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Effect of Organic, Inorganic and Biofertilizers on Yield, Quality and Economics of Guava

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ABSTRACT

An experiment was conducted to assess the effect of organic, inorganic and bio-fertilizers on yield, quality and economics of guava (*Psidium guajava* L.) during 2014-15. Result exhibited maximum total soluble solids (11.37 °Brix) in T4 (100% recommended dose of NPK + 50kg FYM + 150g Azotobacter + 100g PSB). The lowest pH (4.21) was recorded in T4 (100% recommended dose of NPK + 50kg FYM + 150g Azotobacter+100g PSB). The highest ascorbic acid was found in T13 (50% Recommended dose of NPK + 50 kg FYM + 150kg Azotobacter + 100g PSB).The higher total acidity (0.58%) was recorded with T4 (100% recommended dose of NPK + 50kg FYM + 150g Azotobacter + 100g PSB).The maximum (147.78) of fruits yield (q/ha) was obtained in T5 - 100% Recommended dose of NPK + 50kg FYM + 150g Azotobacter + 100g PSB and maximum Cost : Benefit ratio (1:3.53) was recorded in T5.

Introduction

Guava (*Psidium guajava* L.) is one of the most important and extensively cultivated tropical crops of India. It is good source of vitamin-C, pectin, also contains fair amount of calcium and widely used for making of jelly. The ascorbic acid content of guava is four-five times higher than the citrus fruit. It is hardy fruit which can be grown in alkaline and poorly drained soil. Important guava growing states in the country are Uttar Pradesh, Bihar, Madhya Pradesh, Maharashtra, Andhra Pradesh, West Bengal, Tamil Nadu, Gujrat, Punjab, Assam, Karnataka, Orissa, Kerala and Rajasthan. Allahabad district of Uttar Pradesh has the reputation of growing the best quality of guava fruits in the world (Lal and Das, 2017). The three times flowering seasons have been observed in North Indian conditions while two flowering seasons have been reported in other parts of the country. The flowering may affect with plant age and stress (Lal and Nath, 2020b) as well as phenolics content (Lal *et al.*, 2019a). Guava is self pollinated crops but cross pollination also occur to some extent and success of fruit set depend on pollen grains used in pollination (Lal *et al.*, 2019b and c). The continuous harvesting of the fruit may affect the quality production but it may be maintained through crop regulation (Lal *et* *al.,* 2017a), plant growth regulator application (Lal *et al.,* 2013 and 2017). However, weather condition and fruit drop may affect yield and quality of fruits (Lal and Nath, 2020a; Lal *et al.,* 2017b). Intensive agriculture is today's demand to meet the requirement by growing populations but it dramatically increases deforestation and conversion of grassland to agriculture, soil degradation by increasing soil erosion, compaction, crusting and water logging, salinization, alkalisation, acidification, soil pollution and nutrient depletion, reduction of organic matter content in the soil and poisoning water with agricultural chemicals (Sahu *et al.*, 2019). The tremendous use of chemical fertilizers affects soil properties. The efficient soil microbes play an important role, since they are responsible to drive various biological transformations and different pools of carbon (C) and macro- and micronutrients, which facilitate the subsequent establishment of soil-plant-microbe interaction (Sahu *et al.*, 2017). Organic materials help to maintain the population of soil microbes. Application of biofertilizers increases minerals and water uptake, root development, vegetative growth and N- fixations. Nutrition improved in yield and quality in guava (Jayswal *et al.,* 2017b), water melon (Hazarika *et al.,* 2016), cabbage (Kumar *et al.,* 2015a, b). Tracer technique helps to trace the nutrient element in the plants (Diwan *et al.,* 2019). Hence, inorganic and organic as well as biofertilizers are important inputs to boost quality production with minimum hampering into the soil.

