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Sathish BR
Department of Fruit Science, College of Horticulture, Bagalkot, Karnataka, India

Anand B Mastiholi
Department of Fruit Science, College of Horticulture, Bagalkot, Karnataka, India

Kulapati Hipparagi
Department of Fruit Science, College of Horticulture, Bagalkot, Karnataka, India

Allolli TB
Department of Fruit Science, College of Horticulture, Bagalkot, Karnataka, India

Prasanna SM
Department of Fruit Science, College of Horticulture, Bagalkot, Karnataka, India

Rudresh DL
Department of Fruit Science, College of Horticulture, Bagalkot, Karnataka, India

Suvarna Patil
Department of Fruit Science, College of Horticulture, Bagalkot, Karnataka, India

Corresponding Author:
Sathish BR
Department of Fruit Science, College of Horticulture, Bagalkot, Karnataka, India

Effect of jeevamrutha on quality and bio-chemical attributes of guava (*Psidium guajava* L.) cv. L-49 under Northern transition zone of Karnataka

Sathish BR, Anand B Mastiholi, Kulapati Hipparagi, Allolli TB, Prasanna SM, Rudresh DL and Suvarna Patil

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Abstract
The present field investigation was conducted at Regional Horticultural Research and Extension Center, Kumbapur, Dharwad, Karnataka, during 2019-20 and 2020-2021.The objective of the study was to study the influence of application of liquid jeevamrutha at different dosage and frequency on fruit quality and biochemical characteristics of guava cv. L-49. The experiment was designed in two factorial randomized block design with each factor having three levels. Three different levels of liquid jeevamrutha *viz*., 500 l/ha, 750 l/ha and 1000 l/ha at different frequencies like 15 days, 21 days and 30 days was applied to guava trees in the effective root zone area. The combination effect of dosage and frequency of application was compared with recommended package of practice (RPP). The results showed that, application of higher dosage of liquid jeevamrutha *i.e*., 1000 l/ha at an interval of 15 days recorded improved quality and biochemical attributes. Similarly in interactions also D_3F_1 (Application of liquid jeevamrutha @ 1000 l/ha at 15 days interval) recorded higher TSS (12.40 ^{O} Brix), TSS to acid ratio (31.44), ascorbic acid (156.25 mg/100 g), reducing sugars (4.68%), non-reducing sugars (2.69%), total sugars (7.37%), shelf life (7.67 days).When the interactions were compared with control treatment (RPP) significantly higher TSS, sugar content, ascorbic acid and shelf life was recorded in control treatment.

Keywords: Guava, liquid jeevamrutha, leaf nutrients, nitrogen

Introduction
Guava is one of the most important fruit crop of India adopted to both tropical and subtropical conditions. Guava (*Psidium guajava* L.) also known as "apple of the tropics" and "poor man's apple", is the most important, highly productive, delicious and nutritious fruit. In India, guava is cultivated in an area of 265 thousand hectare with an annual production of 4054 thousand tonnes and productivity of 15.3 MT per hectare. In Karnataka, guava is cultivated in an area of 7.18 thousand hectares with an annual production of 140.23 thousand MT with a productivity of 19.52 MT per hectare (Anon, 2018) [2]. Achieving higher productivity without compromising quality is the at most objective of the any fruit production system. There was a huge demand for the Indian fruits and vegetables in the international market but in recent times the demand was slightly dropping because of the presence of harmful chemicals in the Indian produce especially among fruits. The reason is quite true that indiscriminate use of chemical fertilizers and pesticides which destroys the beneficial soil micro flora and fauna that pollute soil and ground water which resulted in the accumulatuin of harmful chemicals in the plant as well as in fruits. Hence, keeping these views in mind is the need of the hour and it needs to be ascertained that the quantum of inorganic fertilizers that could substituted with natural farming preparations and practices (liquid jeevamrutha, ghanajeevamrutha and mulching) and organic farming (FYM, poultry manures, neem based products, biofertilizers, panchagavya *etc*.) practices without sacrificing the yield and deterioration in the fruit quality. In this regard preent experiment entitled "Influence of different dosage and frequency of liquid jeevamrutha application on fruit quality and biochemical attributes of guava (*Psidium guajava*) cv. L-49 under Northern Transition Zone of Karnataka**"** was carried out with an objective to know the influence of application of liquid jeevamrutha at different dosage and frequency on fruit quality and biochemical parameters.

