rice plant disease *Gibberella fujikuroi*. Gibberellic acid regulate fruit development in various ways and at different developmental stages. GA_3 is known to influence both cell division and cell enlargement, resulting in the growth of the plant (Adams *et al.*, 1975). Gibberellic acid application improved quality attributes, according to guava and Dubey *et al.* (2022) in papaya.

Novel organic liquid fertilizer is prepared from banana pseudostem. It contains good amount of macro and micro-nutrients along with growth promoting substances like cytokinins, GA_3, etc. It is used for initiation of flowering, increase fruit setting and reduce fruit drop. It enhances plant growth and maximum conversion of flowers into fruits which ultimately increase yield and quality as well as reduce cost of cultivation. In view of considering above facts, the present experiment was planned on "Effect of novel organic liquid fertilizer and plant growth regulators on quality of guava cv. Lucknow 49".

MATERIALS AND METHODS

The present investigation was carried out at Horticulture Research Farm, Department of Horticulture, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat, India in the years 2021 and 2022 on 4 years old uniform size guava plants planted 5 × 5 m. The soil of the experimental site was loamy sand, locally known as "Goradu" having pH 7.31, EC 0.22 dSm^{-1} and 0.40 % organic carbon.

The experiment was laid out in completely randomized design with eleven treatments *viz.*, T_1 : Brassinosteroids 1 mgl^{-1}, T_2 : Brassinosteroids 2 mgl^{-1}, T_3 : Triacontanol 0.005 mll^{-1}, T_4 : Triacontanol 0.010 mll^{-1}, T_5 : Salicylic acid 100 mgl^{-1}, T_6 : Salicylic acid 150 mgl^{-1}, T_7 : GA_3 100 mgl^{-1}, T_8 : GA_3 150 mgl^{-1}, T_9 : Novel organic liquid fertilizer 20 mll^{-1}, T_{10} : Novel organic liquid fertilizer 40 mll^{-1}, T_{11} : Control and repeated thrice during the two years (2021 and 2022) of research. Foliar spray of novel organic liquid fertilizer and plant growth regulators were imposed in two frequencies i.e. on 2nd July and 2nd August in the year 2021 and on 5th July and 5th August in the year 2022. The spray was done by using foot sprayer. Generally, three liter of solution was sufficient for 4 years old guava plant.

The guava plant bears fruits almost round the year. The winter crop known as *Mrig bahar*, whose fruits ripen from October to December, is better in quality, free from insect-pests and diseases and get higher prices. Hence, in order to obtain a profitable crop, regulation of flowering in *Mrig bahar* was done by withholding of irrigation from December (last irrigation) to May. On 26th and 27th May of both the year (2021 and 2022), pruning was done up to 30 cm old shoot from top with the help of plant pruner and secateurs. Immediately after pruning irrigation was applied for controlling sun heat on plant.

RESULTS AND DISCUSSION

Effect of novel organic liquid fertilizer and plant growth regulators on quality parameters. It is evident from the data presented in Table 1 and 1a that quality parameters were significantly influenced by foliar application novel organic liquid fertilizer and plant growth regulators.

Total soluble solids (°Brix). Application of GA_3 150 mgl^{-1} (T_8) was observed significantly higher total soluble solids (Table 1) *i.e.* 11.70, 11.82 and 11.76 °Brix in 2021, 2022 and pooled analysis, respectively. GA_3 150 mgl^{-1} (T_8) was at par with T_6 (Salicylic acid 150 mgl^{-1}) and T_{10} (Novel organic liquid fertilizer 40 mll^{-1}) in the year 2021, 2022 and in pooled analysis. The minimum total soluble solids *i.e.* 7.87, 8.01 and 7.94 °Brix was reported with treatment T_{11} (Control) during 2021, 2022 and pooled data, respectively.

The total soluble solids was increased might be due to the spraying of GA_3 has stimulated the functioning of a number of enzymes in physiological processes, particularly respiration and photosynthesis, which eventually leads to the buildup of more dry matter, minerals, carbohydrates, starch and other metabolites in fruit. GA_3 also indirectly influences many enzyme systems in plants; out of these, gibberellins are well-known for its role in the activation of the amylase enzyme; this enzyme is in responsible for converting insoluble starch into sugar and pectin, which is found in the middle lamella and cell wall and increase in total soluble solids. This finding is supported by Carpenter *et al.* (2019); Jain *et al.* (2020) in sapota and Maurya *et al.* (2020); Tripathi and Kumar (2022) in mango.

