EFFECT OF ORGANIC-CUM-INORGANIC SOURCES OF NUTRIENTS ON GROWTH, YIELD AND ECONOMICAL GAIN FROM GUAVA

NEELAM TIWARI¹, S. S. SINGH², RAJESH SINGH³ & NEERAJ K. CHARMKAR⁴

^{1,2}Department of Fruit Science (Horticulture), Faculty of Agriculture M.G. Chitrakoot Gramodaya Vishwa Vidyalyaya,
Chitrakoot, Satna, Madhya Pradesh, India

³College of Agriculture, Rewa, Madhya Pradesh, India

⁴Centre for Biotechnology Studies, A.P.S. University, Rewa, Madhya Pradesh, India

ABSTRACT

A field experiment finds out result during 2015 and 2016 to study the organic-cum-inorganic sources of nutrient management (INM) on growth, yield and economical gain from 6 years old guava trees. Application of 100% NPK with Zn, B, Mn micronutrients and organic mulch (T₄) resulted in maximum plant height (4.07 m), the circumference of root stock (38.51 m) and of scion (36.57 m), plant spread E-W and N-S (3.79 to 3.80 m), leaf length (17.98 cm) and width (8.94 cm), tree volume (184 m³), fruits (297/tree), fruit weight (220.8 g), fruit yield (65.58 kg/tree and 181.64 q/ha) as well as net income (Rs.167270/ha) and B:C ratio up to 3.96.

KEYWORDS: Organic-Cum, Plant Spread E-W & B:C ratio Upto 3.96

Received: Nov 13, 2017; **Accepted:** Dec 03, 2017; **Published:** Jan 24, 2018; **Paper Id.:** IJASRFEB201812

INTRODUCTION

Guava (*Psidium guajava* L.) belongs to the family Myrtaceae. Guava is known as the “apple of the tropics” or “poor man’s fruit”. Guava is one of the most promising fruit crops of India and is considered to be one of the exquisite nutritious valuable and remunerative crops (Singh *et al.*, 2000). At present in India, it occupies nearly 0.204 million hectare area with a production of 2.46 million tonnes and productivity 11.12 million tonnes/hectare and in Madhya Pradesh 2763 hectare area with a production of 55260 tonnes and produces 20.0 tonnes/hectare (NBH, 2011). In Rewa region, guava is grown on an area of 277 ha with a production of 2019 tonnes and productivity of 7.29 t/ha, which is very low as compared to the national average. The stagnation and decline in the productivity of guava in Rewa region are due to decline in the soil organic matter, over the mining of nutrient reserve, loss of nutrients and non-availability of cost effective fertilizers.

Integrated nutrient management has been considered as the essential component of sustainable crop production system. Keeping in view the increasing gap between removal and supply of essential plant nutrients, search for alternative plant nutrient sources has gained momentum (Amer *et al.*, 2014). The application of fertilizers even in balanced form may not sustain the soil fertility and productivity in guava orchards. However, research evidences are encouraging about the integrated use of inorganic fertilizers, bio fertilizers and organic manures including crop residues, vermi compost which may improve the soil productivity and crop yield (Singh *et al.*, 2011). Vermicompost contains plant growth regulating materials, such as humic acids and plant growth regulators like auxins, gibberellins and cytokinins (Borang *et al.*, 2016), which are responsible for increased plant

growth and yield of strawberry fruit crops. Bio fertilizers are one of the best modern tools for agriculture and are used to improve the fertility and quality of the soil. It offers an economically attractive and ecologically sound route for augmenting nutrient supply that enables to plant growth and development of fruit crops (Joseph *et al.*, 2015). Such information for guava was lacking in Rewa region, hence the present work was taken up.

MATERIALS AND METHODS

The present experiment finds 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 P₂O₅ 14.33 to 26.88 and available K₂O 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 a randomized block design and replicated thrice. The guava variety Allahabad Safeda was taken as the test variety. The entire dose of the 25 kg FYM and 5 kg vermi compost/tree was applied as basal dose at the onset of monsoon. The required quantity of NPK fertilizers (25, 50 and 100% per tree) was applied in two splits in July and August. The bio fertilizers 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.

