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RESEARCH PAPER

Influence of bio-fertilizers and chemical fertilizers on growth, flowering and fruit characters of guava (*Psidium guajava* L.) cv. ALLAHABAD SAFEDA

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Abstract : The present investigation was carried out during *Kharif-Rabi* season of the year 2011 at Horticultural Research Farm, Department of Horticulture, B. A. College of Agriculture, Anand Agricultural University, Anand. There were twenty treatments and the treatments of comprising organic fertilizers (FYM), bio-fertilizers (*Azotobacter*, PSB), three levels of nitrogen, two levels of phosphorus and 250 g K_2O/ha in all trees excluding absolute control were tried in Randomized Block Design with three replications. The results revealed that treatment of 75% N + 75% P_2O_5 + 100% K_2O+ *Azotobacter* 5ml/tree + PSB 5ml/tree obtained significantly maximum tree height (3.80 m), girth of primary branch (28.67 cm), East West tree spread (5.20 m), North South tree spread (5.13 m) at harvesting stage, minimum number of days for flowering (32.33 days), maximum number of flowers per branch (25.33), fruit set per branch (90.20%) and fruit retention (92.96%), fruit diameter (10.07 cm), fruit weight (215.06 g) and pulp weight (193.44 g) while number of primary and secondary branches were recorded non-significant effect at harvesting stage. the treatment of 100% N + 75% P_2O_5 + 100% K_2O + *Azotobacter* 5ml/tree + PSB 5ml/tree recorded minimum peel weight (15.00 g), minimum number of seeds (111.33) and in treatment of 75% N + 100% P_2O_5 + 100% K_2O + *Azotobacter* 5ml/tree + PSB 5ml/tree recorded minimum weight of seeds (4.0 g).

Key Words : Biofertilizers, Chemical fertilizers, Growth, Flowering, Yield, Guava

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INTRODUCTION

Guava (*Psidium guajava* L.) is one of most important fruit crop belongs to the family 'Myrtaceace'. The major guava growing districts in Gujarat are Bhavnagar, Ahmadabad, Kheda, Mehsana, Sabarkantha, Gandhinagar, Vadodara, Godhra and Dahod. Guava is considered as an apple of the tropics owing to its richness in vitamin C (75-260 mg 100 g^{-1} pulp) a good source of thiamine (0.03-0.07 mg 100 g^{-1} pulp) and riboflavin (0.02-0.04 mg 100 g^{-1} pulp) (Singh *et al.*, 2003). Besides this, guava fruit is also a good source of minerals like phosphorus (22.5-40.0 mg 100 g^{-1}), calcium (10.0-30.0 mg 100 g^{-1}) and iron (0.60-1.39 mg 100 g^{-1}) (Singh *et al.*, 2003). It is good source of pectin (0.5-1.8%) (Adsule and Kadam, 1995). The fruits are used for preparation of jelly and other kinds of preserved products. The use of organic manure along with bio-fertilizers and inorganic fertilizers, a cheap source of available nutrient to plants, has resulted in beneficial effects on growth, yield and quality of various fruit crops under normal spacing (Ram and Rajput, 2000). Biofertilizers are microbial preparations containing living cells of different microorganisms which have the ability to mobilize plant nutrients in soil from unusable to usable form through biological process. They are environmental friendly and play significant role in crop production. It is mainly used for field crops but now-a-days it is used for fruit crops also. The research based information on effect of bio-fertilizers in combination with chemical fertilizers in guava is scanty.

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Considering the importance and future scope of this crop, it is decided to conduct the present investigation to find out the effect of bio-fertilizers and chemical fertilizers on growth, yield and quality of guava cv. ALLAHABAD SAFEDA.

MATERIALS AND METHODS

The present experiment was conducted during *Kharif-Rabi* season of the year 2011 at Horticultural Research Farm, Department of Horticulture, B. A. College of Agriculture, Anand Agricultural University, Anand. There were twenty treatments and the treatments comprising of organic fertilizers (FYM), bio-fertilizers (*Azotobacter*, PSB 5ml/tree each), three levels of nitrogen (500, 375, 250 g N/ha), two levels of phosphorus (250, 157.5 g P_2O_5/ha) and 250 g K_2O/ha in all trees (6 years old) excluding absolute control were tried in Randomized Block Design with three replications. The soil of the experimental site was sandy loam, locally known as "Goradu". The soil was alluvial by their nature of origin, very deep, well drained and fairly moisture retentive. Soils respond well to manures and irrigations. The water table is more than 10 m in depth. Hence, there is no problem of high water table in the area. Recommended doses of fertilizers were applied at the rate of 500 g of nitrogen, 250 g phosphorus and 250 g of potassium in June and it is given in the form of urea, single super phosphate and muriate of potash. Nitrogen was applied in two equal splits in treatment, whereas second dose of nitrogen is given in the mid of October. 5 ml of each bio-fertilizers (*Azotobacter* and PSB) dissolved in 1 litre water was mixed with 50 kg finely powdered FYM (well decomposed organic manure) this mixture will be applied in the onset of monsoon by making ring 15 cm deep and 30 cm away from the main trunk. Cultural practices such as weeding, inter-culturing, earthing up, digging in the ring, removal of water shoots and dead limbs were done as and when required. Irrigation was applied, immediately after application of fertilizers. In the rainy season irrigation was applied as and when required. The data collected for different observations were subjected to statistical analysis of variance technique as described by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

