Integrated nutrient management improves growth and leaf nutrient status of guava cv. Pant Prabhat

Amit Kumar Goswami*, Shant Lal and K.K. Misra
Department of Horticulture, G.B. Pant University of Agriculture and Technology, Pantnagar 263 145, Uttarakhand

ABSTRACT

The present experiment conducted during 2007-2009 to know the effect of biofertilizers enriched in FYM along with half-dose of recommended fertilizers on five- year- old guava plants of cv. Pant Prabhat. The experiment was laid out in a Randomized Block design with 11 treatments replicated thrice with two trees per treatment. In the above experiment, trees grown with half dose of recommended fertilizers (225 g N: 195 g P: 150 g K) + 50 kg FYM enriched with 250 g *Azospirillum* tree^{-1}year^{-1} found most effective to increase the vegetative growth of plants and maximum leaf N and K in the leaf tissue. Maximum leaf P content was recorded in treatment consisting of half-dose of recommended fertilizers + 50 kg FYM + *Trichoderma* (250 g) + *Pseudomonas fluorescens* (250 g). Use of biofertilizers enriched FYM along with half dose of recommended fertilizer was found as a good approach for production of quality guava fruits.

Key words: Guava, INM, growth, leaf nutrient status.

INTRODUCTION

Guava (*Psidium guajava* L.), is a well recognized edible fruit crop of tropical and sub-tropical climates. In recent years, its cultivation is getting popularity due to increasing international trade, better nutritional contents and processing of its value-added products. This is a well known fact that increases in productivity of fruit removes large amounts of essential nutrients from the soil. Without proper management, continuous fruit production reduces nutrient reserves in the soil. Another issue of great concern is the sustainability of soil productivity, as land began to be intensively exhausted to produce higher yields. Overtime, cumulative depletion decreases fruit production, yield and soil fertility and lead to soil degradation. On the other hand, excess supply or continuous use of inorganic fertilizers as source of nutrient in imbalanced proportion is also a problem, causing economic inefficiency, damage to the environment and in certain situations, harm the plants themselves and also to human being who consume them. The use of biofertilizers in enhancing plant growth and yield has gained momentum in recent years because of higher cost of hazardous effect of chemical fertilizers. Nitrogen fixing bacteria were found to enhance the growth and production of various fruits significantly besides improving the microbial activity of rhizosphere (Ghazi, 4). *Azospirillum* is known to add nitrogen to the soil through biological nitrogen fixation, which plays significant role in fruit production. The growth and fruitfulness of a plant depends on nutrient status of the leaf. Leaf constitutes a vital organ in plants and accomplishes important metabolic functions relating to the maintenance of growth and reproductive processes. It is the donor organ from which nutrients and other assimilates are translocated to various sinks to support activities and considered as a most important index tissue to asses the nutrient status of a plant. Hence, addition of appropriate measures to ensure optimum nutrient status will go a long way in maintaining guava trees in vigorous state, which will ensure optimum levels of productivity. The objective of present investigation was to know the effect of biofertilizers on growth and leaf nutrient status of guava cv. Pant Prabhat.

MATERIALS AND METHODS

The present investigation was conducted at Horticulture Research Centre, Patharchatta, Department of Horticulture, GBPUA & T, Pantnagar on five-year-old guava trees. The experiment was laid out in a Randomized Block design with 11 treatments replicated thrice with two trees per replication. The treatment combinations consisting of T_1 (control: 500 g: 200 g: 500 g NPK tree^{-1}), T_2 [T_1 + Zn (0.5%) + B (0.2%) + Mn (1%) as foliar spray twice (August and October)], T_3 (T_1 + organic mulching 10 cm thick), T_4 (T_2 + organic mulching 10 cm thick), T_5 (half T_1 + 50 kg FYM + 250 g *Trichoderma*), T_6 [half-dose of recommended fertilizers (225 g N: 195 g P:150 g K) + 50 kg FYM enriched with 250 g *Azospirillum*], T_7 [half-dose of recommended fertilizers (225 g N: 195 g P:150

*Corresponding author's present address: Division of Fruits and Horticultural Technology, IARI, New Delhi; E-mail: amitk@iari.res.in

g K) + *Azotobacter* (250 g) + 50 kg FYM], T_8 (half-dose of recommended fertilizers (225 g N: 195 g P:150 g K) + 25 kg FYM + 5 kg vermicompost), T_9 [half-dose of recommended fertilizers (225 g N: 195 g P:150 g K) + 50 kg FYM + 250 g *Pseudomonas fluorescence*], T_{10} [half-dose of recommended fertilizers (225 g N: 195 g P:150 g K) + 50 kg FYM + *Trichoderma* (250 g) + *Pseudomonas fluorescence* (250 g)] and T_{11} [half-dose of recommended fertilizers (225 g N: 195 g P:150 g K) + 50 kg FYM enriched with *Aspergillus niger*]. Strains of *Azospirillum* (an associated symbiotic N_2-fixing bacterium) were isolated using N-free semi-solid malate medium. The pure cultures of these strains procured from Department of Microbiology, IARI, New Delhi and culture mixed with FYM at experimental site. Five-month-old recently matured leaf was sampled as an index tissue for leaf analysis at different time intervals. The samples were decontaminated and dried powder of leaf was used for analyzing total nitrogen (by microKjeldhal method), phosphorus (by vanado-molybdo-phosphoric yellow colour method) and potassium (by flame photo-meter method). The tree volume was calculated as per the formula [Tree volume (m^3) = $4/3 \pi a^2 b$] of Westwood *et al.* (10). Plant height, spread and canopy volume were recorded for two years and means were compared using standard errors of the mean.

