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Pratima Gupta
Research Scholar, Department of Horticulture, Allahabad School of Agriculture, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, Uttar Pradesh, India

Devi Singh
Assistant Professor, Department of Horticulture, Allahabad School of Agriculture, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, Uttar Pradesh, India

VM Prasad
Assistant Professor, Department of Horticulture, Allahabad School of Agriculture, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, Uttar Pradesh, India

Vidhur Kumar
Assistant Professor, Department of Agriculture, K.P.H.E.I., Jhalwa, Allahabad State University, Allahabad, Uttar Pradesh, India

Correspondence
Pratima Gupta
Research Scholar, Department of Horticulture, Allahabad School of Agriculture, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, Uttar Pradesh, India

Effect of integrated nutrient management on growth and yield of guava (P*sidium guajava* L.) cv. Allahabad safeda under high density planting

Pratima Gupta, Devi Singh, VM Prasad and Vidhur Kumar

Abstract
The present investigation entitled, "Effect of integrated nutrient managemnt on growth and yield of guava (*Psidium guajava* L.) cv. Allahabad Safeda under high density planting" was conducted at Department of Horticulture, Allahabad School of Agriculture, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad during 2016-17 and 2017-18. The experiment laid out in Randomized Block Design (RBD) with three replications. The experiment consisted of ten treatments viz. (T_0) 100% RDF (NPK-180,90,90g), (T_1) 75% RDF+2.5 kg Vermicompost, (T_2) 50% RDF+2.5 kg Vermicompost, (T_3) 75% RDF+10 kg FYM, (T_4) 50% RDF+10 kg FYM, (T_5) T_3 + Micronutrients (Zn+B+Mn (0.5,0.2,0.1%), (T_6) T_4 + Micronutrients (Zn+B+Mn (0.5,0.2,0.1%), (T_7) 50% RDF+10 kg FYM+Azotobactor, (T_8) 50% RDF+10 kg FYM+ Azotobactor+ PSB (100g/P), (T_9) 50% RDF+10 kg FYM+ VAM, (T_{10}) 50% RDF+10 kg FYM+ Azotobactor+ VAM. The results revealed that the application of 75% RDF+10 kg FYM + Micronutrients (Zn+B+Mn (0.5,0.2,0.1%), (T5) significantly influence the growth and yield of guava. Maximum plant height (256.80 cm), more number of branch (20.56), maximum number of leaves (150.16), maximum plant girth (2.58), higher number of flowers (79.33), more number of fruits (38.23), fruit diameter (6.51 cm), fruit length (6.05 cm) at harvest, fruit volume (121.75 ml), average fruit weight (152.84 g) and number of fruits per plant (5829.59 g) were obtained with treatment T5. The combined application of 75% recommended dose of NPK with FYM (10 kg) and micronutrient gave significantly higher fruit yield per hectare (99.56q/ha).

Keywords: INM, azotobactor, FYM, vericompost, micronutrient

Introduction

Guava (*Psidium guajava* L.), is one of most exquisite, valuable and popular fruits grown in tropical, sub-tropical and some parts of arid regions of India, which belongs to the family Myrtaceae. The total area under guava cultivation and production in India is about 2.51 lakh hectares and 4083,000 MT, respectively. The productivity of guava in India is 16.2 MT/ha. The total area and production of guava in Madhya Pradesh is around 24370 hectares and 9.12 Lakh MT, respectively. Madhya Pradesh ranks first in productivity with 37.4 MT/ha. Guava shares 4.5 percent of area and 3.3 per cent of production among fruit crops in India (Anonynous, 2015) [1].

Guava is one of the richest natural source of vitamin C containing 2 to 5 times more vitamin C than oranges. Among fruits, it ranks third in vitamin C content after Barbados cherry and Aonla. However, these fruits unlike guava are not used in fresh form. Compared to other fruits, the whole guava is a moderately good source of calcium, a fair source of phosphorus and a good source of iron. Guava is an excellent source of dietary fiber, pectin and minerals. it is also stewed and used in short cake and pies. However, guava fruits are processed commercially into jellies, jam, cheese, puree, juice, powder and nectar. Due to their astringent properties, mature guava fruits, leaves, roots, bark and immature fruits are used in local medicines to treat gastroenteritis, diarrhea, and dysentery.