The experimental findings obtained from the present study have been discussed in following heads:

Growth characters :

The result of the present investigation revealed that influence of bio-fertilizers and chemical fertilizers on different growth attributes *viz.*, tree height, girth of primary branch, East West tree spread and North South tree spread at harvesting stage observed significant responses, whereas these parameters were found non-significant differences at initial stage of experiment. The number of primary branch and number of secondary branch at both initial and harvesting stage shows non significant differences. Data presented in Table 1 show non-significant differences on tree height at initial stage of experiment which indicates homogeneity of tree height in experimental plot.

It is clear from the results (Table 1) that treatment T_{14} *i.e.* 75% N + 75% P_2O_5 + 100% K_2O + *Azotobacter* 5ml/tree + PSB 5ml/tree was recorded significantly higher tree height (3.80 m) at harvesting stage, girth of primary branch (28.67 cm), East-West tree spread (5.20 m) at harvesting stage, North-South tree spread (5.13 m) at harvesting stage and number of primary branch and number of secondary branch did not influence by bio-fertilizers in combination with chemical fertilizers.

The positive influence of bio-fertilizers in combination with chemical fertilizers on growth performance in respect of tree height, girth of primary branch, tree spread might be due to fact that application of NPK and FYM along with *Azotobacter* and PSB. The useful effect of nitrogen is certainly the results of an increase in growth attributes. As nitrogen is the major constituent of fertilizers applied and as it is constituent of the protein which is essential for formation of protoplasm thus affecting the cell division and cell elongation and there by more vegetative growth. Higher supply of N made more rapid synthesis of carbohydrate, which was converted into protein and protoplasm increasing the size of cells. Inoculation with *Azotobacter* a biological nitrogen fixer improves the nitrogen use efficiency of the plant (Dutta *et al.*, 2009). In addition to this phosphorus plays an important role in energy transformation and potassium plays an important role in maintenance of cellular organization by regulating the permeability of cellular membrane. Findings are in conformity with those of Ram *et al.* (2005), Shukla *et al.* (2009) in guava and Baviskar *et al.* (2011) in sapota.

Flowering parameters :

Data presented in Table 2 show significant differences on days to flowering. It is clear from the results that treatment T_{14} *i.e.* 75% N + 75% P_2O_5 + 100% K_2O + *Azotobacter* 5ml/tree + PSB 5ml/tree recorded significantly minimum days required for flowering (32 days), higher number of flowers per branch (25.33), the maximum fruit set (90.20%) and fruit retention (92.96%). The minimum days required for flowering, higher flowering and fruit set with higher fruit retention might be due to increased nutrient availability from NPK, FYM, the organic phosphorus from phosphobacteria and *Azotobacter* which may have increased various endogenous hormonal levels in plant tissue which might be responsible for enhancing flowering pollen germination and pollen tube which might have ultimately increased fruit set and higher fruit retention. The results of present findings are confirmed due to findings of earlier workers Dheware and Waghmare (2009) in sweet orange and Shukla *et al.* (2009) in guava.

Table 1: Effect of bio-fertilizers and chemical fertilizers on growth of guava (*Psidium guajava* L.) cv ALLAHABAD SAFEDA