Material and Methods
The present field experiment was conducted at Regional horticulture research and extension center, Kumbapur, Dharwad during 2019-2020 and 2020-2021.

Dharwad comes under Northern Transitional Zone (Zone 8) of Karnataka, which lies between the Western heavy rainfall areas of Hilly Zone (Zone 9) and low rainfall areas of planes of Northern Dry Zone (Zone 3) of Karnataka with average rainfall of 870 mm. The experiment was laid out in the factorial randomized design (FRBD) with two factors each having three levels. There are totally 12 treatments which were replicated thrice. Factor I- Dosage of liquid jeevamrutha (D) includes three levels *ie.*, D_1(500 litre/ha), D_2 (750 litre/ha) and D_3 (1000 litre/ha) and Factor II- Frequency of application (F) includes three levels *ie.*, F_1(application of liquid jeevamrutha once in 15 days), F_2 (application of liquid jeevamrutha once in 21 days) and F_1(application of liquid jeevamrutha once in 30 days). These combinations were compared with Control treatment *ie*., RPP (N:P:K @ 300:120:150 g per tree+ FYM @ 25 kg per tree). In order to check the individual effect of liquid jeevamrutha and ghanajeevamrutha, combination treatments were compared with RPP, only jeevamrutha application and only ghanajeevamrutha application and the treatment details are furnished in table 1. Total soluble solids were determined with the help of hand refractometer where the juice from randomly selected fruit per replication was extracted and strained through muslin cloth. The strained juice was stirred properly and then the drop of this juice was placed on the prism of hand refractometer and per cent total soluble solids was obtained from direct reading and expressed in ^{o}Brix. The titratable acidity of guava was calculated by titration method (Srivastava and Kumar, 1994.). The ratio was calculated by dividing TSS with the acidity. The titrimetric method of Lane and Eynon as described by Ranganna (1986) was adopted for the estimation of reducing sugars. The total sugar content was expressed as percentage in terms of invert sugar according to the formula as described by Ranganna (1986). The per cent of non-reducing sugars was obtained by subtracting the values of reducing sugars from that of total sugar and expressed in percentage. Ascorbic acid content of guava was estimated by using the method given by AOAC (1990), which was based on the reduction of 2, 6-dichlorophenol indophenols (2, 6-DCPIP) by ascorbate.

Table 1: Treatment details and combinations (D × F)

T_1	D_1F_1	Application of liquid jeevamrutha @ 500 litre/ha
T_2	D_1F_2	Application of liquid jeevamrutha @ 500 litre/ha
T_3	D_1F_3	Application of liquid jeevamrutha @ 500 litre/ha
T_4	D_2F_1	Application of liquid jeevamrutha @ 750 litre/ha
T_5	D_2F_2	Application of liquid jeevamrutha @ 750 litre/ha
T_6	D_2F_3	Application of liquid jeevamrutha @ 750 litre/ha
T_7	D_3F_1	Application of liquid jeevamrutha @ 1000 litre/ha
T_8	D_3F_2	Application of liquid jeevamrutha @ 1000 litre/ha
T_9	D_3F_3	Application of liquid jeevamrutha @ 1000 litre/ha
T_{10}	-	Application of liquid jeevamrutha @ 500 litre/ha
T_{11}	-	Application of ghanajeevamrutha @ 1000 kg/ha at
T_{12}	RPP	Recommended Package of Practice (N:P:K @

Note: * Organic mulching was common to all the treatments except T_{12}

* Ghanajeevamruth @ 1000 kg per hectare applied common to all the treatments from T_1 to T_9

Results and Discussion

Fruit TSS (^{o} Brix)