Conventional (chemical based) farming is non-sustainable because of many problems such as loss of soil health and productivity from excessive erosion and low farm income from high production costs etc. In view of these, there is an increasing awareness about alternate agriculture system known as integrated nutrient management. The basic concept of integrated nutrient management (INM) is the adjustment of plant nutrient supply with proper combination of chemical fertilizers, organic manure and biofertilizers suitable to the system of land use and ecological, social and economic conditions. *Azotobacter* is known to add nitrogen to the soil through biological nitrogen fixation. VAM fungi function mnutualistically by transporting slowly mobile ions of P, Zn and Cu from soil profile which lies beyond depletion zone of active roots. It also promotes and increase nitrate reduce enzyme activity and

It also promotes and increase nitrate reduce enzyme activity and promotion of antifungal substances. Phosphorus solubilising microorganisms helps in transforming inorganic fixed phosphates to available form by microbial action and have greater economical importance in improving plant nutrition. The activity of phosphorus solubilizing microbes (PSM) can be improved by using them in combination with organic manures. Vermicompost, the compost prepared by earthworms has gained popularity in recent years, which is a rich source of growth promoting substance. s *viz.*, growth hormones, enzymes and vitamins (Bhawalkar, 1992). There is an urgent need for an alternative nutritional package to attain long term sustainability for fruit production as well as for maintaining soil health and productivity under INM system. Keeping the above facts in view, an experiment was conducted to find out the INM effects of integrated nutrient management on pre bearing growth and sustainable production of guava.

Materials and Methods

The present experiment was carried out at Department of Horticulture, Allahabad School of Agriculture, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad (UP) during rainy and winter season of the years, 2016-17 and 2017-18. The experiment was conducted in Randomized Block Design (RBD) with three replications. The experiment was consisted of ten treatments viz., Control (T_0) 100% RDF (NPK-180,90,90g), (T_1) 75% RDF+2.5 kg Vermicompost, (T_2) 50% RDF+2.5 kg Vermicompost, (T_3) 75% RDF+10 kg FYM, (T_4) 50% RDF+10 kg FYM, (T_5) T_3 + Micronutrients (Zn+B+Mn (0.5,0.2,0.1%), (T_6) T_4 + Micronutrients (Zn+B+Mn (0.5,0.2,0.1%), (T_7) 50% RDF+10 kg FYM+Azotobactor, (T_8) 50% RDF+10 kg FYM+ Azotobactor+ PSB (100g/P), (T_9) 50% RDF+10 kg FYM+ VAM, (T_{10}) 50% RDF+10 kg FYM+ Azotobactor+ VAM. The whole of the organic manure was applied as a basal dose on the onset of monsoon. Then required doses of fertilizers were applied in the month of August and then bio-fertilizers were applied one week after each application of inorganic fertilizer. For application of manure and fertilizers the top soil around the tree equal to the leaf canopy of the tree was dug up to 30 cm and the fertilizers were uniformly mixed into the soil, which was then leveled. Irrigation was supplied immediately after fertilizer application. Micronutrient were applied before flowering of guava plants. The various growth parameters *viz.*, plant height, number of branches per plant and number of leaves were recorded with the help of measuring device at the time of fertilizer application. Fruit length and diameter were noted using the vernier caliper, volume of fruit was recorded by water displacement method and weight of fruit was recorded using electronic weigh balance.