Treatments	Tree height at initial stage (m)	Tree height at harvesting stage (m)	Girth of primary branch at initial stage (cm)	Girth of primary branch at harvesting stage (cm)	Tree spread (m)		Tree spread (m)		Number of primary branches/ tree at initial and harvesting stage	Number of secondary branches/ tree at initial and harvesting stage
					East – west at initial stage	East – west at harvesting stage	North – South at initial stage	North – South at harvesting stage		
T_1	2.97	3.07	20.42	21.19	3.53	4.13	3.43	4.08	3.67	7.33
T_2	3.00	3.10	20.44	23.41	3.77	4.47	3.90	4.65	3.67	9.00
T_3	3.33	3.43	21.43	23.03	4.17	4.98	3.72	4.55	3.33	8.00
T_4	3.23	3.32	20.55	21.67	3.90	4.62	3.93	4.73	3.67	9.67
T_5	3.40	3.53	21.48	23.41	4.05	4.93	4.02	4.90	3.33	8.33
T_6	3.06	3.17	20.44	22.50	4.12	5.07	4.20	5.03	3.67	9.33
T_7	3.22	3.33	20.81	22.70	4.28	4.98	4.00	4.85	4.00	9.33
T_8	3.30	3.45	25.84	27.66	4.15	5.05	3.97	5.03	3.33	9.67
T_9	3.17	3.33	25.06	27.14	3.53	4.30	3.85	4.68	2.67	6.33
T_{10}	3.50	3.59	23.67	25.60	4.07	4.85	3.60	4.48	3.00	8.00
T_{11}	3.00	3.13	22.42	23.18	3.47	4.22	4.02	4.92	3.67	8.33
T_{12}	3.00	3.12	22.59	24.43	4.03	5.00	3.35	4.27	3.00	8.00
T_{13}	3.17	3.30	22.18	24.08	3.42	4.18	3.42	4.28	3.67	9.00
T_{14}	3.60	3.80	26.41	28.67	4.20	5.20	4.10	5.13	4.33	9.67
T_{15}	3.20	3.32	22.99	24.99	3.57	4.37	4.07	4.98	3.00	9.00
T_{16}	3.33	3.43	21.09	22.83	3.80	4.43	3.97	4.85	3.33	7.33
T_{17}	3.23	3.33	24.17	26.09	4.10	4.98	3.60	4.55	3.67	7.33
T_{18}	3.03	3.17	21.52	23.38	3.42	4.17	3.87	4.92	3.00	7.67
T_{19}	3.07	3.17	23.95	25.92	3.67	4.33	3.80	4.78	2.67	7.00
T_{20}	3.63	3.75	23.63	25.41	3.40	4.32	3.80	4.67	3.33	9.33
S.E.±	0.16	0.15	1.38	1.43	0.23	0.23	0.19	0.19	0.33	0.74
C.D. at 5 %	NS	0.44	NS	4.09	NS	0.66	NS	0.55	NS	NS
C.V. %	8.63	7.89	10.56	10.15	10.31	8.59	8.67	7.11	16.60	15.36

T_1: Absolute control, T_2: 500N + 250 P_2O_5 + 250 K_2O g/tree (RDF), T_3: 100% N + 100% P_2O_5 + 100% K_2O + *Azotobacter* 5ml/tree, T_4: 100% N + 100% P_2O_5 + 100% K_2O + PSB 5ml/tree, T_5: 100 % N + 100% P_2O_5 + 100% K_2O + *Azotobacter* 5ml/tree + PSB 5ml/tree, T_6: 100% N + 75% P_2O_5 + 100% K_2O + *Azotobacter* 5ml/tree, T_7: 100% N + 75% P_2O_5 + 100% K_2O + PSB 5ml/tree, T_8: 100 % N + 75% P_2O_5 + 100% K_2O + *Azotobacter* 5ml/tree + PSB 5ml/tree, T_9: 75% N + 100% P_2O_5 +100% K_2O + *Azotobacter* 5ml/tree, T_{10}: 75% N + 100% P_2O_5 + 100% K_2O + PSB 5ml/tree, T_{11}: 75 % N + 100% P_2O_5 + 100% K_2O + *Azotobacter* 5ml/tree + PSB 5ml/tree, T_{12}: 75% N + 75% P_2O_5 + 100% K_2O + *Azotobacter* 5ml/tree, T_{13}: 75% N + 75% P_2O_5 + 100% K_2O + PSB 5ml/tree, T_{14}: 75 % N + 75% P_2O_5 + 100% K_2O + *Azotobacter* 5ml/tree + PSB 5ml/tree, T_{15}: 50% N + 100% P_2O_5 + 100% K_2O + *Azotobacter* 5ml/tree, T_{16}: 50% N + 100% P_2O_5 +100% K_2O + PSB 5ml/tree, T_{17}: 50% N + 100% P_2O_5 + 100% K_2O + *Azotobacter* 5ml/tree + PSB 5ml/tree, T_{18}: 50% N + 75% P_2O_5 + 100% K_2O + *Azotobacter* 5ml/tree , T_{19}: 50% N + 75% P_2O_5 + 100% K_2O + PSB 5ml/tree, T_{20}: 50% N + 75% P_2O_5 + 100% K_2O − *Azotobacter* 5ml/tree + PSB 5ml/tree

Table 2 : Effect of bio-fertilizers and chemical fertilizers on flowering and fruit characters of guava (*Psidium guajava* L.) cv ALLAHABAD SAFEDA