RESULTS AND DISCUSSIONS

Vegetative Growth Parameters

The vegetative growth characters of 6 years old Allahabad Safeda trees have been evaluated after applying IPNM treatments by recording the observations on plant height, canopy height, circumference of root stock, plant spread (E-W and N-S), leaf length and width, fresh, and dry weight of leaf and volume per tree. These vegetative growth parameters i.e. plant height, canopy height, plant girth, and leaf were influenced up to significant extent due to treatments. The treatments T₄, T₁₀ and T₁₅, resulted in an equally maximum increase in the plant and canopy height, girth, plant spread in both the directions (N-S and E-W) as well as leaves observations and volume of tree over control and other treatments (Table 1). The second, third and fourth best treatments were T₁₅, T₉, and T₁₀, respectively. The most beneficial effect of these IPNM treatments might be due to plant growth promoting applied inputs like organic manures, organic mulching, and bio fertilizers as well as improvement in the physical, chemical, and biological properties of the soil in the long-term on repeated applications. It might have also stimulated micro-biological activities in the soil.

In fact, the leaf is the factory for the conversion of solar energy into the chemical energy by the process of photosynthesis. The adequate supply of multi nutrients resulted in their proper utilization in the process of photosynthesis due to increase in the leaf number and leaf size i.e. photosynthetic area. Thus, the increased production of photo synthates (food material) brought about an increase in the vegetative growth parameters. The leaf is the principal site of plant metabolism and the changes in nutrient supply are reflected in the composition of the leaf.

The present findings corroborate with those of Athani *et al.* (2007), Naik and Babu (2007), Ram *et al.* (2007) who found that vermicompost with FYM and inorganic fertilizers resulted increase in the vegetative growth. Similar findings have been reported by Monga *et al.* (2002), Ram *et al.* (2005), Khan *et al.* (2007), Ram and Pathak (2007), Kumar *et al.* (2007), Dutta *et al.* (2009), Patel *et al.* (2009), Shukla *et al.* (2009), Dwivedi (2013), Agnihotri *et al.* (2013), Amer *et al.* (2014), Beer and Singh (2015) and Singh *et al.* (2015).

Productivity Parameters

The number of fruits/tree and fruit weight as well as the yield of fruits per tree and per hectare were increased equally maximum in T₄ (100% NPK + micronutrients + organic mulching), followed by T₁₀ (50% NPK + 25 kg FYM + 250 g *Trichoderma* + 250 g *Pseudomonas*) and T₁₅ (50% NPK + 25 kg FYM + 5 kg vermicompost). The maximum increase in yield parameters might be attributed to the better nutritional environment due to the application of organic matter which improved the soil health by improving physico-chemical and biological activities of the soil and also stimulated soil microbiological activity. Athani *et al.* (2007 a, b) reported that application of 75% RDF + 10 kg vermicompost was found a significant increase in yield and fruit quality of guava cv. Sardar. Ram *et al.* (2007) reported that the application of different fertilizers, organic manures and biofertilizers improved the vegetative growth, number of fruits and yield of guava cv. Sardar. Similar findings have been found by Ram and Pathak (2007), Naik and Babu (2007), Ram *et al.* (2007), Kumar *et al.* (2009), Dutta *et al.* (2009), Patel *et al.* (2009), Shukla *et al.* (2009), Agnihorti *et al.* (2013), Dwivedi (2013), Bohane and Tiwari (2014), Joseph *et al.* (2015), Pongener and Alila (2015) and Singh *et al.* (2015)..

Mulching is very beneficial. It reduces the loss of moisture from the soil, enhances the rate of penetration of run of water and controls the growth of weeds, thus eliminating the competition between the weeds and the guava trees. It also encourages the development of a better root system of young guava plants. Verma *et al.* (2005) found the best response of mulching materials and method of P and K fertilizer application in apple cv. Red Delicious.

Application of integrated inputs of fertilizers, organic manures and biofertilizers as in T₇ to T₁₅ also increased the yield in guava cv. Allahabad Safeda. It may be due to increased rhizosphere microbial activity and larger quantity of nutrients in the soil. Ram *et al.* (2007) found that the application of different fertilizers, organic manures and biofertilizers improved the vegetative growth, number of fruits and yield of guava cv. Sardar. The similar findings were found by Monga *et al.* (2002), Mitra *et al.* (2007), Agnihotri *et al.* (2013) and Dwivedi (2013), Amer *et al.* (2014), Bohane and Tiwari (2014), Singh *et al.* (2015), Joseph *et al.* (2015), Singh *et al.* (2015), Pongener and Alila (2015) and Beer and Singh (2015).

