Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.2619

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **5 (1):** 720-728 (2017)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Planting Geometry, Integrated Nutrient Management and Its Effect on Postharvest Quality of Guava Cv. Lalit during Rainy Season

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Received: 20.02.2017 | Revised: 27.02.2017 | Accepted: 28.02.2017

ABSTRACT

The guava (Psidium guajava L.) cv. Lalit" was studied under different spacing (2 x 2, 3 x 3, 6 x 3 and 6 x 6 m) in rainy season for postharvest quality at Regional Horticulture Research Station, College of Horticulture, Bengaluru. The maximum TSS (15.14 ^{0}B), titratable acidity (0.44 %), sugar:acid ratio (39.17), total sugars (15.57 %), reducing sugars (9.19 %) and ascorbic acid (169.24 mg 100^{-1} g pulp), PLW (9.31 %), Firmness of fruit (3.50 kg/cm^2). The integrated nutrient management maximum TSS (15.77 ^{0}B), titratable acidity (0.34 %), sugar:acid ratio (52.70), total sugars (16.74 %), reducing sugars (9.91 %) and ascorbic acid (184.52 mg 100^{-1} g pulp), PLW (6.85 %), Firmness of fruit (4.55 kg/cm^2) was recorded.

Key words: *TSS, acidity, total sugars, reducing sugars, ascorbic acid, PLW, guava*

INTRODUCTION

Guava (*Psidium guajava* L.) is a popular fruit crop in India. It belongs to the family Myrtaceae. It can be grown in tropical and subtropical climate and it adapted for diverse soil and agro climatic conditions. It is relatively precocious and prolific in fruit bearing nature, could give highly remunerative for crop production. The fruits are highly nutritious, it has a rich source of vitamin 'C' after barbados cherry (1500 mg 100^{-1}g) and aonla (700 mg 100^{-1}g) and Vitamin 'C' content of fruits vary from 95.75 to 239.00 mg 100^{-1} g cultivars of guava[13]. Plant density and nutritional management play an important role in obtaining good quality of fruits. The application of huge amount of chemical fertilizers hampers the fruit quality, soil health and causes environmental pollution. So, the INM approach gives away to overcome these problems. The integrated approach of organic, inorganic and bio-fertilizers were used to know the effect on quality of guava fruits.

MATERIAL AND METHODS

The present research was carried out at the Regional Horticultural Research Experimental Centre (RHREC), UHS, Campus, Bengaluru during the year 2012-13 and the research was conducted on three-year-old guava trees.

Cite this article: Kumar, R.K., Jaganath, S., Guruprasad, T. R. and Tayeeb Ulla, H.M., Planting Geometry, Integrated Nutrient Management and Its Effect on Postharvest Quality of Guava Cv. Lalit during Rainy Season, *Int. J. Pure App. Biosci.* **5(1):** 720-728 (2017). doi: http://dx.doi.org/10.18782/2320-7051.2619

The research plot laid with four different plant densities included, 2 x 2 m, 3 x 3 m, 6 x 3 m and 6 x 6 m. The treatment comprises of T_1: FYM (10 kg) + recommended NPK (50:25:75 g plant^{-1}), T_2: Vermicompost (10 kg) + recommended NPK, T_3: FYM (5 kg) + vermicompost (5 kg) + recommended NPK, T_4: FYM (10 kg) + vermicompost (10 kg) + 50% recommended NPK, T_5: *Azotobacter* (20 g) + FYM (10 kg) + 50% recommended NPK, T_6: *Azotobacter* (20 g) + vermicompost (10 kg) + 50% recommended NPK, T_7: PSB (20 g) + FYM (10 kg) + 50% recommended NPK, T_8: PSB (20 g) + vermicompost (10 kg) + 50% recommended NPK, T_9: *Azotobacter* (20 g) + PSB (20 g) + FYM (10 kg) + 50% recommended NPK, T_{10}: *Azotobacter* (20 g) + PSB (20 g) + vermicompost (10 kg) + 50% recommended NPK. The bio-fertilizers were procured from Department of Microbiology, University of Agricultural Sciences, Bengaluru. The experiment was statistically carried out by split plot design with ten treatments replicated thrice with two trees per replication. The observations recorded for fruit quality in 'ambe' bahar season in 2013.