The foliar application of novel organic liquid fertilizer likewise increases total soluble solids of fruit. The increased in the total soluble solids might be due to the effect of nutrients on physiological processes such as respiration and photosynthesis, which improved the supply of dry matter, minerals and carbohydrates towards the developing fruits.

Acidity (%). The significantly minimum acidity (Table 1) *i.e.* 0.36, 0.35 and 0.36 % was recorded with GA_3 150 mgl^{-1}(T_8) during 2021, 2022 and in pooled data, respectively. GA_3 150 mgl^{-1} (T_8) was at par with T_6 (Salicylic acid 150 mgl^{-1}) T_7 (GA_3 100 mgl^{-1}) T_9 (Novel organic liquid fertilizer 20 mll^{-1}) and T_{10} (Novel organic liquid fertilizer 40 mll^{-1}) in 2021 and it was at par with T_{10} (Novel organic liquid fertilizer 40 mll^{-1}) in 2022 and pooled data. Maximum acidity *i.e.* 0.49, 0.50 and 0.49 % was recorded with treatment T_{11} (Control) during both years 2021, 2022 and pooled analysis, respectively.

An acidity was reduced might be due to that acid under the influence of a higher concentration of GA_3 might have been rapidly converted into sugar and their derivatives by the revocable reaction of the glycolytic pathway, which is utilized in several physiological activities. As guava is a climacteric fruit, the acidity percentage of guava reduced due to the conversion of acid into sugar and its use as a respiratory substrate during the period of growth and development of the fruit. Jain *et al.* (2020) in sapota, Maurya *et al.* (2020); Tripathi and Kumar (2022) in mango.

Similarly, Novel organic liquid fertilizer also reduced the acidity it might be due to novel organic liquid fertilizer contains macro, micro elements and plant growth regulators which decrease acidity. Respirational demand and adequate supply of nutrients, synthesis of invertase and starch splitting enzymes decrease the acidity in fruit.

Ascorbic acid (mg/100 g). Application of GA_3 150 mgl^{-1} (T_8) wasnoted significantly higher ascorbic acid (Table 1) values of 198.25, 201.56 and 199.91 mg/100 g pulp in the year 2021, 2022 and pooled results, respectively. It was at par with treatments T_5 (Salicylic acid 100 mgl^{-1}), T_6 (Salicylic acid 150 mgl^{-1}), T_7 (GA_3 100 mgl^{-1}), T_9 (Novel organic liquid fertilizer 20 mll^{-1}) and T_{10} (Novel organic liquid fertilizer 40 mll^{-1}) in the year 2021 and 2022. In pooled analysis it was at par with T_6 (Salicylic acid 150 mgl^{-1}), T_7 (GA_3 100 mgl^{-1}) and T_{10} (Novel organic liquid fertilizer 40 mll^{-1}). The minimum ascorbic acid *i.e.* 176.33, 178.44 and 177.38 mg/100 g pulp was reported with treatment T_{11} (Control) during the year 2021, 2022 and pooled data, respectively.

The perceptive increase in ascorbic acid with gibberellic acid may have a catalytic effect on ascorbic acid's biosynthesis from its precursor glucose 6-phosphate during the growth and development of fruit or the inhibition of its alteration to dehydroascorbic acid by ascorbic acid oxidase or both. Similar results were reported earlier by Carpenter *et al.* (2019); Maurya *et al.* (2020); Tripathi and Kumar (2022) in mango and El-Sayed (2021) in mandarin.

Novel organic liquid fertilizer contains macro, micro elements and plant growth regulators which might helped in improving the fruit quality of fruit. The novel organic liquid fertilizer contains higher amount of potassium and phosphorus which improved the ascorbic acid content in fruit. Similar results were also observed by Patel *et al.* (2018) in mango.

Total Sugar (%). The significantly highest total sugar (Table 1a) was recorded with GA_3 150 mgl^{-1} (T_8) *i.e.* 9.53, 9.71 and 9.62 % during 2021, 2022 as well as in pooled analysis, respectively. Whereas, minimum total sugar *i.e.* 6.89, 6.92 and 6.91 % was noticed under T_{11} (Control) during 2021, 2022 and in pooled analysis, respectively.