Fruit Yield and Economical Gain

Yield attributes and therefore the economics of different treatments were significantly influenced by the application of organic manures, inorganic fertilizers, bio fertilizers and their combinations. The treatment T₄ gave the highest yield (181.64 q/ha), followed by T₁₀ (174.40 q), T₁₅ (172.93 q) and T₁₄ (165.42 q/ha), whereas the low yield was obtained under T₁ (98.85 q/ha). Eventually the similar trend was also observed regarding the economics of different treatments. The maximum net profit per hectare was obtained from T₄ (Rs. 387520/ha), followed by T₁₀ (Rs.362320/ha) and then T₁₅ and T₁₄ (Rs.360270 and Rs.341530/ha, respectively), while it was minimized under T₁ control (Rs.186270/ha). Benefit: cost ratios were also in the higher range of these treatments. The higher income was due to higher fruit yield in these treatments. Shukla *et al.* (2009) observed that the combined application of 50 per cent dose of recommended NPK + 50 kg FYM + 250 g *Azotobactor* gave significantly higher yield 28.95 kg per plant with higher B:C ratio 2.53. Similar findings have been reported by Dutta and Banik (2002), Dey *et al.* (2005), Athani *et al.* (2007), Dwivedi *et al.* (2010), Binpal *et al.* (2013), Dwivedi (2013), Bohane and Tiwari (2014) and Beer and Singh (2015).

CONCLUSION

In this over all study economical gain from guava as a sources of nutrients we have found ,the treatment of T₄ gave the highest yield (181.64 q/ha), followed by T₁₀ (174.40 q), T₁₅ (172.93 q) and T₁₄ (165.42 q/ha), whereas the 82

Neelam Tiwari, S. S. Singh, Rajesh Singh & Neeraj K. Charmkar Impact Factor (JCC): 5. 9857 NAAS Rating: 4.13 lowest yield was obtained under T1 (98.85 q/ha). The maximum net profit per hectare was obtained from T4 (Rs. 387520/ha), followed by T10 (Rs.362320/ha) and then T15 and T14 (Rs.360270 and Rs.341530/ha, respectively). Application of integrated inputs of fertilizers, organic manures and bio-fertilizers as in T7 to T15 also increased the yield in guava. There are also found similarity between previous literatures. So we can say that we are on the right path to gain economic benefits from natural products by artificial methods.

REFERENCES

1. Agnihotri, A.; Tiwari, R. and Singh, O.P. (2013). Effect of crop regulators on growth, yield and quality of guava. *Annals of Plant and Soil Research*, **15**(1): 54-57.
2. Amer, Watisungla; Sharma, Y.K. and Sharma, S.K. (2014). Response of maize to integrated nutrient management in acidic soils of Nagaland. *Annals of Plant and Soil Research*, **16**(4): 349-352.
3. Athani, S.I.; Praburaj, H.S.; Ustad, A.I.; Swamy, G.S.K.; Patil, P.B. and Kotikal, Y.K. (2007 a). Effect of organic and inorganic fertilizers on growth, leaf, major nutrient and chlorophyll content and yield of guava cv. Sardar. *Acta Horticulturae (ISHS)* **735**: 381-385.
4. Athani, S.I.; Ustad, A.I.; Praburaj, H.S.; Swamy, G.S.K.; Patil, P.B. and Kotikal, Y.K. (2007 b). Influence of vermicompost on growth, fruit yield and quality of guava cv. Sardar. *Acta Horticulturae (ISHS)* **735**: 386-388.
5. Beer, Karma and Singh, Anil. K. (2015). Effect of vermicompost and biofertilizers on strawberry: Chlorophyll and nutrients concentration in leaves.. *Annals of Plant Soil Research*, **17**(1): 211-214.
6. Binepal, Mandeep Kaur; Tiwari, Rajesh and Kumawat, B.R. (2013). Effect of integrated nutrient management on physio-chemical parameters of guava under Malwa plateau conditions of Madhya Pradesh. *Annals of Plant and Soil Research*, **15**(1): 47-49.
7. Bohane, Lasha and Tiwari, Rajesh (2014). Effect of integrated nutrient management on physico-chemical parameters of ber under Malwa plateau conditions. *Annals of Plant and Soil Research*, **16**(4): 346-348.
8. Borang, Beaury; Sharma, Y.K. and Sharma, S.K. (2016). Effect of various substrates on performance of earthworm and quality of vermicompost. *Annals of Plant and Soil Research*, **18**(1): 37-42.
9. Dutta, P.; Moji, S.B. and Das, B.S. (2009). Studies on the response of bio fertilizer on growth and productivity of guava. *Indian Journal of Horticulture*, **66**(1): 39-42.
10. Dwivedi, Deepa H.; Rubee Lata and Ram, R.B. (2010). Effect of bio fertilizer and organic manures on yield and quality of guava cv. Red fleshed. *The Scientific Temper*, **193**: 193-198.
11. Dwivedi, Vandana (2013). Effect of integrated nutrient management on yield, quality and economics of guava. *Annals of Plant and Soil Research*, **15**(2): 149-151.
12. Joseph, M.H.; Dhargave, T.S.; Deshpande, C.P. and Srivastava, A.K. (2015). Microbial solubilisation of phosphate: *Pseudomonas* versus *Trichoderma*. *Annals of Plant Soil Research*, **17**(3): 227-232.
13. Kumar, Promod and Rehalia, A.S. (2007). Standardization of micronutrient ranges in mango (*Mangifera indica* L.) by orchard survey. *The Asian Journal of Horticulture*, **2**(1): 218-221.
14. Mitra, S.K.; Gurung, M.R. and Pathak, P.K. (2007). Integrated nutrient management in high density guava orchards. *Acta Horticulturae (ISHS)* **849**: International Symposium on Guava and other Myrtaceae.