Chemical analysis: The guava fruits were analysed for Total Soluble Solids (TSS), titratable acidity, total sugars, reducing sugars, sugar:acid ratio, ascorbic acid physiological loss in weight and firmness during storage

Using "Digital-hand refractometer (0-53°Brix)" the total soluble solids of the guava fruits were recorded and expressed in degree Brix (ºB).

Titratable acidity was determined by titration method[1]. Ready to serve juice was homogenized in a blender and 10 ml of extract guava juice was mixed with distilled water and volume was made up to 50 ml. A known volume of the filtrate (10 ml) was titrated against 0.01N NaOH using phenolphthalein as indicator. Acidity was calculated as percentage of citric acid equivalents using citric acid standard curve. The TSS: acidity ratio was calculated by dividing the value of TSS by that of titratable acidity.

$$Acidity\ (\%) = \frac{Titre\ Value\ X\ Std.Value(mg)X\ Total\ Vol.of\ Extract\ X\ CorrectionFactor\ X\ 100}{Assay\ Volume\ X\ Weight\ of\ Sample(g)X1000}$$

Reducing sugars in the guava were estimated using Lane and Eynon (1923) method with modifications[10]. Ten grams of sample were taken and grinded in the pestle and mortar. Grinded sample was taken in 250 ml volumetric flask. To this 5 ml of lead acetate solution was added, shaked and allowed to stand for 10 min. Excess of lead was precipitated using 6 ml of potassium oxalate solution. Volume was made up to 250 ml by adding water and filtered. The filtrate was used for titration. Fehling's solution A and B, 5 ml of each was taken and little water was added to it and filtrate was added from the burette and the mixture was heated to the boiling. Little more filtrate was added to get red colour development. Then one per cent methylene blue aqueous solution was added and titration was continued while boiling hot, till the appearance of brick red colour as an end point. Reducing sugars were estimated and the values were expressed as percentage on weight basis .

$$Reducing\ Sugars(\%) = \frac{FactorXVolume\ Madeup}{Titre\ Value\ X\ Weight\ of\ Sample}X100$$

Total sugars were estimated by using lead acetate free filtrate was taken by the method given for reducing sugars by Ranganna[10]. Fifty ml of this filtrate was taken and to it 5 ml of concentrated 1N HCl was added and then kept overnight for slow inversion. It was cooled immediately and the acid was neutralized with 40 per cent NaOH in the beginning and 0.1 N NaOH near end point using phenolphthalein as an indicator. Making the media slightly alkaline and then making up the volume to 100 ml. This solution was used for titrating against Fehling's solution. Total sugars were estimated and the values were expressed as percentage on weight basis.

$$Total\ Sugars(\%) = \frac{FactorXVolume\ MadeupXVolume\ made\ after\ inversion}{Titre\ Value\ X\ Weight\ of\ SampleXAliquot\ taken\ for\ inversion} X100$$

Sucrose (%) = (% total sugars - % reducing sugars) × 0.95

Vitamin C content was determined by 2, 6-Dichlorophenol indophenol (DCPIP) method[2]. Ten grams of extract guava juice was mixed thoroughly with 4% oxalic acid solution, squeezed through a muslin cloth and volume was made up to 50 ml. Vitamin C content present in the solution was estimated by titrating a known quantity of the extract against DCPIP. Vitamin C content was calculated as mg of ascorbic acid equivalents per 100 g fresh weight using a standard curve of L-Ascorbic acid.

$$Vitamin\ C\ (mg\ 100g^{-1}) = \frac{Titre\ Value\ X\ Std.Value\ X\ Total\ Volume\ of\ Extract\ X\ 100}{Assay\ Volume\ X\ Weight\ of\ Sample(g)X1000}$$

Fruit firmness was determined using a texture analyzer (model: TA+, Stable micro systems, UK) using compression test. The sample was compressed using a cylindrical probe (2 mm diameter) by programmed settings as follows, Mode: measures force in compression. Speed: Pre test : 5 mm/second, Test speed : 2 mm/second, Post test speed : 10 mm/second, Distance : 10 mm. First peak force (N) in the force deformation curve was taken as firmness of the sample.