Significant difference in TSS was found during 2019-20, 2020-2021 and also in pooled data and when the interaction treatments were compared with RPP, jeevamrutha and ghanajeevamrutha. Pooled data revealed that, significantly highest TSS was recorded in RPP (recommended package of practice) (12.77 ^{0}B) which was on par with D_3F_1 (12.40 °B) and significantly lowest TSS was recorded with the application of ghanajeevamrutha @ 1000 kg/ha (10.23 °B). But TSS was not influenced significantly by dosage, frequency and also by their interactions. The highest TSS recorded in RPP might be due to application of fertilizers and FYM as it fastens the metabolic transformation of starch and pectin into soluble compounds and rapid translocation of sugars from leaves to the developing fruits and also due to increased micro nutrients, macro nutrients, carbohydrate (%) and protein (%) content. These findings are in agreement with the results of Gangadhar *et al.* (2020) [3] and Sahana *et al.* (2020) [10].

Fruit Acidity (%)

Acidity of the fruits was not influenced significantly by the application of different dosage of liquid jeevamrutha and ghanajeevamrutha and also by their interaction effects. However, significant difference in fruit acidity was noticed when the interaction treatments were compared wirh control treatments (RPP, only jeevamrutha and only ghanajeevamrutha application) with significantly the lowest TSS recorded in RPP (0.37%). Potassium is the major nutrient which is responsible for the maintenance of the fruit quality. Potassium plays a prominent role in neutralization of organic acids which were produced by the oxaloacetates with the help of the enzyme polyphenol pyruvate (PEP). Neutralization of organic acids due to a high potassium level in tissues could have also resulted in the reduction in acidity (Tisdale and Nelson 1966) [12]. The results are in close conformity with Nalina and Kumar (2007) [8] in cv. Robusta, Kumar and Kumar (2007) [6] in cv. Neypoovan, Kumar *et al.* (2008) in cv. Robusta and Nandankumar *et al.* (2011) [9] in cv. Nanjanagudu Rasabale.

Ascorbic acid (mg/100 g)

Ascorbic acid content in guava fruit was not influenced significantly either by dosage of liquid jeevamrutha or ghanajeevamrutha or also by their interaction but, varied significantly when the interaction treatments were compared with control treatments (RPP, only jeevamrutha and only ghanajeevamrutha application). Significantly the highest ascorbic acid content was recorded in RPP (158.91 mg/ 100 g) and the lowest was recorded with application of ghanajeevamrutha (143.83 mg/100 g) (Table 2). Oxidation of ascorbic acid is the major problem which restricts its accumulation in the tissues but it can be prevented by the proper nutrition with potassium. In the present investigation, increased ascorbic acid content in the fruits in RPP treatment might be due to potassium application as a part of nutrient source which might help to slow down the enzyme system that encouraged the oxidation of ascorbic acid, thus helping the plants to accumulate more ascorbic acid in the fruits (Ananthi *et al*., 2004) [1]. The high energy status in crops well supplied with potassium also promotes synthesis of secondary metabolites, like vitamin C (Mengel, 1997) [7]. These results are in close conformity with Shira *et al.* (2012) [11] in cv. Martaman (*Musa* AAB).

Total sugar content (%)