Results and Discussion

Growth characters

The applications of integrated nutrient management treatments were significantly effective in improving the growth characters (Table 1). Among treatments, the application of (T_5) 75% RDF, (NPK 120:60:60 kg/ha) + 10t FYM + (Zn+B+Mn (0.5,0.2,0.1%), was found to be most significantly superior in compression of other treatments and recorded taller plants (256.80 cm) which was significantly at par with 75% RDF, (NPK 120:60:60 kg/ha) + 10t FYM. Treatment receiving 75% RDF, (NPK 120:60:60 kg/ha) + 10t FYM + (Zn+B+Mn (0.5,0.2,0.1%), produced more number of leaves (150.16), higher number of branches (20.93) and plant girth (2.58 m3) as compared all other treatments. However, minimum growth attributes were obtained under control (100% RDF) in present investigations. This might be due to the fact that growth and development of above ground parts of plant are determined primarily by the activity of apical meristem, because the leaf primordial is formed there. The stem elongation depends initially on the new tissue formed at the apex and many of the hormonal signals which determine the later growth and development of all plant parts. It becomes clear that, higher dose of inorganic fertilizers along with manures and micronutrients increased availability of nutrients. Similar findings have been reported by Dutta *et al.* (2009) [2], Dwivedi *et al*. (2018) [3] and Jamwal *et al*. (2018) [5] in guava. Nitrogen positively influenced the vegetative growth of the plant, phosphorus plays an important role in photosynthesis and accumulation of food material and potassium plays an important role in carbohydrate and protein synthesis and in the regulation of water relations. It may also act as a catalyst in the formation of more complex substances and in the acceleration of enzyme activity. These nutrients also play an important role in metabolic activities of the plant resulting in the synthesis of chlorophyll and cytochromes which are essential for photosynthesis and respiration process in the plants. Application of organic manures with biofertilizers reported to facilitate the wider absorption of micro and micronutrient which help in better growth and development of plant. Sahu *et al.* (2015) [11] also confirm the results.

Effect of INM on yield and yield attributes

The application of organic fertilizer with combination of inorganic fertilizer and micronutrient were significantly affected yield and yield attributing characters of guava in present experimentation. The treatment receiving (T_5) 75% RDF, (NPK 120:60:60 kg/ha) + 10t FYM + (Zn+B+Mn (0.5,0.2,0.1%), recorded maximum number of flower per plant (79.33), higher number of fruits per plant (38.23), fruit diameter (6.51 cm), fruit length (6.05 cm), fruit volume (121.75 m3) and average weight of fruit (152.84 g) which was at par with treatment 75% RDF+ 10 T FYM and significantly higher all other treatments, whereas these values were minimum with the treatment of T0 (100% RDF). Among different treatment combinations, treatment containing 75% RDF, (NPK 120:60:60 kg/ha) + 10t FYM + (Zn+B+Mn (0.5,0.2,0.1%), had positive influence on yield per plant and per hectare (Table 3). This treatment recorded significantly maximum fruit yield per plant (5829.29 g) and fruit yield per hectare which were at par with treatments 75% RDF+ 10 T FYM. However, minimum fruit yield per plant and per hectare were recorded under the treatment of control (100% RDF). The higher yield with different combinations of organic, inorganic and micronutrients could be attributed to sustained availability of major as well as micro nutrients which is evident from the higher accumulation of nutrients by guava plant from soil. The effect was more pronounced during the second year with combination of organic and inorganic with micronutrients. It is well known that nitrogen is the constituent of proteins, enzymes and chlorophyll and involves in all the processes associated with photosynthesis and growth, hence increase in weight and yield due to nitrogen application is obvious. The increase in weight and yield by addition of adequate quantity of phosphorus was possibly due to its association with various chemical reactions in the cell and is responsible for the synthesis of protoplasm.

Hence, an increase in the vegetative growth was resulted in more carbohydrates assimilation, which may partly be responsible for higher yields. It is assumed that potassium plays an important part in carbohydrate and protein synthesis and in the regulation of water relations in living cells. It may also act as a catalyst in the formation of more complex substances and in the acceleration of enzyme activity. Carbohydrates and co-enzymes are beneficial in increasing size of fruits and ultimately weight of the fruit.

The inclusion of FYM and micronutrients with chemical fertilizer greatly helped in improving the flower and fruit attributes. The application of nitrogen, phosphorus, potash, manures, bio-fertilizer to synthesize of amino acid act as precursor of polyamine and secondary messenger in growth characters and development of flowers. Synthesis of this amino acid is also influenced by phytohormones which are formed in plant due to the application of chemical and bio-fertilizers were reported by Goswami *et al.* (2012) [4], Surage *et al.* (2017) [13] and Dwivedi *et al*. (2018) [3] also reported similar results in guava. The significant increase in number of fruits per plant might be due to active and rapid multiplication of bacteria especially in rhizosphere creating favourable condition for nitrogen fixation and phosphorus solubilization at higher rate through nitrogen supply by nitrogenous fertilizers and supply of other nutrients, bacterial secretion, hormone production and supply of antibacterial and antifungal compounds, which were favourable for growth and ultimately increased yield. These findings corroborate with that of Singh (2008) [12], Rubee Lata *et al.* (2011) [10], Mamnindla *et al.* (2014) [8] and Kumrawat *et al*. (2018) [6].