Physiological loss in weight of fruits were done by taking fruit weight during storage at regular intervals with the help of an electronic balance. Physiological loss in weight was calculated by using the following formula and data were expressed in percentage.

$$PLW(\%) = \frac{Initial\ Weight - Weight\ after\ known\ Storage\ Period}{Initial\ Weight} X100$$

RESULTS AND DISCUSSION

The total soluble solids of rainy season were presented (Table1) and it has significant impact by spacing and integrated nutrient management. In rainy season fruits total soluble solids were vary at different densities 2 x 2 m, 3 x 3 m, 6 x 3 m and 6 x 6 m (14.77, 14.93, 14.97, 15.14 ^{0}Brix respectively) proclaimed the significant results. The application of *Azotobacter* @ 20 g + PSB @ 20 g + vermicompost @ 10 kg + 50 % recommended NPK (T_{10}) results higher total soluble solids (15.77 ^{0}Brix), followed by the combination of *Azotobacter* @ 20 g + PSB @ 20 g + FYM @ 10 kg + 50 % recommended NPK (T_9) (15.44 ^{0}Brix). The titratable acidity of guava fruits showed significant prominence in spacing and integrated nutrient management. The rainy season fruits (2013) perceived by the results at different densities for titratable acidity showed at different densities 6 x 3 m and 6 x 6 m recorded minimum acidity of 0.44 % respectively. Application of *Azotobacter* @ 20 g + PSB @ 20 g + vermicompost @ 10 kg + 50 % recommended NPK (T_{10}) were significantly influenced by organic and inorganic sources of nutrients, results in least titratable acidity (0.34 %) and the highest titratable acidity (0.62 %) was observed in (T_1).

Total sugar of fruits was directly related with the sweet taste and mainly dependent on plant physiological aspects and photosynthetic activity and the data presented in Table(2) proclaimed statistical significant differences observed in different planting densities as a treatments i.e. (2 x 2 m), (3 x 3 m), (6 x 3 m) and (6 x 6 m) total sugar of fruits in rainy season (2013) shows significant results (15.53, 15.55, 15.55 & 15.57 %) were recorded. Integrated nutrient management showed significant results were recorded in total sugar (T_{10}) - *Azotobacter* @ 20 g + PSB @ 20 g + vermicompost @ 10 kg + 50 % recommended NPK) (16.74 %). The reducing sugar was most important biochemical parameter which is responsible for sweet taste of guava fruit. The reducing sugars divulge that there is a statistical significant differences observed in different planting densities as treatments i.e. (2 x 2 m), (3 x 3 m), (6 x3 m) and (6 x 6 m) reducing sugars of fruits in rainy season (2013) shows (9.10, 9.11, 9.16 & 9.19 %) were recorded. Integrated nutrient management showed significant fruition was recorded in treatment (T_{10} - *Azotobacter* @ 20 g + PSB @ 20 g + vermicompost @ 10 kg + 50 % recommended NPK) (9.91 %).

The sugar: acid ratio determines the taste of fruit where moderate values always offer peculiar blend/flavor of that an individual fruit. The data revealed that the sugar : acid ratio of fruits was significantly influenced by spacing and integrated nutrient management during rainy season. In rainy season (2013) the sugar : acid ratio of fruits were recorded under different spacing 2 x 2 m (37.97), 3 x 3 m (38.11), 6 x 3 m (39.13) and 6 x 6 m (39.17) was found significant among the different densities of plants. The integrated nutrient management studies revealed that the treatment (T_{10}) *Azotobacter* @ 20 g + PSB @ 20 g + vermicompost @ 10 kg + 50 % recommended NPK shows highest sugar : acid ratio of fruits (52.70). The ascorbic acid content of guava **w**as influenced by integrated nutrient management and different spacing. At the different spacing 2 x 2 m, 3 x 3 m, 6 x 3 m & 6 x 6 m (162.75, 167.63, 167.67 & 169.24 mg 100^{-1} g pulp respectively) was observed in rainy season (2013). The application of *Azotobacter* @ 20 g + PSB @ 20 g + vermicompost @ 10 kg + 50 % recommended NPK (T_{10}) results higher amount of ascorbic acid content (184.52 mg 100^{-1} g pulp), the lowest ascorbic acid content (152.80 mg 100^{-1} g pulp) observed in (T_1) FYM @ 10 kg + recommended NPK 50:25:75 g per plant (Table 3).