15. Monga, P.K.; Kumar, Harish; Vij, V.K. and Aulakh, P.S. (2002). Effect of NPK on yield and fruit quality of sweet orange cv. Jobba. *Indian Journal of Horticulture*, **59**(4): 378-381.
16. Naik, M.H. and Sri Hari Babu, R. (2007). Feasibility of organic farming in guava (*Psidium guajava* L.). *Acta Horticulturae (ISHS)*, **735**: 365-372.
17. Neeraj K. Charmkar, Shrikant Kol and Rishabh D. Saket, 2017. "Associational study of fto gene polymorphism with obesity in vindhyana" *International Journal of Current Research*, 9,(09), 56902-56905.region",
18. NBH (2011). All India area, production and productivity of guava. www.nbh.gov.in.
19. Patel, V.B.; Singh, S.K.; Asrey, Ram; Nain, Lata; Singh, A.K. and Singh, Laxman (2009). Microbial and inorganic fertilizers application influenced vegetative growth, yield, leaf, nutrient status and soil microbial biomass in sweet orange cv. Mosambi. *Indian Journal of Horticulture*, **66**: 163-168.
20. Pongener, K. Azungla and Pauline Alila (2015). Nutrient profile of passion-fruit leaf and fruit as influenced by integrated plant nutrient management. *Annals of Plant and Soil Research*, **17**(3): 318-322.
21. Padma Shri Mishra, Shrikant Kol, Rashmi Arnold and R.M. Mishra. 2016. Pathogenicity of Dental Caries; Isolation and Antimicrobial Efficacy by Herbal Plants. *Int .J .Curr. Microbiol.App.Sci.* 5(7): 929-935.
22. Ram, R.A.; Bhiringuvanshi, S.R.; Garg, N. and Pathak, R.K. (2007 a). Studies on organic production of guava (*Psidium guajava* L.) cv. Allahabad Safeda. *Acta Horticulturae (ISHS)*, **735**: 373-379.
23. Ram, R.A. and Pathak, R.K. (2007 b). Integration of organic farming practices for sustainable production of guava. A case study. *Acta Horticulturae (ISHS)*, **735**: 357-363.
24. Shukla, A.K.; Sarolia, D.K.; Kumari, Bhavana; Kaushik, R.A.; Mahawere, L.N. and Bairwa, H.L. (2009). Evaluation of substrate dynamics for integrated nutrient management under high density planting of guava cv. Sardar. *Indian Journal of Horticulture*, **66**(4): 461-463.
25. Singh, Anil K.; Karma Beer and Pal, A.K. (2015). Effect of vermicompost and biofertilizers on strawberry I: Growth, flowering and yield.. *Annals of Plant Soil Research*, **17**(2): 196-199.
26. Saket, Rishabh Dev, et al. "Complement receptor type-1 (CD35) gene polymorphism and Plasmodium falciparum Malaria." *International Journal of Medical Research & Health Sciences* 4.2 (2015): 422-431.
27. Singh, Gorakh; Singh, A.K. and Verma, A. (2000). Economic evaluation of crop regulation treatment in guava (*Psidium guajava* L.). *Indian Journal of Agriculture Science*, **70**: 226-230.
28. Singh, T.K.; Dwivedi, Vandana and Singh, D.B. (2011). Integrated nutrient management of guava. *Mysore Journal of Agricultural Sciences*, **45**(4): 923-925.
29. Verma, M.L.; Bhadewaj, S.P.; Thakur, B.C. and Bhandari, A.R. (2005). Nutritional and mulching studies in apple. *Indian Journal of Horticulture*, **62**(4): 332-335.