Materials and Methods

An experiment was conducted to assess the effect of organic, inorganic and bio-fertilizers on yield, quality and economics of guava (*Psidium guajava* L.) during 2014-15 at the Research Farm of KVK Majhgawan, District Satna, MP which is situated in the North-east part of Madhya Pradesh at latitude 24°' 31 N', longitude 81° 15 E' and altitude of 306 meters above the mean sea level. The region is semi-arid and sub-tropical having hot and dry summer followed by rainy season and cold winter. The average rainfall varies from 3.5 mm to 79.96 mm. The rainfall is observed mainly from July to September and sometimes winter showers are also received. All the fruits were harvested from the tree and the total weight was taken. Fruit yield was expressed in kg per tree. The amount of total soluble solids present in the ripened fruit juice was determined by Hand Refractometer and expressed in percentage. The pH of fruit was measured by digital pH meter and average value was analyzed. Specific gravity was determined by water displacement method. As per the existing market prices the input and output costs were computed treatment - wise and different economics parameters viz., cost of cultivation, gross return, net return and benefit cost ratio were calculated. The data recorded during the course of investigation were subjected to statistical analysis as per method of analysis of variance (Fisher, 1936). The significance of the treatment effect were judged with the help of 'F' variance ratio test Greater calculated 'F' value (variance ratio) was compared with the table value, the effect was considered to be significant. The significant difference between the means was tested against the critical difference at 5% level of significance.

Results and Discussion

The data on total soluble solids (°Brix) as influenced by different treatments are presented in table 1. The maximum total soluble solids (11.37 °Brix) was recorded with T4 (100% recommended dose of NPK + 50kg FYM + 150g Azotobacter + 100g PSB). The maximum total soluble solids (°Brix) in T4 may be due to the fact that there was more supplement of nutrients to the plants. TSS is not influenced by number of fruits and fruit weight (Lal *et al.,* 2020). Azotobacter and PSB substantially would have added more nitrogen and solubilized more phosphorus to plants, respectively. FYM and Vermicopmost contain micronutrients which help in proper development of fruits and fruit quality as well. Similar findings were also reported by Uma *et al.*, (2002) and Ramet *et al.*, (2007).

The lowest pH (4.21) was recorded in T4 (100% recommended dose of NPK + 50kg FYM + 150g Azotobacter+100g PSB).The reduction is pH with application of biofertilizer like (Azotobacter and PSB) may be due to the formation of such metabolites which reduced the acidity percentage in fruits (Gopal and Sen 2001). The highest ascorbic acid was found in T13 (50% Recommended dose of NPK + 50 kg FYM + 150kg Azotobacter + 100g PSB).The higher total acidity (0.58%) was recorded with T4 (100% recommended dose of NPK + 50kg FYM + 150g Azotobacter + 100g PSB) which might be due to more number of fruit retention (Nagraj *et al.*, 2019). The results are in confirmation with the application of Azotobacter and PSB which increase the total acidity percentage in guava fruits. This has also been reported by Kirad *et al.*, (2009) and Mitra *et al.*, (2010).The highest TSS (12.07^{0}Brix), Ascorbic acid (244.4mg/100g), Total Sugar (8.45%), Reducing Sugar (4.91%) and Non-Reducing Sugar (3.54%) was recorded in guava with application of 5 kg FYM + 2 kg VC + 75% RDF {225:150:150g NPK} + *Azotobactor*150gm + PSB 100gm / Plant (Jayswal *et al.*, 2017a).Differences in sugar content might be due to maximum conversation of starch into sugar (Lal *et al.,* 2018).

Table.1 Effect of organic, inorganic and bio-fertilizers on quality of fruit

Treatments	TSS	pH	Ascorbic acid (mg/100g)	Acidity (%)
T1 - 100% recommended dose of NPK	7.85	5.61	164.35	0.35
T2 - 100% Recommended dose of NPK + 10kg Vermicompost	9.28	5.22	188.12	0.42
T3 - 100% Recommended dose of NPK + 50kg FYM	9.59	5.16	188.9	0.44
T4 - 100% Recommended dose of NPK + 10kg Vermicompost + 150g Azotobacter + 100g PSB	11.1	4.35	209.91	0.55
T5 - 100% Recommended dose of NPK + 50kg FYM + 150g Azotobacter + 100g PSB	11.37	4.21	213.6	0.58
T6 - 75% Recommended dose of NPK + 10kg Vermicompost	8.71	5.4	185.23	0.39
T7 - 75% Recommended dose of NPK + 10kg Vermicompost + 150g Azotobacter + 100g PSB	10.48	4.72	194	0.52
T8 - 75% Recommended dose of NPK +50 kg FYM	9.13	5.35	186.16	0.41
T9 - 75% Recommended dose of NPK + 50 kg FYM + 150g Azotobacter + 100g PSB	10.72	4.5	203.25	0.54
T10 - 50% Recommended dose of NPK + 10kg Vermicompost	8.07	5.55	173.16	0.36
T11 - 50% Recommended dose of NPK + 50kg FYM	8.48	5.41	184.2	0.38
T12 - 50% Recommended dose of NPK + 10kg Vermicompost + 150g Azotobacter + 100g PSB	9.79	5	190	0.46
T13 - 50% Recommended dose of NPK + 50 kg FYM + 150kg Azotobacter + 100g PSB	10.09	4.9	192.63	0.48
S.Ed (±)	0.2372	0.0463	3.0912	0.0154
C.D. at 5%	0.4896	0.0957	6.3803	0.0319