In the rainy season the physiological weight loss of fruits was minimum (8.51 %) in 2 x 2 m spacing. The integrated nutrient study reveals that the minimum physiological weight loss was (6.85 %) observed in T_{10} (*Azotobacter* @ 20 g + PSB @ 20 g + vermicompost @ 10 kg + 50 % recommended NPK). The fruit records the maximum (4.07 kg/cm^2) firmness in 2 x 2 m spacing. Whereas, the integrated nutrient studies reveals that the minimum seed hardness was (4.55 kg/cm^2) observed in (T_{10}) *Azotobacter* @ 20g + PSB @ 20g + vermicompost @ 10kg + 50% recommended NPK (Table 4).

The improvement of fruit quality in, total soluble solid, total sugars, reducing sugars and ascorbic acid content by the application of optimum dose of NPK may be explained that the phosphorus enters into the composition of phospholipids and nucleic acids were combine with proteins and results in formation of nucleo proteins which are important constituents of nuclei of the cells. Potassium acts as a catalyst in the formation of more complex substances and in the acceleration of enzyme activity. These carbohydrates and coenzymes are beneficial in improving fruit quality. Nitrogen enhanced the uptake of phosphorus and potassium. The chain reactions in these components and beneficial effect of worms which is brought about by mucoses deposit of epidermal cells an coelomic fluids of earthworms, rich in plant growth substances and through rapid mineralization and transformation of plant nutrients in soil and also through the exertion of plant promoting substances, vitamins and amino acid content produced by the microorganism of bio-fertilizers might have possibly been a reason of the improvement in quality of the fruit[4].

The significant increase in TSS (^{0}B) and ascorbic acid content was observed with the application of organic manures, leading to availability of nutrients in rhizosphere for a longer period. So, the application of organic manures along with chemical fertilizers improves the soil fertility status i.e. during the decomposition of organic manures organic acids were released which will be solubilizing some of the insoluble nutrient compounds and make it available to the plant, it also improves soil aeration, water holding capacity of soil improves aggregate formation, suppresses the some of the pests and diseases[7,8].

The similar findings were agreed that the fruit quality in guava was governed by the application of nutrients by integrated approach will significantly increase in TSS may be attributed to increased absorption of nutrients by the plants as a result of improved physico-chemical and biological activities in the soil and the combined role of these inputs upon the better portioning of metabolites from source to the sink[6]. The improvement in fruit quality by an increase in TSS content of fruits might have been due to beneficial role of nutrients on the process of photosynthesis which ultimately led to the accumulation of large amount of carbohydrates and there by increased TSS content of fruits. The acidity of guava fruits significantly decreased with the application of nutrients. This might be due to increase in sugar content with the application of nutrients. Nitrogen treatment fruits improves fruit quality by increasing the TSS, sugar, ascorbic acid and decreasing acidity of fruits[14]. The upsurges in TSS, TSS/acid ratio and decreased acidity of guava fruits due to application of NPK have also been reported in guava[11]. The effect of inorganic fertilizer along with bio-fertilizer on guava cv. Sardar shows the highest total soluble solids (11.80 ^{0}Brix), total sugar (9.58 %), TSS/acid ratio (25.73) and ascorbic acid (128.52 mg 100^{-1} g pulp) were recorded under fruits treated with 100 % N + 100 % P_2O_5 + *Azospirillum* + VAM (T_5) followed by T_4 (100 % N + 50 % P_2O_5 + VAM inoculation) while control recorded minimum control of their bio-chemical qualities. Acid content of fruit was also minimum (0.44) in T_5[5]. The results obtained in guava are also in accordance with present findings[9]. The similar findings were recorded in sapota fruits, where the plants applied with of nitrogen fixing bacteria (*Azotobacter*) with lower dose of inorganic fertilizers might have exhibited regulatory role on the absorption and translocation of various metabolites, in which carbohydrates are most important which affects the quality of fruits. During ripening of fruits the carbohydrates reserves of the root and stem are drawn upon heavily and hydrolyses into sugars hence results in better fruit quality[3]. Fruit quality was significantly influenced by the application of different treatment combinations of organic manures, organic fertilizers and bio-fertilizers. Quality parameter such as TSS (14.0 ^{0}Brix), ascorbic acid (198.30 mg 100^{-1} g pulp), reducing sugar (4.77 %), and total sugars (8.10 %) contents were significantly higher with the application of 50 per cent dose of recommended NPK + 50 kg FYM along with 250 g *Azotobacter* (T_7) except acidity (0.47 %) which was found minimum in 50 per cent dose of recommended NPK + 25 kg FYM + 250 g *Azospirillum* (T_6) and maximum in 50 per cent dose of recommended NPK + 25 kg FYM + 250 g *Pseudomonas flourescence* (T_9)[12].