RESULTS AND DISCUSSION

Trees grown with half dose of recommended fertilizers (225 g N: 195 g P: 150 g K) + 50 kg FYM enriched with 250 g *Azospirillum* tree^{-1}year^{-1} produced maximum tree height, spread, girth, volume, number of new shoots emergence per branch, annual increase in shoot length (Tables 1 & 2). However, significant differences were not observed in trunk girth. Maximum leaf N and K content was observed in treatment containing half dose of recommended fertilizers (225 g N: 195 g P: 150 g K) + 50 kg FYM enriched with 250 g *Azospirillum* tree^{-1}year^{-1}. Maximum leaf P content was recorded in treatment consisting of half dose of recommended fertilizers (225 g N: 195 g P: 150 g K) + 50 kg FYM + *Trichoderma* (250 g) + *Pseudomonas fluorescence* (250 g) (Table. 3). Results of present study are in accordance with Pathak and Ram (7) who observed improvement in the vegetative growth parameter in guava with the application of different fertilizers, organic manure and bio-fertilizers. The increase in tree height, spread, volume, shoot length and number of shoot emergence per branch could be attributed to the stimulative activity of microflora in the rhizosphere leading to increased nutrient availability and hence vigorous plant growth (Singh *et al.*, 8; Aseri *et al.*, 1). The biofertilizers inoculation helps the plants to increase the dehydrogenase, alkaline phosphatase, nitrogenase and hydrolysis enzyme activities mainly due to increase in the rhizosphere microbial population as a consequence of the inoculation treatments (Aseri and Tarafdar, 2). The free living N_2 fixer can affect plant growth not only by fixing N_2 but also by altering microbial balance, solubilizing fixed soil phosphorus, suppressing pathogenic microorganisms

Table 1. Effect of various treatments on annual increase in height, spread, trunk diameter and volume of guava tree.

Treatment	Annual increase in plant height (m)		Annual increase in plant spread (m)		Annual increase in trunk dia. (cm)		Annual increase in tree volume (m^3)	
	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09
T_1	0.15	0.16	0.30	0.33	2.00	2.05	0.009	0.012
T_2	0.18	0.20	0.44	0.41	2.08	2.16	0.019	0.027
T_3	0.17	0.18	0.36	0.40	2.28	2.25	0.015	0.013
T_4	0.22	0.23	0.50	0.57	2.42	2.56	0.046	0.032
T_5	0.20	0.19	0.44	0.47	2.19	2.32	0.026	0.024
T_6	0.24	0.25	0.58	0.66	2.68	2.71	0.055	0.041
T_7	0.22	0.24	0.54	0.62	2.63	2.56	0.048	0.036
T_8	0.19	0.20	0.42	0.43	2.25	2.44	0.020	0.015
T_9	0.21	0.22	0.43	0.46	2.37	2.45	0.025	0.016
T_{10}	0.22	0.23	0.51	0.59	2.28	2.43	0.047	0.035
T_{11}	0.20	0.21	0.43	0.40	2.09	2.16	0.017	0.021
CD at 5%	0.028	0.031	0.054	0.048	NS	NS	0.009	0.009

Table 2. Effect of various treatments on number of newly emerging shoots per branch and annual increase in shoot length in guava.

Treatment	No. of shoots emergence per branch				Annual increase in shoot length (cm)			
	2007-08		2008-09		2007-08		2008-09	
	Rainy	Winter	Rainy	Winter	Rainy	Winter	Rainy	Winter
T_1	24.52	5.88	26.56	5.78	6.81	1.95	6.27	1.44
T_2	30.48	6.48	32.57	7.09	7.40	2.93	8.40	2.53
T_3	31.15	6.97	34.20	7.47	8.36	2.93	7.39	2.40
T_4	34.86	8.33	37.23	8.33	11.48	3.31	11.58	3.43
T_5	27.99	6.52	34.62	7.37	9.27	2.46	9.42	2.50
T_6	35.54	9.84	41.24	9.80	12.88	4.09	13.35	4.21
T_7	31.65	7.62	36.81	8.25	11.10	3.47	11.91	3.84
T_8	30.28	6.88	30.31	7.63	9.46	3.23	9.83	2.91
T_9	30.64	7.58	31.73	8.24	10.29	3.09	9.91	2.65
T_{10}	33.23	8.39	34.29	9.22	12.42	3.73	11.87	3.49
T_{11}	29.66	7.51	32.37	8.00	9.54	3.16	7.81	3.09
CD at 5%	4.790	1.520	4.050	1.549	0.627	0.366	1.483	0.458

