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Research Paper

EFFECT OF ORGANIC-CUM-INORGANIC SOURCES OF NUTRIENTS ON PHYSICO-CHEMICAL QUALITIES OF GUAVA

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ABSTRACT
A field experiment find out result during 2015 and 2016 to study the organic-cum-inorganic sources of nutrients on physico-chemical qualities of guava trees. Application of 100% NPK with Zn, B, Mn micronutrients and organic mulch (T_4) brought about significantly highest fruit length (6.76 cm), pulp thickness (1.44 cm), seed cavity diameter (4.43 cm), number of seeds (3.47/fruit), 100-seed weight (1.36 g) and pulp-seed ratio (74.47). This was followed by T_{10} and T_{15}. In case of chemical qualities, the same T_4 treatment recorded highest TSS (12.21 ^{o}Brix), lowest acidity (0.53%) and ascorbic acid (157.8 mg/100 g pulp) and higher reducing and non-reducing sugars (4.85 and 3.15%, respectively) with increased storage life of fruits. The maximum N, P and K contents in leaves were found in T_7 to T_{11} treatments.

INTRODUCTION

Guava (*Psidium guajava* L.) is one of the most promising fruit crops of India and is considered to be one of the exquisite nutritionally valuable and remunerative crops. It is known as "poor man's apple" which is a rich source of ascorbic acid and protein. The ascorbic acid content in guava varies from 75 to 260 mg/100 g depending on the cultivar, season, location and stage of maturity. The fruits harvested during winter season are superior in quality in comparison to rainy season fruits. It contains considerable amount of Ca, P and Fe. However, 80 per cent of the iron remains in seed and is not utilizable.

Excessive use of ago-chemicals led to increase in productivity at the expense of quality, while degrading the precious natural resources. Integrated plant nutrient management (IPNM) has been found to improve the physico-chemical qualities of guava fruits (Shukla *et al.*, 2009 and Dwivedi, 2013). Vermicompost being a rich source of macro- and micronutrients and vitamins, plant growth regulators, humic acid and beneficial microflora appeared to be the best organic source in maintaining soil fertility on sustainable basis towards an eco-friendly environments (Edwards and Arancon, 2004). Vermicompost application to different field crops has been known to reduce the requirement of chemical fertilizers without any reduction in crop yield (Giraddi, 2000). The changes in physico-chemical properties due to integrated nutrient plant management on guava has not been studied in Rewa region, hence the present research was taken up.

MATERIALS AND METHODS

The present experiment find out result during 2015 and 2016. The soil of the guava orchard was mixed red black with clay-loam in texture having soil pH 7.23 to 7.29, available-N 289 to 341 kg/ha, available P_2O_5 14.33 to 26.88 and available K_2O 266 to 288 kg/ha. The experiment consisted of 15 treatments (Table 1) keeping three plants of 6 years old in each treatment. The treatments were arranged in randomized block design and replicated thrice. The guava variety Allahabad Safeda was taken as the test variety. The entire dose of 25 kg FYM and 5 kg vermicompost/tree was applied as basal dose on the onset of monsoon. The required quantity of NPK fertilizers (25, 50 and 100% per tree) were applied in two splits in July and August. The biofertilizers were applied one week after each application of NPK fertilizers. Micronutrients (Zn, B and Mn) were foliar sprayed twice in August and October. The periodical observations were recorded on growth and yield parameters including estimation of economics per hectare under each treatment. Physical and chemical parameters of fruits were determined using to average size fruits collected randomly from each replication. The TSS (^{o}Brix) was determined with the help of a hand refractometer. Acidity was estimated by simple acid-alkali titration method as described in A.O.A.C. (1997). Sugars in fruits were estimated by the method suggested by Nelson (1944). Assay method of ascorbic acid was followed as given by Ranganna (1977). The estimation of pectin was according to the method of Shelukhina and Fedichkina (1994).

RESULTS AND DISCUSSION

Physical quality of fruits

The results in Table 1 reveal that the application of 100% NPK with Zn, B, Mn micronutrients and organic mulch (T_4) brought about significantly highest fruit length (6.76 cm), pulp thickness (1.44 cm), seeds per fruit (347), pulp-seed ratio (74.47), 100-seed weight (1.36 g) and seed cavity diameter (4.43 cm). This was followed by T_{10} and T_{15} treatments. All these physical fruit qualities were significantly superior to control where only 100% NPK was applied.