Table 1: Effect of high density guava and integrated nutrient management of guava fruits on quality parameters in rainy season

Treatments	Total soluble solids (%)					Titratable acidity (%)				
	S_1	S_2	S_3	S_4	Mean	S_1	S_2	S_3	S_4	Mean
T_1	13.88	14.05	14.05	14.29	**14.07**	0.64	0.61	0.63	0.57	**0.62**
T_2	14.09	13.75	14.29	14.49	**14.15**	0.56	0.56	0.53	0.54	**0.55**
T_3	14.19	14.76	14.49	14.84	**14.57**	0.53	0.53	0.53	0.51	**0.52**
T_4	14.39	14.69	14.69	14.9	**14.67**	0.48	0.48	0.49	0.46	**0.48**
T_5	14.69	15.23	14.9	15.1	**14.98**	0.43	0.43	0.42	0.43	**0.43**
T_6	14.9	15.27	15.1	15.3	**15.14**	0.4	0.39	0.39	0.41	**0.4**
T_7	15.1	16.01	15.4	15.4	**15.48**	0.39	0.39	0.37	0.37	**0.38**
T_8	15.3	14.79	15.5	15.5	**15.28**	0.37	0.38	0.35	0.37	**0.37**
T_9	15.5	14.93	15.61	15.71	**15.44**	0.35	0.36	0.35	0.37	**0.36**
T_{10}	15.71	15.77	15.71	15.91	**15.77**	0.34	0.35	0.32	0.32	**0.34**
Mean	**14.77**	**14.93**	**14.97**	**15.14**		**0.45**	**0.45**	**0.44**	**0.44**	
	S.E.m ±		**CD @ 5 %**			**S.E.m ±**		**CD @ 5 %**		
S	0.001		0.005			0.0001		0.0005		
T	0.003		0.007			0.0011		0.003		
S x T	0.005		0.015			0.0021		0.0058		

T_1: FYM (10 kg) + recommended NPK (50:25:75 g plant^{-1})	T_6: *Azotobacter* (20 g) + vermicompost (10 kg) + 50% recommended NPK
T_2: Vermicompost (10 kg) + recommended NPK	T_7: PSB (20 g) + FYM (10 kg) + 50% recommended NPK
T_3: FYM (5 kg) + vermicompost (5 kg) + recommended NPK	T_8: PSB (20 g) + vermicompost (10 kg) + 50% recommended NPK
T_4: FYM (10 kg) + vermicompost (10 kg) + 50% recommended NPK	T_9: *Azotobacter* (20 g) + PSB (20 g) + FYM (10 kg) + 50% recommended NPK
T_5: *Azotobacter* (20 g) + FYM (10 kg) + 50% recommended NPK	T_{10}: *Azotobacter* (20 g) + PSB (20 g) + vermicompost (10 kg) 50% recommended NPK

S_1- 2 x 2 m	**S_2- 3 x 3 m**	**S_3- 6 x 3 m**	**S_4- 6 x 6 m**

Table 2: Effect of high density guava and integrated nutrient management of guava fruits on quality parameters in rainy season

Treatments	Total sugars (%)					Reducing sugars (%)				
	S_1	S_2	S_3	S_4	Mean	S_1	S_2	S_3	S_4	Mean
T_1	14.86	14.94	14.87	14.85	**14.88**	8.51	8.54	8.51	8.76	**8.58**
T_2	15.12	15.02	15.03	15.04	**15.05**	8.78	8.7	8.84	8.87	**8.8**
T_3	15.17	15.19	15.23	15.24	**15.21**	8.79	8.78	8.9	8.89	**8.84**
T_4	15.19	15.26	15.31	15.3	**15.27**	8.9	8.87	8.92	8.94	**8.91**
T_5	15.34	15.33	15.41	15.48	**15.39**	8.91	8.95	9.03	8.96	**8.96**
T_6	15.42	15.49	15.51	15.51	**15.48**	9.01	8.97	9.05	9.1	**9.03**
T_7	15.5	15.52	15.53	15.53	**15.52**	9.02	9.08	9.07	9.15	**9.08**
T_8	15.95	15.95	15.98	15.98	**15.96**	9.6	9.61	9.6	9.63	**9.61**
T_9	15.96	15.98	15.98	16.04	**15.99**	9.64	9.68	9.72	9.68	**9.68**
T_{10}	16.8	16.78	16.65	16.74	**16.74**	9.86	9.9	9.93	9.93	**9.91**
Mean	**15.53**	**15.55**	**15.55**	**15.57**		**9.1**	**9.11**	**9.16**	**9.19**	
	S.E.m±		**CD @ 5 %**			**S.E.m±**		**CD @ 5 %**		
S	0.0004		0.0013			0.001		0.003		
T	0.0063		0.0178			0.005		0.014		
S x T	0.012		0.0338			0.01		0.027		