Table 1: Effect of integrated nutrient management on growth attributes of guava (mean of two years)

	Treatment	Plant height (cm)	No of branches/plant	No of leaves/plant	plant girth (cm)	No of flowers/plant	No of fruit per plant
T_0	100% RDF (NPK-180,90,90g)	147.73	14.48	93.05	1.84	48.93	18.33
T_1	75% RDF+2.5 kg Vermicompost	213.93	17.05	119.20	2.23	70.00	28.55
T_2	50% RDF+2.5 kg Vermicompost	199.33	16.18	108.09	2.09	66.45	26.80
T_3	75% RDF+10 kg FYM	249.83	19.38	137.83	2.51	76.15	35.68
T_4	50% RDF+10 kg FYM	203.50	16.75	112.92	2.15	66.93	27.25
T_5	T_3 + Micronutrients (Zn+B+Mn (0.5,0.2,0.1%)	256.80	20.93	150.16	2.58	79.33	38.23
T_6	T_4 + Micronutrients (Zn+B+Mn (0.5,0.2,0.1%)	231.45	18.45	131.57	2.41	74.50	34.00
T_7	50% RDF+10 kg FYM+Azotobactor	190.58	15.40	100.52	1.97	62.73	25.08
T_8	50% RDF+10 kg FYM+ Azotobactor+ PSB (100g/P)	216.18	17.35	124.57	2.34	72.65	32.03
T_9	50% RDF+10 kg FYM+ VAM	187.35	15.18	97.49	1.92	60.53	23.63
T_{10}	50% RDF+10 kg FYM+ Azotobactor+ VAM	194.35	15.50	104.32	2.02	64.80	26.25
	F- test	S	S	S	S		
	SEm ±	3.08	0.27	1.83	0.03	1.03	0.48
	CD at 5%	9.16	0.79	5.43	0.10	3.07	1.43

Table 2: Effect of integrated nutrient management on yield and yield attributes of guava (mean of two years)

	Treatment	Fruit diameter (cm)	Fruit length (cm)	Fruit volume (m3)	Fruit weight (g)	Fruit yield /plant (g)	Fruit yield q/ha
T_0	100% RDF (NPK-180,90,90g)	5.63	4.59	102.09	96.28	1765.74	27.50
T_1	75% RDF+2.5 kg Vermicompost	6.19	5.70	114.61	133.48	3801.73	62.43
T_2	50% RDF+2.5 kg Vermicompost	6.03	5.54	110.55	127.20	3398.57	51.33
T_3	75% RDF+10 kg FYM	6.38	5.93	119.86	148.31	5277.71	90.12
T_4	50% RDF+10 kg FYM	6.10	5.61	112.92	129.33	3517.00	57.01
T_5	T_3 + Micronutrients (Zn+B+Mn (0.5,0.2,0.1%)	6.51	6.05	121.75	152.84	5829.59	99.56
T_6	T_4 + Micronutrients (Zn+B+Mn (0.5,0.2,0.1%)	6.29	5.86	118.61	143.33	4864.76	79.46
T_7	50% RDF+10 kg FYM+Azotobactor	5.91	5.28	108.63	111.25	2790.57	45.62
T_8	50% RDF+10 kg FYM+ Azotobactor+ PSB (100g/P)	6.25	5.77	116.73	137.38	4395.41	70.75
T_9	50% RDF+10 kg FYM+ VAM	5.84	5.12	106.31	106.10	2503.71	40.97
T_{10}	50% RDF+10 kg FYM+ Azotobactor+ VAM	5.99	5.45	108.57	116.88	3069.14	48.76
	F- test	S	S	S	S		
	SEm ±	0.10	0.09	1.64	2.15	44.19	1.05
	CD at 5%	0.29	0.26	4.86	6.38	131.28	3.13

Conclusion

Thus, on the basis of results, summarized above it can be concluded that application of 75% RDF+10 kg FYM + Micronutrients (Zn+B+Mn (0.5, 0.2, 0.1%) were proved to be the best for improving the growth, yield and quality of guava (*Psidium guajava* L.) cv. Allahabad safeda under high density planting in eastern part of Uttar Pradesh. It also concluded that guava grow winter season are beneficial and profitable for farmers

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