Dosage of liquid jeevamrutha did not influence total sugars during 2019-20. However, significant differences during 2020-21 and in pooled data were observed for total sugars. During 2020-2021 and in pooled data, significantly the highest total sugars were recorded when the liquid jeevamrutha was applied @ 1000 litre per hectare (L_3) (7.18% and 7.05%, respectively) which was on par with L_2 (6.98% and 6.85%, respectively) and significantly the lowest total sugar content was recorded in L_1 (6.71% and 6.62%, respectively). Total sugar content in guava fruit during 2019-2020 and 2020-2021 did not vary significantly due to ghanajeevamrutha application. However, it varied significantly in pooled data only. In pooled data, significantly the highest total sugar content was recorded by the application of ghanajeevamrutha @ 1500 kg per hectare (G_3) (6.95%) which was on par with G_2 (6.85%) and significantly the lowest total sugar was recorded in G_1 (6.72%). Interaction effect of liquid jeevamrutha and ghanajeevamrutha application did not vary significantly during 2019-20, 2020-21 and also in pooled data with respect to total sugar content in guava fruit. Significant difference was noticed in total sugars when the interaction treatments were compared with control treatments (RPP, only jeevamrutha and only ghanajeevamrutha application) during 2019-2020, 2020-21 and also in pooled data. In pooled data, significantly the highest total sugars was recorded in RPP (Recommended package of practice) (7.49%) which was on par with L_3G_3 (7.17%), L_3G_2 (7.09%) and L_3G_1 (6.89%) and significantly the lowest total sugars was recorded with application of only ghanajeevamrutha 1000 kg per hectare (6.21%). The increase in total sugars with the frequent application of the highest dosages of liquid jeevamrutha might be attributed to the conversion of reserved starch and other insoluble carbohydrates into soluble sugars. The results are supported with the findings of Jhade *et al.* (2020) [4] and Sahana *et al.* (2020) [10]. When the interactions were compared with control treatments (RPP, only jeevamrutha and only ghanajeevamrutha), significantly the highest total sugar content was recorded in RPP (7.53%) which can be attributed to increase in reducing sugars (4.79%) and non-reducing sugars (2.70%) in fruits of RPP treatment. Increase in sugar content of the fruit could be attributed to potassium application, because potassium involved in carbohydrate synthesis, breakdown, translocation and synthesis of protein and favours the conversion of starch into simple sugars during ripening by activating sucrose synthase enzyme, resulting in accumulation of high sugar content in the fruits. Results of this investigation are in close confirmation with findings of Nandankumar *et al.* (2011) [9] in cv. Nanjangudu rasabale and Kumar *et al*. (2008) [5] in cv. Robusta.

