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Short communication

Studies on integrated nutrient management on yield and quality of guava cv. Pant Prabhat

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ABSTRACT

An investigation was carried out during on five-year-old guava cv. Pant Prabhat to evaluate the effect of different organic (farm-yard-manure and vermicompost) and inorganic fertilizers (macro- and micro-nutrients) as well as bio-fertilizers (*Trichoderma, Azotobacter*, *Azospirillum*, *Pseudomonas fluorescence* and *Aspergillus niger*) with organic mulches in different combinations on yield and fruit quality. In the above experiment, trees applied with half dose of recommended fertilizers (225 g N_2O: 195 g P_2O_5: 150 g K_2O) + 50 kg FYM inoculated with 250 g *Azospirillum* tree^{-1} year^{-1} found most effective to increase the vegetative growth, yield as well as quality of fruits in both the seasons during both the year. Maximum fruit set and yield in rainy (83.33%, and 72.16 kg tree^{-1}) and winter (34.32 % and 6.53 kg tree^{-1}) were recorded with the application of 225g N_2O, 195 g P_2O_5 and 150 g K_2O along with 50 kg FYM enriched with 250 g *Azospirillum* tree^{-1}year^{-1}. Fruit quality (total soluble solids, ascorbic acid, per cent reducing sugars, total sugar, TSS:acid ratio and pectin content) in both rainy and winter seasons were found better in fruits from the plants receiving 500 g : 200 g : 500 g NPK tree^{-1} + Zn (0.5%) + B (0.2%) + Mn (1%) as foliar spray twice (August and October) along with organic mulching 10 cm thick. Therefore, it is suggested to incorporate bio-fertilizers enriched FYM along with half dose of recommended fertilizers for sustainable production of quality guava fruits.

Key words: Guava, Inorganic fertilizer, bio-fertilizer, fruit yield and quality.

Guava (*Psidium guajava* L.) is one of the hardiest fruit trees adaptable to a variety of soil and climatic conditions. Among the various factors, which affect the production and productivity of guava, nutrient management assumes greater significance. Sustainable management is required to produce a profitable crop which includes cultural practices and obviously a well planned nutrient management of the orchard. An issue of great concern is the sustainability of soil productivity, as land began to be intensively exhausted to produce higher yields. Achieving balance between the nutrient requirements of plants and the nutrient reserves in the soil is essential for maintaining high yields and soil fertility, preventing environmental contamination and sustaining fruit production over the long term. Therefore, to maximize and sustain the productivity without deteriorating soil health, the nutrient management practices should be tailored by judicious integration of chemical fertilizers, organic manures and bio-fertilizers. Number of studies indicated improved efficacy of fertilizer nutrients with combined use of manure and fertilizers or combined use of inorganic fertilizers in addition to enzymatic activities of soil and also improved leaf nutrient status of guava (Goswami *et al*., 6). The nutritional requirement of guava varied from other crops, due to its perennial nature, flowering and fruiting behaviour, and high yielding nature. Keeping these facts in mind, the present investigation was, therefore, undertaken on guava cv. Pant Prabhat.

The present investigation was carried out at Horticulture Research Centre, Patharchatta, Department of Horticulture, GBPUA&T, Pantnagar on five-year-old guava trees for three consecutive years. The experiment was laid out in randomized block design with 11 treatments replicated thrice with two trees per replication. The treatment combinations were T_1 (500 g N_2O: 200 g P_2O_5: 500 g K_2O 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-dose of T_1 + 50 kg FYM + 250 g *Trichoderma*), T_6 [half-dose of recommended + 50 kg FYM enriched with 250 g *Azospirillum*], T_7 [half-dose of recommended fertilizers (225 g N: 195 g P:150 g K) + *Azotobacter* (250 g) + 50 kg FYM], T_8 (half-dose of recommended fertilizers + 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}

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[half-dose of recommended fertilizers (225 g N_2O: 195 g P_2O_5: 150 g K_2O) + 50 kg FYM enriched with *Aspergillus niger*]. Native 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 well decomposed FYM at experimental site. Among the chemical fertilizers, 500 g N_2O: 200 g P_2O_5: 500 g K_2O tree^{-1} was applied as control and in other as per treatment with different concentrations. Nitrogen was applied in two split doses. Half doses of N (urea) and full dose of phosphorus (single super phosphate) and potassium (muraite of potash) were given in the last week of June and rest half-dose of nitrogen in the first week of October during both the years. Foliar spray with zinc sulphate (0.5%), boric acid (0.2%) and manganese sulphate (1.0%) were applied in August and October as per treatments. The trees were sprayed with the help of a foot sprayer, using 0.1 per cent Teepol® as surfactant. Doses of vermicompost were applied in a ring around the base of the tree and covered in January in the tree basin (15 cm deep), while bio-fertilizers enriched FYM were applied through band application method followed by light irrigation to maintain adequate soil moisture for micro-organism proliferation. The number of flower buds, the number of fruit set, yield per tree, pulp acidity, ascorbic acid, total sugars and pectin content of fruits were recorded for two years by the methods described in by Ranganna (9). The titrable acidity was calculated as per method of AOAC (2).