T_1: FYM (10 kg) + recommended NPK (50:25:75 g plant^{-1})	T_6: *Azotobacter* (20 g) + vermicompost (10 kg) + 50% recommended NPK
T_2: Vermicompost (10 kg) + recommended NPK	T_7: PSB (20 g) + FYM (10 kg) + 50% recommended NPK
T_3: FYM (5 kg) + vermicompost (5 kg) + recommended NPK	T_8: PSB (20 g) + vermicompost (10 kg) + 50% recommended NPK
T_4: FYM (10 kg) + vermicompost (10 kg) + 50% recommended NPK	T_9: *Azotobacter* (20 g) + PSB (20 g) + FYM (10 kg) + 50% recommended NPK
T_5: *Azotobacter* (20 g) + FYM (10 kg) + 50% recommended NPK	T_{10}: *Azotobacter* (20 g) + PSB (20 g) + vermicompost (10 kg) 50% recommended NPK

S_1- 2 x 2 m	**S_2- 3 x 3 m**	**S_3- 6 x 3 m**	**S_4- 6 x 6 m**

Table 3: Effect of high density guava and integrated nutrient management of guava fruits on quality parameters in rainy season

Treatments	**Sugar:acid ratio**					**Ascorbic acid (mg 100^{-1} pulp)**				**Mean**
	S_1	**S_2**	**S_3**	**S_4**	**Mean**	**2x2 m**	**3x3 m**	**6x3 m**	**6x6 m**	
T_1	25.63	24.25	27.19	24.64	**25.43**	149.06	153.53	153.56	155.07	**152.8**
T_2	29.17	29.2	30.4	29.98	**29.69**	151.64	156.19	156.22	157	**155.26**
T_3	30.04	30.05	30.68	30.37	**30.28**	153.74	158.36	158.39	159.94	**157.61**
T_4	33.49	33.57	34.63	32.41	**33.52**	160.4	165.21	165.24	166.86	**164.43**
T_5	37.67	37.85	37.71	38.01	**37.81**	161.15	165.98	166.02	167.64	**165.2**
T_6	41.46	40.92	39.74	42.3	**41.11**	163.18	168.07	168.1	169.75	**167.27**
T_7	43.41	43.48	44.07	44.99	**43.99**	166.09	171.08	171.11	172.79	**170.27**
T_8	44.36	45.37	45.3	45.92	**45.24**	168.8	173.87	173.9	175.61	**173.05**
T_9	44.71	45.58	46.2	48.35	**46.21**	173.46	178.66	178.7	180.45	**177.82**
T_{10}	49.73	50.87	55.43	54.77	**52.70**	180	185.4	185.44	187.26	**184.52**
Mean	**37.97**	**38.11**	**39.13**	**39.17**		**162.75**	**167.63**	**167.67**	**169.24**	
	S.E.m±		**CD @ 5 %**			**S.E.m±**		**CD @ 5 %**		
S	0.0001		0.0005			0.03		0.12		
T	0.0011		0.003			0.06		0.17		
S x T	0.0021		0.0058			0.12		0.33		