Table 2: Fruit quality parameters in guava cv. L-49 as influenced by different dosage of liquid jeevamrutha and ghanajeevamrutha

Treatment	TSS (^{0} Brix)			Acidity (%)			TSS-Acid ratio			Ascorbic acid (mg/100 g)		
	2019-20	2020-2021	Pooled	2019-20	2020-2021	Pooled	2019-20	2020-2021	Pooled	2019-20	2020-2021	Pooled
Liquid jeevamrutha												
L_1	11.32	11.60	11.46^b	0.42	0.43	0.42	27.25	27.34	27.30^b	151.90	153.74	152.82
L_2	11.69	11.84	11.77^{ab}	0.41	0.43	0.42	28.65	27.62	28.13^b	154.98	156.97	155.98
L_3	11.85	12.10	11.97^a	0.39	0.41	0.40	30.35	29.65	30.00^a	155.48	158.54	157.01
S.Em±	0.19	0.15	0.12	0.01	0.01	0.01	0.84	0.93	0.55	2.11	2.26	1.10
C.D. @ 5%	NS	NS	0.37	NS	NS	NS	NS	NS	1.64	NS	NS	NS
Ghanajeevamrutha												
G_1	11.42	11.62	11.52	0.41	0.43	0.42	27.87	27.25	27.56^b	152.84	155.79	154.31
G_2	11.55	11.84	11.70	0.41	0.42	0.42	28.39	27.98	28.18^{ab}	154.07	155.85	154.96
G_3	11.88	12.08	11.98	0.40	0.41	0.40	29.99	29.39	29.69^a	155.46	157.61	156.54
S.Em±	0.19	0.15	0.12	0.01	0.01	0.01	0.84	0.93	0.55	2.11	2.26	1.10
C.D. @ 5%	NS	NS	NS	NS	NS	NS	NS	NS	1.64	NS	NS	NS
Interaction												
L_1G_1	11.21	11.35	11.28	0.42	0.45	0.43	26.96	26.22	26.59	150.43	153.90	152.16
L_1G_2	11.36	11.65	11.51	0.42	0.43	0.43	26.84	27.02	26.93	151.98	152.40	152.19
L_1G_3	11.40	11.80	11.60	0.41	0.41	0.41	27.95	28.79	28.37	153.31	154.91	154.11
L_2G_1	11.48	11.62	11.55	0.42	0.44	0.43	27.56	26.78	27.17	153.91	155.60	154.75
L_2G_2	11.53	11.81	11.67	0.41	0.43	0.42	28.21	27.36	27.79	154.96	156.77	155.87
L_2G_3	12.06	12.10	12.08	0.40	0.42	0.41	30.16	28.73	29.44	156.08	158.54	157.31
L_3G_1	11.59	11.88	11.74	0.40	0.41	0.41	29.10	28.75	28.92	154.18	157.88	156.03
L_3G_2	11.77	12.06	11.92	0.39	0.41	0.40	30.10	29.56	29.83	155.26	158.37	156.82
L_3G_3	12.18	12.35	12.27	0.38	0.40	0.39	31.85	30.64	31.24	157.01	159.37	158.19
S.Em±	0.33	0.26	0.21	0.01	0.03	0.01	1.45	1.61	0.95	3.66	3.91	1.91
C.D. @ 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
J	11.23	11.34	11.28	0.45	0.45	0.45	24.96	26.08	25.52	149.62	150.37	150.00
GJ	11.02	11.23	11.13	0.46	0.49	0.48	24.06	23.61	23.84	143.34	144.32	143.83
RPP	12.77	12.47	12.62	0.37	0.35	0.36	34.62	35.50	35.06	157.71	160.10	158.91
S.Em±	0.37	0.34	0.29	0.02	0.03	0.02	1.51	1.83	0.93	3.63	3.53	1.79
C.D. @ 5%	NS	NS	0.85	NS	NS	0.05	4.42	5.36	2.72	NS	NS	5.25