Reducing sugar (%). The data (Table 1a) showed that the reducing sugar was found significantly higher with **t**reatment T_8, under the application of GA_3 150 mgl^{-1} *i.e.* 5.89, 5.97 and 5.93 % in 2021, 2022 and pooled data, respectively. The minimum reducing sugar *i.e.*4.10, 4.11 and 4.10 % was recorded with treatment T_{11} (Control) during 2021, 2022 and pooled result, respectively.

Non-reducing sugar (%). Application of GA_3 150 mgl^{-1} (T_8) recorded significantly higher non-reducing sugar(Table 1a)*i.e.*, 3.65, 3.74 and 3.69 % and it was at par with T_6 (Salicylic acid 150 mgl^{-1}) and T_{10} (Novel organic liquid fertilizer 40 mll^{-1}) during the year 2021, 2022 and pooled analysis, respectively. The minimum non-reducing sugar *i.e.* 2.79, 2.81 and 2.80 % was reported with treatment T_{11} (Control) during 2021, 2022 and pooled data, respectively.

The increase in sugar content of fruit might be due to the application of gibberellic acid probably improved the physiology and photosynthetic ability of leaves, which led to availability of carbohydrates and better translocation of essential components in the fruit, followed by assimilation and utilization of photosynthate by the developing fruit and also increased the hydrolysis of polysaccharides into simple sugars and conversion of organic acids into sugars by metabolic activities. These results are in close conformity with the findings of Carpenter *et al.* (2019); Jain *et al*. (2020) in sapota, Maurya *et al.* (2020); Tripathi and Kumar (2022) in mango.

Novel organic liquid fertilizer contains macro and micro nutrients which promote hydrolysis of starch into sugars and acts as a catalyst in oxidation decrease processes in plants.

Table 1: Effect of novel organic liquid fertilizer and plant growth regulators on quality parameters of guava.

Treatment No.		Total soluble solids (°Brix)			Acidity (%)			Ascorbic acid(mg/100 g)		
		2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
T_1		8.41	8.57	8.49	0.46	0.47	0.47	181.00	183.81	182.41
T_2		9.23	9.52	9.37	0.44	0.43	0.44	185.22	187.63	186.42
T_3		8.10	8.16	8.13	0.48	0.49	0.48	179.16	182.30	180.73
T_4		8.78	8.85	8.82	0.45	0.46	0.45	183.12	185.78	184.45
T_5		9.89	10.03	9.96	0.41	0.42	0.41	188.78	189.74	189.26
T_6		11.25	11.34	11.30	0.38	0.39	0.39	193.95	195.10	194.52
T_7		10.70	10.98	10.84	0.39	0.40	0.40	192.10	194.52	193.31
T_8		11.70	11.82	11.76	0.36	0.35	0.36	198.25	201.56	199.91
T_9		10.23	10.39	10.31	0.39	0.41	0.40	190.54	191.40	190.97
T_{10}		11.45	11.62	11.54	0.37	0.38	0.37	196.26	197.23	196.74
T_{11}		7.87	8.01	7.94	0.49	0.50	0.49	176.33	178.44	177.38
(T)	S.Em ±	0.28	0.27	0.19	0.01	0.01	0.008	4.37	4.31	2.88
	C. D. (P = 0.05)	0.81	0.79	0.55	0.03	0.03	0.02	12.81	12.63	8.20
(Y)	S.Em ±			0.09			0.004			1.31
	C. D. (P = 0.05)			NS			NS			NS
(Y×T)	S.Em ±			0.27			0.011			4.34
	C. D. (P = 0.05)			NS			NS			NS
C.V. %		4.88	4.68	4.78	4.44	4.74	4.59	4.03	3.93	3.98

Table 1a: Effect of novel organic liquid fertilizer and plant growth regulators on quality parameters of guava.