and by producing metabolites that stimulate plant development. This is an indication of the fact that *Azospirillum* and compost hastened the vegetative growth by virtue of their nutrient releasing properties. Higher uptake of nutrients was due to synergistic effect of improved biomass and higher nutrient concentration in the inoculated plants. The increase in leaf nitrogen content due to *Azospirillum,* which soften middle lamella through action of pectinolytic enzymes, thus, enhancing mineral absorption. Improvement in soil aeration and better soil moisture retention in root zone increased microbial nitrogen fixation and, thus, improved the availability of macro- and micro-nutrients. The addition of FYM improved the physical conditions of soil, root development and more soil moisture retention which resulted in increased absorption of water and nutrients and, consequently improved the leaf nutrient status (Morselli *et al*., 6). Interestingly, in the present study, *Azospirillum* with FYM and half dose of recommended NPK had significantly increased the N levels of leaf as compared to control. The P level in leaf increased by application of different composition of bio and chemical fertilizers due to the fact that phosphorus solubilizing microbes present in the soil solubilize the fixed phosphorus and make it easily available to the plant (Sundara *et al*., 9). More availability of P under PSB treatments can be attributing to the chelating agents and form stable complexes with Fe and Al and thereby release P to the soil solution making it available for more uptake by the plants (Gogoi *et al*., 5).

The present study represents the positive response of biofertilizer on growth and leaf nutrient status of guava cv. Pant Prabhat and the results showed that biofertilizers application played a vital role to increase the growth of guava. The application of half-dose of recommended fertilizers + 50 kg FYM enriched with 250 g *Azospirillum* was found to be most effective in increasing vegetative growth in guava. The leaf nutrient status of guava was highly influenced by biofertilizer treatment and highest leaf N and K was recorded with half-dose of recommended fertilizers + 50 kg FYM + 250 g *Azospirillum.* Highest leaf P was recorded with half recommended fertilizers + 50 kg FYM + *Trichoderma* (250 g) + *Pseudomonas fluorescencse* (250 g).

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Table 3. Effect of various treatments on leaf nitrogen, phosphorus and potassium content of guava.

Treatment combination	Leaf N level (% of dry weight)						Leaf P level (% of dry weight)						Leaf K level (% of dry weight)					
	2007-08			2008-09			2007-08			2008-09			2007-08			2008-09		
	April	October	January	April	October	January	April	October	January	April	October	January	April	October	January	April	October	January
T_1	1.839	1.713	1.523	1.948	1.835	1.676	0.169	0.154	0.139	0.180	0.157	0.147	1.303	1.010	0.973	1.389	1.282	1.174
T_2	1.947	1.840	1.597	2.073	1.939	1.801	0.178	0.155	0.143	0.189	0.164	0.149	1.557	1.357	1.197	1.557	1.330	1.263
T_3	2.059	1.923	1.709	2.141	2.019	1.864	0.193	0.158	0.144	0.204	0.161	0.151	1.603	1.303	1.156	1.603	1.394	1.256
T_4	2.252	2.087	1.866	2.198	2.109	1.997	0.188	0.173	0.157	0.199	0.176	0.164	1.673	1.420	1.226	1.673	1.535	1.369
T_5	2.005	1.912	1.688	2.137	2.017	1.862	0.183	0.157	0.140	0.194	0.166	0.145	1.592	1.406	1.202	1.592	1.398	1.288
T_6	2.347	2.153	1.983	2.417	2.201	2.122	0.195	0.168	0.148	0.206	0.174	0.151	1.803	1.513	1.335	1.770	1.538	1.444
T_7	2.227	2.090	1.937	2.307	2.188	2.029	0.192	0.170	0.155	0.203	0.177	0.153	1.723	1.460	1.236	1.723	1.496	1.360
T_8	2.087	1.947	1.720	2.129	2.024	1.840	0.195	0.173	0.152	0.206	0.181	0.155	1.607	1.380	1.202	1.607	1.407	1.330
T_9	2.109	1.964	1.738	2.186	1.997	1.892	0.213	0.192	0.172	0.224	0.201	0.181	1.620	1.403	1.188	1.620	1.418	1.300
T_{10}	2.182	1.931	1.867	2.211	2.077	1.884	0.219	0.197	0.177	0.233	0.208	0.187	1.687	1.470	1.319	1.687	1.527	1.378
T_{11}	2.117	2.047	1.823	2.189	2.034	1.886	0.205	0.183	0.166	0.219	0.196	0.178	1.583	1.293	1.113	1.583	1.413	1.284
CD at 5%	0.187	0.188	0.196	0.150	0.164	0.134	0.015	0.015	0.019	0.014	0.013	0.010	0.148	0.106	0.126	0.139	0.102	0.084

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