Note: L_1- Application of jeevamrutha @ 500 l/ha (2.8 l /tree) G_1- Application of ghanajeevamrutha @ 1000 kg/ha (5.6 kg/tree)
L_2 –Application of jevamrutha @ 750 l/ha (4.2 l /tree) G_2- Application of ghanajeevamrutha @1250 kg/ha (7.0 kg/tree)
L_3- Application of jeevamrutha @ 1000 l/ha (5.6 l /tree) G_3- Application of ghanajeevamrutha @ 1500 kg/ha (8.4 kg/tree)
J - Only jeevamrutha @ 500 l/ha (5.6 l /tree) once in 21 days G- Only ghanajeevamrutha @ 1000 kg/ha (5.6 kg/tree
RPP- Recommended package of practice (NPK @ 300:120:150 g/tree + FYM @ 25 kg/tree)

Shelf life (days)

Shelf life of the fruit was not influenced significantly by the application of liquid jeevamrutha, ghanajeevamrutha, their interactions and also comparison of interaction treatments with control treatments (RPP, only liquid jeevamrutha and only ghanajeevamrutha application).

Table 3: Fruit bio-chemical parameters in guava cv. L-49 as influenced by different dosage of liquid jeevamrutha and ghanajeevamrutha

Treatment	Reducing sugars (%)			Non-Reducing sugars (%)			Total sugars (%)			Shelf life (Days)		
	2019-20	2020-2021	Pooled	2019-20	2020-2021	Pooled	2019-20	2020-2021	Pooled	2019-2020	2020-2021	Pooled
Liquid jeevamrutha												
L_1	4.26	4.37	4.31^b	2.28	2.34^b	2.31^b	6.54	6.71^b	6.62^b	6.44	7.00	6.72
L_2	4.35	4.43	4.39^b	2.37	2.55a	2.46^a	6.72	6.98^a	6.85^a	7.00	7.00	7.00
L_3	4.44	4.59	4.52^a	2.47	2.59^a	2.53^a	6.91	7.18^a	7.05^a	7.11	7.44	7.28
S.Em±	0.07	0.07	0.04	0.07	0.05	0.03	0.10	0.08	0.05	0.34	0.39	0.22
C.D. @ 5%	NS	NS	0.11	NS	0.14	0.10	NS	0.24	0.16	NS	NS	NS
Ghanajeevamrutha												
G_1	4.27	4.41	4.34	2.30	2.47	2.38	6.57	6.88	6.72^b	6.56	6.89	6.72
G_2	4.38	4.45	4.41	2.38	2.49	2.43	6.76	6.94	6.85^{ab}	6.78	7.11	6.94
G_3	4.41	4.53	4.47	2.44	2.52	2.48	6.85	7.05	6.95^a	7.22	7.44	7.33
S.Em±	0.07	0.07	0.04	0.07	0.05	0.03	0.10	0.08	0.05	0.34	0.39	0.22
C.D. @ 5%	NS	NS	NS	NS	NS	NS	NS	NS	0.16	NS	NS	NS
Interaction												
L_1G_1	4.20	4.31	4.26	2.24	2.31	2.28	6.44	6.62	6.53	6.33	6.67	6.50
L_1G_2	4.29	4.31	4.30	2.27	2.35	2.31	6.56	6.66	6.61	6.33	7.00	6.67
L_1G_3	4.29	4.47	4.38	2.32	2.36	2.34	6.61	6.83	6.72	6.67	7.33	7.00
L_2G_1	4.25	4.38	4.32	2.31	2.54	2.43	6.56	6.92	6.74	6.67	6.33	6.50
L_2G_2	4.38	4.42	4.40	2.37	2.53	2.45	6.75	6.95	6.85	7.00	7.33	7.17
L_2G_3	4.42	4.48	4.45	2.44	2.57	2.51	6.86	7.06	6.96	7.33	7.33	7.33
L_3G_1	4.35	4.53	4.44	2.34	2.55	2.45	6.69	7.08	6.89	6.67	7.67	7.17
L_3G_2	4.46	4.61	4.53	2.52	2.58	2.55	6.98	7.20	7.09	7.00	7.00	7.00
L_3G_3	4.53	4.64	4.58	2.55	2.63	2.59	7.08	7.27	7.17	7.67	7.67	7.67
S.Em±	0.11	0.12	0.06	0.12	0.08	0.06	0.17	0.14	0.09	0.58	0.67	0.38
C.D. @ 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
J	4.14	4.19	4.17	2.18	2.27	2.22	6.32	6.45	6.39	6.33	6.67	6.50
GJ	4.06	4.08	4.07	2.09	2.20	2.14	6.15	6.28	6.21	6.00	6.33	6.17
RPP	4.77	4.82	4.79	2.69	2.71	2.70	7.46	7.53	7.49	6.00	6.33	6.17
S.Em±	0.12	0.13	0.07	0.11	0.09	0.07	0.17	0.15	0.09	0.55	0.67	0.36
C.D. @ 5%	NS	0.39	0.20	0.32	0.25	0.19	0.49	0.44	0.28	NS	NS	NS

Note: L_1- Application of jeevamrutha @ 500 l/ha (2.8 l /tree) G_1- Application of ghanajeevamrutha @ 1000 kg/ha (5.6 kg/tree)
L_2 –Application of jevamrutha @ 750 l/ha (4.2 l /tree) G_2- Application of ghanajeevamrutha @1250 kg/ha (7.0 kg/tree)
L_3- Application of jeevamrutha @ 1000 l/ha (5.6 l /tree) G_3- Application of ghanajeevamrutha @ 1500 kg/ha (8.4 kg/tree)
J - Only jeevamrutha @ 500 l/ha (5.6 l /tree) once in 21 days G- Only ghanajeevamrutha @ 1000 kg/ha (5.6 kg/tree)
RPP- Recommended package of practice (NPK @ 300:120:150 g/tree + FYM @ 25 kg/tree)

Conclusion

From the results of the study it can be concluded that, more frequent application of higher dosage of liquid jeevamrutha improved the fruit biochemical and quality parameters, however, RPP recorded significantly higher values with respect to quality and biochemical parameters as compared to jeevamrutha treatments.

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