Guava responded well to both inorganic fertilizer and organic manure application. Results revealed significant differences amongst various growth attributes and fruit yield in guava. It is evident from the data presented in Tables 1 & 2 that the trees under different treatments showed significant differences in yield and quality parameters over control. The yield and quality parameters were significantly influenced by the application of organic manure enriched with bio-fertilizers along with inorganic fertilizers. Trees grown with half- dose of recommended fertilizers (225 g N_2O: 195 g P_2O_5: 150 g K_2O) + 50 kg FYM enriched with 250 g *Azospirillum* tree^{-1}year^{-1} produced maximum numbers of flower buds per branch (60.28 and 60.86 in rainy and 34.36 and 34.00 in winter season), per cent fruit set (83.33 and 85.01 in rainy and 34.32 and 35.42 in winter season), total number of fruits per tree (599.20 and 625.09 in rainy and 50.54 and 52.64 in winter season) and total yield (78.68 and 83.66 kg tree^{-1}) during both rainy and winter season in both the year (Table 1). Increased plant yield may be due to better uptake and utilization of major- and micro-nutrients as well as positive interaction between bio-fertilizer and chemical fertilizers resulting in increased nutrient status in soil and more nutrients uptakes by the plants (Dutta *et al*., 4; Ram *et al*., 8).

The beneficial effect of inorganic fertilizer along with bio-fertilizer on fruit quality was also observed. Data presented in Table 2 revealed that different treatments of inorganic fertilizers along with bio-fertilizer significantly increased the TSS, total sugars, ascorbic acid, TSS:acid ratio, sugar: acid ratio as well as pectin content of the fruits. Maximum TSS (10.00 and 11.02 °Brix in rainy and 12.29 and 12.61 in winter), ascorbic acid (129.86 and 141.07 mg/g in rainy and 286.69 and 294.96 in winter), total sugars (9.38 and 9.59 per cent in rainy and 10.02 and 9.33 in winter)] and pectin content (0.867 and 1.004% in Rainy and 1.205 and 1.253 in winter) during both the season of the two years with the application of 500 g: 200 g: 500 g NPK tree^{-1} year^{-1} + Zn (0.5 per cent) + B (0.2 per cent) + Mn (1 per cent) along with organic mulching 10 cm thick. Maximum TSS: acid ratio (51.32 and 55.48 in rainy and 53.78 and 57.56) was recorded in same treatment. In general, winter fruits showed superior quality compared with the fruits harvested in the rainy season. The possible reason of increase in such parameter is due to adequate supply of nutrient, better growth and development of plants. (Asari *et al*., 3; Shukla *et al*., 10; Mitra *et al*., 7). Addition of organic manures and biofertilizers to the soil in conjunction with chemical fertilizers increases the availability of nutrients on long term basis, resulting in favourable effect on plant growth. Soil properties were also improved by adding organic manures in combination with inorganic fertilizers (Ahmed *et al*., 1; Gagoi *et al*., 5). This phenomenon was totally absent with regard to yield and yield components also, significant differences were noticed due to application of different treatments. When only inorganic fertilizers were used continuously Balanced nutrient supply is necessary not only for obtaining higher and regular yields of better quality fruits but also for increasing shelf life of fruits.

Experimental findings revealed that different treatments consist of inorganic fertilizer along bio-fertilizers and mulching significantly increased the yield and quality of guava. Application of 225 g N_2O: 195 g P_2O_5: 150 g K_2O + 50 kg FYM enriched with 250 g *Azospirillum* tree^{-1} year^{-1} improved fruiting, per cent fruit set, total number of fruits per tree and highest yield of guava.

Table 1. Effect of various treatments on flowering, fruit set, total number of fruits and yield of guava cv. Pant Prabhat.