The increase in physical qualities of fruits by the application of organic-cum-inorganic nutrients as in T_4, T_{10} and T_{15} might be due to increased availability of multi-plant nutrients and growth hormones in required amount during the entire cropping period which caused vigorous vegetative development of the plants and ultimately production of more photosynthates and the nutrient combinations that accelerated the metabolic activities of the plant. Nitrogen positively encouraged the vegetative growth of the plant, phosphorus played an important role in photosynthesis and accumulation of food material. Potassium played an unique role in the carbohydrate and protein synthesis and acted as a catalyst in the formation of more complex substances and in the acceleration of enzyme activity. Improvement in the physical qualities of fruits on account of vermicompost application as in T_{15} might have attributed to the translocation of nutrients from the soil to the plants and enhanced supply of macro and micro-nutrients during the entire growing season of guava trees. Biofertilizers as in T_{10} encouraged better growth and accumulated optimum dry matter with the induction of growth hormones, which stimulated cell division, cell elongation; activated the photosynthesis process, as well as energy transformation which in turn caused increase in the physical qualities of guava fruits. Dey *et al.* (2005), Kumar *et al.* (2008), Athani *et al.* (2007 a and b), Dwivedi *et al.* (2010), Agnihotri *et al.* (2013) and Dwivedi (2013) also reported similar results in guava.

Chemical quality of fruits

The same treatment (T_4) recorded highest TSS (12.21^{o}Brix), lowest acidity (0.53%) and ascorbic acid (157.8 mg/100 g pulp) and higher reducing and non-reducing sugars (4.85 and 3.15 %, respectively) with increased storage life of fruits (Table 1). Their application significantly influenced the chemical constituents of the guava fruits on account of the fact that applied IPNM treatments contained variable nutrient composition from different sources (FYM, organic mulch, vermicompost and biofertilizers). Their combined functions and nutrient releasing pattern were quite different. As a result, the different IPNM treatments increased some of the fruit qualities and decreased the others. For example the TSS was found higher in case of T_{14}, T_4 and T_3 IPNM treatments, whereas ascorbic acid was obtained higher from T_1, T_2 and T_{13} treatments, whereas non-reducing sugar was observed higher from T_1, T_2 and T_3. The acidity of fruits was found lower in treatments T_2, T_4, T_{12} and T_{14}, and higher in many other treatments. Most of these nutrients were found significantly superior to control having only 100% NPK. The improvement in ascorbic acid, total soluble solids, reducing and non-reducing sugars by the application of optimum dose of NPK may be explained by the fact that phosphorus enters into the composition of phospholipids and nucleic acids, the latter combines with proteins and result in the formation of nucleo-proteins which are important constituents of the 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 co-enzymes are beneficial in the improvement of 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 and 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 microorganism of applied biofertilizers might have possibly been the reasons of the improvement in quality of the guava fruits. Similar findings have also been reported by Athani *et al.* (2007), Kumar *et al.* (2009), Shukla *et al.* (2009), Sharma *et al.* (2009) in guava; Katiyar *et al* (2009), Yadav *et al.* (2011) and Binepal *et al.* (2013) in mango.

The maximum increase in TSS content in T_4 treatment could have been due to further synthesis and accumulation of photosynthates in the fruits on the tree. The decrease in acidity was reported to be due to normal respiration and conversion of metabolites into sugar. The total sugar content of fruits increased due to increased supply of multi-nutrients which might be due to more conversion of starch into sugar i.e. quick metabolic transformation of starch into soluble sugars (Agnihotri *et al.*, 2013). The results corroborate with the findings of Athani *et al.* (2007 a, b), Mitra *et al.* (2007), Ram and Pathak (2007), Naik and Babu (2007), Kumar *et al.* (2009), Patel *et al.* (2009), Katiyar *et al.* (2009), Shukla *et al.* (2009), Binepal *et al.* (2013) and Dwivedi (2013) who reported the fruit quality being superior with organic manures applied alone compared to inorganic fertilizers.

Leaf analysis

The total nitrogen, phosphorus and potassium contents in guava leaves were found to be significant due to IPNM treatments. The maximum N, P and K contents in leaves were recorded in T_7 to T_{11} treatments (Table 1). Such increases in N, P and K contents in leaves may be due to synergistic effect of these applied nutrients which might have contributed to more absorption and translocation of N, P and K nutrients. This has resulted in higher uptake of these nutrients and maintained better harmony between photosynthesis and translocation which ultimately resulted in higher yield. The results of the present findings are in close agreement with those of Athani *et al.* (2007), Khan *et al.* (2007), Naik and Babu (2007), Ram *et al.* (2007), Shukla *et al.* (2009), Dutta *et al.* (2009), Singh *et al.* (2009), Singh *et al.*(2009) and Parihar and Bhadoria (2010).