T_1: FYM (10 kg) + recommended NPK (50:25:75 g plant^{-1})	T_6: *Azotobacter* (20 g) + vermicompost (10 kg) + 50% recommended NPK
T_2: Vermicompost (10 kg) + recommended NPK	T_7: PSB (20 g) + FYM (10 kg) + 50% recommended NPK
T_3: FYM (5 kg) + vermicompost (5 kg) + recommended NPK	T_8: PSB (20 g) + vermicompost (10 kg) + 50% recommended NPK
T_4: FYM (10 kg) + vermicompost (10 kg) + 50% recommended NPK	T_9: *Azotobacter* (20 g) + PSB (20 g) + FYM (10 kg) + 50% recommended NPK
T_5: *Azotobacter* (20 g) + FYM (10 kg) + 50% recommended NPK	T_{10}: *Azotobacter* (20 g) + PSB (20 g) + vermicompost (10 kg) + 50% recommended NPK

S_1- 2 x 2 m	**S_2- 3 x 3 m**	**S_3- 6 x 3 m**	**S_4- 6 x 6 m**

Table 4: Effect of high density guava and integrated nutrient management of guava fruits shelf life studies in rainy season

Treatments	Physiological loss of weight (%)				Mean	Firmness of fruit (kg/cm^2)				Mean
	S_1	S_2	S_3	S_4		S_1	S_2	S_3	S_4	
T_1	9.54	10.68	9.62	10.8	**10.16**	3.66	3.81	3.62	3.24	**3.58**
T_2	9.28	10.64	9.44	10.7	**10.02**	3.84	3.86	3.65	3.21	**3.64**
T_3	8.99	10.63	9.44	10.58	**9.91**	3.88	3.88	3.68	3.29	**3.68**
T_4	8.7	9.18	9.25	10.01	**9.29**	3.93	3.94	3.79	3.3	**3.74**
T_5	8.52	9.04	8.97	9.26	**8.95**	3.98	3.97	3.87	3.33	**3.79**
T_6	8.33	8.59	8.92	9.05	**8.72**	4.02	4.03	3.94	3.37	**3.84**
T_7	8.04	7.85	8.75	8.94	**8.4**	4.11	4.07	3.99	3.4	**3.89**
T_8	7.93	7.56	8.38	8.8	**8.17**	4.16	4.12	4.04	3.45	**3.94**
T_9	7.87	6.97	8.22	7.64	**7.67**	4.48	4.21	4.16	3.8	**4.16**
T_{10}	7.84	5.73	6.5	7.32	**6.85**	4.66	4.73	4.25	4.55	**4.55**
Mean	**8.51**	**8.69**	**8.75**	**9.31**		**4.07**	**4.06**	**3.90**	**3.50**	
	S.E.m ±		**CD @ 5 %**			**S.E.m ±**		**CD @ 5 %**		
S	0.07		0.24			0.1		0.35		
T	0.12		0.34			0.01		0.02		
S x T	0.24		0.67			0.1		0.29		

T_1: FYM (10 kg) + recommended NPK (50:25:75 g $plant^{-1}$)	T_6: *Azotobacter* (20 g) + vermicompost (10 kg) + 50% recommended NPK
T_2: Vermicompost (10 kg) + recommended NPK	T_7: PSB (20 g) + FYM (10 kg) + 50% recommended NPK
T_3: FYM (5 kg) + vermicompost (5 kg) + recommended NPK	T_8: PSB (20 g) + vermicompost (10 kg) + 50% recommended NPK
T_4: FYM (10 kg) + vermicompost (10 kg) + 50% recommended NPK	T_9: *Azotobacter* (20 g) + PSB (20 g) + FYM (10 kg) + 50% recommended NPK
T_5: *Azotobacter* (20 g) + FYM (10 kg) + 50% recommended NPK	T_{10}: *Azotobacter* (20 g) + PSB (20 g) + vermicompost (10 kg) + 50% recommended NPK

S_1- 2 x 2 m	**S_2- 3 x 3 m**	**S_3- 6 x 3 m**	**S_4- 6 x 6 m**

CONCLUSION

The effect of bio-fertilizer along with inorganic fertilizer on quality of guava cv. Lalit was studied. Experimental findings revealed that different treatments of bio-fertilizers and inorganic fertilizer significantly increased the total soluble solids, total sugars reducing sugar, sugar:acid ratio and ascorbic acid content PLW and firmness was minimum in fruits, whereas, the minimum acidic content was declined in fruits were observed in the combination of *Azotobacter* @ 20 g + PSB @ 20 g + vermicompost @ 10 kg + 50 % recommended NPK while control recorded minimum. Inoculation of *Azotobacter* and PSB along with inorganic fertilizers also proved effective.

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