Treatment	No. of flower bud emergence per branch				Fruit set (%)				No. of fruits tree^{-1}				Yield (kg tree^{-1})				Total yield (kg tree^{-1})	
	2007-08		2008-09		2007-08		2008-09		2007-08		2008-09		2007-08		2008-09			
	Rainy	Winter	Rainy	Winter	Rainy	Winter	Rainy	Winter	Rainy	Winter	Rainy	Winter	Rainy	Winter	Rainy	Winter	2007-08	2008-09
T_1	34.52	16.36	39.06	19.46	58.21	25.84	61.76	24.66	456.36	24.89	463.50	23.38	47.39	2.80	49.79	2.76	50.19	52.56
T_2	39.39	18.73	43.29	22.61	63.71	28.64	69.76	27.72	503.71	29.21	521.87	29.30	53.99	3.39	56.71	3.55	57.37	60.25
T_3	41.77	20.39	46.65	26.40	68.41	27.65	69.15	29.30	479.37	37.54	536.83	39.97	54.94	4.53	60.84	5.00	59.47	65.84
T_4	56.36	30.90	56.43	31.40	82.06	32.58	82.85	33.59	563.83	45.88	584.33	49.43	65.88	5.79	68.96	6.44	71.67	75.40
T_5	52.26	25.36	50.40	30.38	69.38	29.08	70.13	27.54	534.50	41.57	560.27	44.30	60.97	5.19	64.26	5.72	66.16	69.98
T_6	60.28	34.36	60.86	34.00	83.33	34.32	85.01	35.42	599.20	50.54	625.09	52.64	72.16	6.53	76.49	7.16	78.68	83.66
T_7	57.12	32.14	56.58	32.83	80.50	31.88	79.60	31.10	584.98	47.44	612.44	49.30	68.89	6.05	73.49	6.51	74.94	80.00
T_8	47.25	25.51	48.77	28.45	68.23	28.41	70.67	28.63	525.14	42.56	578.21	42.82	58.29	5.39	66.89	5.53	63.68	72.43
T_9	44.44	29.19	49.31	31.04	73.41	29.97	75.84	30.59	558.02	40.54	582.71	44.97	62.66	5.83	66.64	5.71	68.49	72.36
T_{10}	54.61	29.80	57.28	33.36	77.81	31.97	81.34	31.44	587.56	46.44	598.35	48.29	67.74	5.13	72.99	6.37	72.87	79.27
T_{11}	41.45	24.97	51.59	29.21	68.76	30.22	74.62	30.63	548.65	41.40	580.40	44.49	61.62	5.04	65.40	5.66	66.66	71.07
CD at 5%	5.683	3.606	4.533	3.502	4.983	3.283	5.615	4.048	22.985	5.333	19.113	6.252	3.610	0.638	3.375	0.839	3.883	3.325

Table 2. Effect of various treatments on on physico-chemical composition of guava fruits.

Treatment	TSS (°Brix)				Ascorbic acid (mg/100 g pulp)				TSS : acid				Sugar : acid				Total sugars (%)				Pectin content (%)			
	2007-08		2008-09		2007-08		2008-09		2007-08		2008-09		2007-08		2008-09		2007-08		2008-09		2007-08		2008-09	
	Rainy	Winter	Rainy	Winter	Rainy	Winter	Rainy	Winter	Rainy	Winter	Rainy	Winter	Rainy	Winter	Rainy	Winter	Rainy	Winter	Rainy	Winter	Rainy	Winter	Rainy	Winter
T_1	8.39	9.52	8.71	9.44	112.03	257.32	118.92	248.40	26.78	25.30	24.66	26.51	21.90	18.62	15.94	15.93	6.87	7.01	5.62	5.68	0.723	1.033	0.804	1.043
T_2	8.74	9.77	9.41	10.05	118.02	258.65	120.77	265.49	30.53	29.65	30.41	30.86	25.77	25.90	25.91	23.71	7.40	8.55	8.03	7.72	0.743	1.047	0.850	1.103
T_3	8.73	9.72	9.84	10.93	120.67	260.71	124.48	266.75	34.63	25.84	33.24	37.74	28.95	22.05	28.03	28.79	7.34	8.30	8.29	8.32	0.747	1.120	0.877	1.177
T_4	10.00	12.29	11.02	12.61	129.86	286.69	141.07	294.96	51.32	53.78	55.47	57.56	47.85	43.87	48.25	44.57	9.38	10.02	9.59	9.74	0.867	1.205	1.004	1.253
T_5	9.72	10.21	9.73	10.75	119.66	269.53	130.70	277.06	36.63	33.64	28.45	35.82	30.30	30.94	25.56	29.42	8.07	9.35	8.75	8.81	0.767	1.123	0.883	1.170
T_6	9.87	12.08	10.72	12.11	125.97	281.51	137.10	292.92	47.93	47.06	47.57	46.57	45.02	38.13	41.49	36.00	9.29	9.75	9.34	9.33	0.840	1.190	0.940	1.243
T_7	9.76	11.45	9.97	11.51	121.70	274.81	133.58	275.06	40.22	35.76	35.23	37.13	35.70	28.96	31.20	29.06	8.67	9.27	8.82	8.99	0.793	1.158	0.900	1.174
T_8	9.34	10.04	9.31	10.41	121.30	271.74	120.75	268.77	35.18	29.80	31.92	30.63	27.47	26.36	29.26	25.18	7.31	8.87	8.53	8.56	0.770	1.107	0.887	1.153
T_9	9.66	10.89	9.92	11.70	121.91	278.77	129.58	276.82	39.36	30.84	32.50	35.47	35.42	26.17	29.08	26.98	8.71	9.22	8.88	8.88	0.793	1.128	0.890	1.183
T_{10}	9.80	11.46	10.68	11.77	125.66	280.86	138.53	283.27	42.67	37.19	39.95	41.75	39.32	31.21	34.42	32.59	9.03	9.64	9.16	9.21	0.827	1.177	0.927	1.200
T_{11}	9.02	10.69	10.28	11.89	121.93	277.20	128.07	273.84	33.12	31.77	33.19	39.32	30.50	26.22	27.40	28.17	8.33	8.81	8.49	8.53	0.777	1.067	0.873	1.163
CD at 5%	0.340	1.006	0.720	1.013	6.703	8.386	8.021	8.153	6.31	4.00	6.15	5.15	3.11	5.76	5.82	4.18	0.828	0.728	0.679	0.604	0.069	0.021	0.091	0.055

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