Treatment No.		Total Sugar (%)			Reducing sugar (%)			Non-reducing sugar (%)			Shelf life (days)		
		2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
T_1		7.23	7.25	7.24	4.33	4.36	4.35	2.90	2.89	2.90	3.33	3.47	3.40
T_2		7.52	7.75	7.64	4.65	4.74	4.70	2.87	3.01	2.94	3.60	3.73	3.67
T_3		7.02	7.09	7.05	4.20	4.23	4.21	2.82	2.86	2.84	3.13	3.20	3.17
T_4		7.45	7.62	7.54	4.54	4.58	4.56	2.91	3.04	2.97	3.47	3.53	3.50
T_5		7.84	8.01	7.93	4.80	4.91	4.86	3.04	3.10	3.07	4.73	4.80	4.77
T_6		8.89	9.03	8.96	5.43	5.48	5.46	3.46	3.55	3.51	4.93	5.00	4.97
T_7		8.56	8.67	8.61	5.25	5.35	5.30	3.31	3.32	3.31	4.00	4.13	4.07
T_8		9.53	9.71	9.62	5.89	5.97	5.93	3.65	3.74	3.69	4.47	4.60	4.53
T_9		8.13	8.20	8.16	4.98	5.02	5.00	3.15	3.18	3.17	3.73	3.87	3.80
T_{10}		9.01	9.09	9.05	5.43	5.50	5.47	3.57	3.59	3.58	4.27	4.33	4.30
T_{11}		6.89	6.92	6.91	4.10	4.11	4.10	2.79	2.81	2.80	3.07	3.13	3.10
(T)	S.Em ±	0.17	0.16	0.12	0.13	0.11	0.09	0.11	0.11	0.08	0.12	0.13	0.08
	C. D. (P = 0.05)	0.49	0.48	0.33	0.38	0.34	0.25	0.33	0.33	0.23	0.34	0.39	0.24
(Y)	S.Em ±			0.05			0.04			0.04			0.04
	C. D. (P = 0.05)			NS			NS			NS			NS
(Y×T)	S.Em ±			0.17			0.12			0.11			0.12
	C. D. (P = 0.05)			NS			NS			NS			NS
C.V. %		3.62	3.49	3.56	4.58	4.00	4.30	6.24	6.01	6.12	5.15	5.73	5.46

Shelf life (days). The appraisal of data (Table 1a) on shelf life indicates that significantly maximum shelf life *i.e.* 4.93, 5.00 and 4.97 days was recorded with salicylic acid 150 mgl^{-1} (T_6) during the years 2021, 2022 and in pooled analysis, respectively which was at par with T_5 (Salicylic acid 100 mgl^{-1}). Whereas, minimum shelf life *i.e.* 3.07, 3.13 and 3.10 days was noticed under T_{11} (Control) during the years 2021, 2022 and in pooled analysis, respectively.

Regarding shelf life, salicylic acid mightincrease fruit firmness (Srivastava and Dwivedi 2000) by reducing the activity of cell wall degrading enzyme like cellulase, polygalacturonase and xylanase. Salicylic acid was decrease in fruit metabolic activities results in a reduction in fruit water loss and carbohydrate depletion rate and consequently, effectively delays the fruit senescence process, thereby preventing postharvest decay and extending the storage life. Another important factor for extending shelf life of guava fruit is the ability of salicylic acid to induce systematic acquired resistance (SAR) providing considerable protection against abiotic stresses and pathogen attack. These observations are in agreement with Lokesh *et al.* (2020); Chourasia (2021) in mango, Devarakonda *et al.* (2020) in papaya and Kanwal *et al.* (2021) in ber.

CONCLUSIONS

From the two years of field study, it can be concluded that foliar application of GA_3 150 mgl^{-1} improved fruit quality parameters like total soluble solids, acidity, ascorbic acid, total sugar, reducing sugar and non-reducing sugar. While, application of salicylic acid 150 mgl^{-1} improved shelf life of guava fruits which was sprayed twice, first at July and second at August.

FUTURE SCOPE

1. As there is a growing emphasis on sustainable and environmentally friendly agricultural practices, the use of novel organic liquid fertilizer and plant growth regulators aligns with this trend. The research can contribute to sustainable farming practices by reducing the reliance on synthetic chemicals and minimizing environmental impacts

2. The success of this research may encourage farmers to diversify their crops and experiment with novel organic liquid fertilizer and plant growth regulators on various fruit crops. This can lead to a more resilient and diverse agriculture sector

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Conflict of Interest. None.

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