Table 1: Vegetative Growth of Guava Fruits cv. Allahabad Safeda as Influenced by Integrated Nutrient Management (Mean of Two Years)

S. No.	Treatments	Plant Height (m)	Circumference of Root-Stock (m)	Circumference of Scion (m)	Plant Spread E-W (m)	Plant Spread N-S (m)	Leaf Length (cm)	Leaf Width (cm)	Tree Volume (m ³)	Fruits/Tree	Fruit Weight (g)	Fruit Yield (kg/Tree)	Fruit Yield (q/ha)	Net Income (Rs/ha)	B:C ratio
T ₁	500 g; 200 g; 500 g NPK/tree (as control)	3.73	36.87	34.18	3.09	3.11	16.44	7.04	111.47	221.01	161.50	35.69	98.85	135270	3.65
T ₂	T ₁ + Zn (0.5%) + B (0.2%) + Mn (1%) as foliar spray twice (August and October)	3.81	37.18	35.71	3.30	3.35	17.03	7.41	131.79	228.28	165.65	37.81	104.73	144270	3.72
T ₃	T ₁ + organic mulching @ 10 cm thick	3.85	37.29	35.80	3.43	3.41	17.72	7.73	144.82	239.81	181.50	43.53	120.58	160770	3.95
T ₄	T ₁ + organic mulching @ 10 cm thick	4.07	38.51	36.57	3.80	3.79	17.98	8.94	184.09	296.93	220.85	65.58	181.64	167270	3.96
T ₅	25% recommended dose of fertilizer + 25 kg FYM + 250 g <i>Aspergillus niger</i>	3.94	37.08	35.08	3.54	3.58	16.94	7.30	156.27	251.33	202.05	50.79	140.67	134520	3.19
T ₆	25% recommended dose of fertilizer + 25 kg FYM + 125 g <i>Aspergillus niger</i>	3.95	36.91	35.93	3.41	3.39	17.83	7.68	144.23	270.34	190.00	51.36	142.27	149720	3.44
T ₇	25% recommended dose of fertilizer + 25 kg FYM + 125 g <i>Trichoderma</i>	3.92	37.94	35.01	3.52	3.61	16.52	7.91	155.72	253.11	175.25	44.36	122.86	149670	3.45
T ₈	25% recommended dose of fertilizer + 25 kg FYM + 125 g <i>Trichoderma</i> + 125 g <i>Pseudomonas</i>	3.88	38.10	35.75	3.56	3.64	17.02	7.21	157.71	279.43	168.80	47.17	130.64	143970	3.35
T ₉	50% recommended dose of fertilizer + 25 kg FYM + 250 g <i>Pseudomonas fluorescens</i>	3.85	38.05	35.79	3.61	3.64	17.31	7.45	132.26	285.55	169.85	48.51	134.37	156070	3.45
T ₁₀	50% recommended dose of fertilizer + 25 kg FYM + 250 g <i>Trichoderma</i> + 250 g <i>Pseudomonas</i>	4.03	38.43	36.47	3.67	3.75	17.85	8.80	173.86	295.02	213.40	62.96	174.40	155070	3.44
T ₁₁	50% recommended dose of fertilizer + 25 kg FYM + 250 g <i>Aspergillus niger</i>	3.90	36.97	35.75	3.59	3.56	17.20	7.54	156.21	258.48	174.65	45.15	125.06	152070	3.41
T ₁₂	50% recommended dose of fertilizer + 25 kg FYM + 250 g <i>Trichoderma</i>	3.85	37.96	35.95	3.61	3.58	17.39	7.07	148.71	273.78	176.05	48.21	133.52	148420	3.40
T ₁₃	50% recommended dose of fertilizer + 25 kg FYM + 250 g <i>Ascopirillum</i>	3.94	37.83	36.08	3.59	3.59	17.32	7.10	159.15	277.40	179.30	49.75	137.81	151030	3.44
T ₁₄	50% recommended dose of fertilizer + 25 kg FYM + 250 g <i>Azotobacter</i>	3.89	37.92	36.28	3.62	3.64	17.41	7.44	150.64	292.23	204.35	59.72	165.42	150030	3.42
T ₁₅	50% recommended dose of fertilizer + 25 kg FYM + 5 kg vermicompost	4.02	38.19	36.40	3.63	3.71	17.74	8.72	169.20	294.61	211.90	62.43	172.93	159270	3.57
	S.E.m.	0.003	0.022	0.024	0.007	0.007	0.018	0.024	0.705	0.929	0.725	0.336	0.006	--	--
	C.D. at 5%	0.016	0.100	0.110	0.030	0.031	0.082	0.112	3.305	4.355	3.400	1.576	0.029	--	--