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Table 1 Physical, chemical and leaf analysis parameters of guava fruits cv. Allahabad Safeda as influenced by integrated nutrient management (Mean of two years)

S. No.	Treatments	Fruits length (cm)	Width of fruits (cm)	Pulp thickness	Seed cavity diameter (cm)	Seeds/ fruit	100-seed weight (g)	Pulp-seed ratio	Storage life of fruits	TSS (^{0}Brix)	Acidity of fruits (%)	Ascorbic acid (mg/100 mg pulp)	Reducing sugar percentage	N-content (%)	P-content (%)	K-content (%)
T_1	500 g : 200 g : 500 g NPK/tree (as control)	6.29	6.40	1.29	3.98	316	1.23	72.60	5.20	11.86	0.58	187.80	4.59	0.92	0.06	0.87
T_2	T_1 + Zn (0.5%) + B (0.2%) + Mn (1%) as foliar spray twice (August and October)	6.51	6.52	1.22	3.77	328	1.29	72.83	5.55	12.17	0.53	188.85	4.79	0.94	0.06	0.83
T_3	T_1 + organic mulching @ 10 cm thick	6.58	6.50	1.29	3.98	335	1.32	73.76	5.50	12.21	0.55	168.90	4.75	0.93	0.06	0.88
T_4	T_2 + organic mulching @ 10 cm thick	6.76	7.15	1.44	4.43	347	1.36	74.47	7.85	12.21	0.53	157.80	4.85	0.94	0.06	0.87
T_5	25% recommended dose of fertilizer + 25 kg FYM + 250 g *Aspergillus niger*	6.52	6.79	1.35	4.17	325	1.30	72.54	5.20	11.57	0.58	156.85	4.61	0.93	0.06	0.84
T_6	25% recommended dose of fertilizer + 25 kg FYM + 125 g *Aspergillus niger*	6.43	6.71	1.33	4.12	320	1.28	72.73	5.75	12.02	0.55	169.20	4.62	0.94	0.06	0.86
T_7	25% recommended dose of fertilizer + 25 kg FYM + 125 g *Trichoderma*	6.50	6.77	1.35	4.18	318	1.25	73.98	5.90	11.66	0.59	186.95	4.67	0.95	0.05	0.90
T_8	25% recommended dose of fertilizer + 25 kg FYM + 125 g *Trichoderma* + 125 g *Pseudomonas*	6.56	6.89	1.36	4.21	318	1.26	74.08	6.00	12.10	0.59	169.80	4.65	0.97	0.06	0.86
T_9	50% recommended dose of fertilizer + 25 kg FYM + 250 g *Pseudomonas florescence*	6.61	7.02	1.37	4.23	334	1.25	73.68	6.20	11.61	0.57	169.05	4.76	0.98	0.06	0.84
T_{10}	50% recommended dose of fertilizer + 25 kg FYM + 250 g *Trichoderma* + 250 g *Pseudomonas*	6.74	7.11	1.43	4.34	342	1.33	74.47	7.75	11.53	0.58	172.95	4.64	0.97	0.07	0.92
T_{11}	50% recommended dose of fertilizer + 25 kg FYM + 250 g *Aspergillus niger*	6.68	6.80	1.38	4.28	336	1.30	73.84	6.15	11.92	0.57	170.25	4.75	0.98	0.06	0.90
T_{12}	50% recommended dose of fertilizer + 25 kg FYM + 250 g *Trichoderma*	6.56	6.81	1.35	4.17	335	1.29	73.87	6.80	12.00	0.53	178.80	4.77	0.95	0.06	0.86
T_{13}	50% recommended dose of fertilizer + 25 kg FYM + 250 g *Azospirillum*	6.51	6.98	1.35	4.17	333	1.30	74.01	6.60	11.83	0.59	189.00	4.84	0.93	0.05	0.94
T_{14}	50% recommended dose of fertilizer + 25 kg FYM + 250 g *Azotobacter*	6.70	7.41	1.39	4.24	340	1.33	74.00	6.00	12.19	0.52	179.30	4.89	0.95	0.05	0.86
T_{15}	50% recommended dose of fertilizer + 25 kg FYM + 5 kg vermicompost	6.74	7.06	1.42	4.27	342	1.32	74.47	7.80	11.91	0.58	184.65	4.64	0.96	0.06	0.87
	S.Em±	**0.005**	**0.011**	**0.002**	**0.0063**	**0.368**	**0.0014**	**0.026**	**0.034**	**0.0091**	**0.00094**	**0.401**	**0.0037**	**0.00078**	**0.00016**	**0.0012**
	C.D. at 5%	**0.023**	**0.052**	**0.011**	**0.030**	**1.725**	**0.0065**	**0.120**	**0.159**	**0.043**	**0.00044**	**1.880**	**0.0170**	**0.0036**	**0.00084**	**0.0055**