Treatments	Days to flowering	Number of flowers per branch	Fruit set per branch (%)	Fruit retention per branch (%)	Fruit diameter (cm)	Fruit weight (g)	Pulp weight (g)	Peel weight (g)	Number of seeds per fruit	Weight of seeds per fruit (g)
T_1	54.33	16.00	57.59	74.62	8.71	160.25	124.44	28.33	198.33	6.67
T_2	51.67	18.33	62.74	78.40	9.00	180.98	145.67	27.33	177.33	6.33
T_3	44.67	18.67	85.17	88.84	9.33	177.40	146.56	24.33	130.00	5.67
T_4	45.33	17.00	67.32	80.33	9.81	181.88	146.67	25.33	154.67	6.00
T_5	38.00	18.33	66.90	79.91	9.11	188.14	164.56	17.67	139.00	4.67
T_6	47.67	18.33	62.25	79.31	9.46	182.41	152.78	20.67	171.00	6.00
T_7	45.00	18.00	60.13	80.59	9.28	199.80	173.33	20.33	152.33	5.33
T_8	34.67	23.67	81.55	91.79	9.09	212.30	190.56	15.00	117.33	5.00
T_9	40.67	17.67	71.90	88.89	9.61	195.37	168.11	20.67	133.33	6.33
T_{10}	42.00	18.67	78.01	89.28	9.03	182.19	153.44	20.00	141.67	6.33
T_{11}	37.67	18.00	65.85	90.89	9.45	184.94	160.67	18.00	111.33	4.00
T_{12}	49.33	17.67	75.27	90.87	9.18	201.21	168.44	26.00	151.00	5.33
T_{13}	48.67	17.33	68.17	86.90	9.14	192.74	161.78	24.67	145.33	5.67
T_{14}	32.33	25.33	90.20	92.96	10.07	215.06	193.44	16.00	113.00	4.33
T_{15}	50.33	21.00	72.53	79.89	9.20	198.84	172.67	20.67	133.67	5.33
T_{16}	45.33	18.67	83.67	87.61	9.36	188.52	162.89	20.00	154.33	5.00
T_{17}	38.00	18.00	79.70	90.94	9.14	190.43	166.78	18.33	117.33	4.67
T_{18}	48.67	18.33	86.74	87.25	9.09	183.56	157.44	20.67	133.67	5.00
T_{19}	47.67	18.00	72.02	88.63	9.23	183.31	156.56	20.00	139.67	5.67
T_{20}	41.67	19.33	85.80	88.94	9.21	198.30	174.67	18.67	116.00	4.67
S.E. ±	2.25	0.96	3.98	4.00	0.22	8.26	7.78	1.14	5.11	0.34
C.D. at 5 %	6.43	2.74	11.40	11.46	0.63	23.65	22.28	3.26	14.62	0.98
C.V. %	8.81	8.80	9.36	8.07	4.11	7.53	8.32	9.35	6.25	10.93

Fruit characters :

Among different treatments significantly the maximum tree height was recorded in treatment T_{14} *i.e.* 75% N + 75% P_2O_5 + 100% K_2O + *Azotobacter* 5ml/tree + PSB 5ml/tree which also recorded significantly higher fruit diameter (10.07 cm), fruit weight (215.06 g) maximum pulp weight (193.44 g). While, the treatment T_{11} *i.e.* 75% N + 100% P_2O_5 + 100% K_2O + *Azotobacter* 5ml/tree + PSB 5ml/tree recorded minimum peel weight (15.00 g).

Data regarding minimum number of seeds (111.33) in guava fruit under the treatment were recorded in T_{11} (75% N + 100% P_2O_5 + 100% K_2O + *Azotobacter* 5ml/tree + PSB 5ml/tree). Whereas, Minimum seeds weight (4.0 g) was recorded in T_{11} (75% N + 100% P_2O_5 + 100% K_2O + *Azotobacter* 5ml/tree + PSB 5ml/tree) as compared to other treatments. Better fruit quality with respect to fruit diameter, fruit weight, pulp weight, peel weight, number of seeds per fruit and seeds weight per fruit might be due to fact that NPK along with FYM and bio-fertilizers application caused accumulation of more food material in the trees and lead to an efficient utilization of the same for development of fruit. The marked effect of nitrogen on various characters of fruits was due to fact that, it increased the efficiency of metabolic processes of the tree and thus encouraged the growth of the plant in general and consequently the various parts of the plant including fruit. N, P and K fertilizer application, which might have resulted in high rate of photosynthesis results in higher carbohydrate accumulation in fruit thereby increasing in fruit diameter and weight. As the application of NPK significantly enhanced the plant growth and through its beneficial effects, which in turn resulted in an increased in fruit size (Singh *et al.* 2003). These observations are in agreement with findings of Athani *et al.* (2007) and Ram *et al.* (2007) in guava and Patel and Naik (2010) in sapota.

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