Table.2 Effect of organic, inorganic and bio-fertilizers on economics of fruit

Treatments	Fruit yield (q/ha)	Selling price (Rs/q)	Cross returns (Rs./ha)	Cost of cultivation (Rs./ha)	Net returns (Rs./ha)	Benefit cost ratio
T1 - 100% recommended dose of NPK	79.24	1000	79240	27881	51359	2.84
T2 - 100% Recommended dose of NPK + 10kg Vermicompost	125.61	1000	125610	18021	87589	3.3
T3 - 100% Recommended dose of NPK + 50kg FYM	125.9	1000	125900	36461	89439	3.44
T4 - 100% Recommended dose of NPK + 10kg Vermicompost + 150g Azotobacter + 100g PSB	144.69	1000	144680	43871	100809	3.19
T5 - 100% Recommended dose of NPK + 50kg FYM + 150g Azotobacter + 100g PSB	147.78	1000	147780	41861	105919	3.53
T6 - 75% Recommended dose of NPK + 10kg Vermicompost	121.33	1000	121340	37084	84256	3.27
T7 - 75% Recommended dose of NPK + 10kg Vermicompost + 150g Azotobacter + 100g PSB	137.24	1000	137240	42934	94306	3.19
T8 - 75% Recommended dose of NPK +50 kg FYM	124.42	1000	124420	35524	88896	3.5
T9 - 75% Recommended dose of NPK + 50 kg FYM + 150g Azotobacter + 100g PSB	138.46	1000	138460	41374	97086	3.34
T10 - 50% Recommended dose of NPK + 10kg Vermicompost	119.74	1000	119740	36142	83598	3.31
T11 - 50% Recommended dose of NPK + 50kg FYM	118.87	1000	118870	34582	84288	3.43
T12 - 50% Recommended dose of NPK + 10kg Vermicompost + 150g Azotobacter + 100g PSB	128.02	1000	128020	41992	86028	3.04
T13 - 50% Recommended dose of NPK + 50 kg FYM + 150kg Azotobacter + 100g PSB	133.24	1000	133240	40432	92808	3.29

There was significant difference among various treatments for fruits yield (q/ha) in guava (Table 2). The maximum (147.78) of fruits yield (q/ha) was obtained in T5 - 100% Recommended dose of NPK + 50kg FYM + 150g Azotobacter + 100g PSB. The maximum fruits yield in T5 may be due to the fact that there was more supplement of nutrients to the plants. Azotobacter and PSB substantially would have added more nitrogen and solubilized more phosphorus to plants, respectively. The increase yield under this treatment was associated with increase the number of fruit, low percentage of fruit drop, and more fruit retention as also reports earlier (Lal *et al.,* 2013; Lal and Das, 2017) and other reason might be attributed to the improved soil environment with better moisture status and increased availability of plant nutrients which lead to better uptake of moisture by the plants, resulting in better vegetative growth, development and yield (Kumar *et al.,* 2015c). Plants received congenial environment and produces more carbohydrate in leaves and food materials are transported to fruits. Similar findings were also reported by Aske *et al.,* (2017), Shiurkar *et al.,* (2016a) and Shiurkar *et al.,* (2016b). Maximum gross return per hectare (Rs. 147780) was recorded in T4 (100% recommended dose of NPK + 50kg FYM + 150g Azotobacter + 100g PSB) and minimum gross return (Rs. 79240) per hectare was recorded in to (100%recommended dose of NPK). Maximum net return per hectare (Rs. 105918.55) was recorded in T4 (100% recommended dose of NPK + 50kg FYM + 150g Azotobacter + 100g PSB) and minimum net return (Rs. 51358.55) per hectare was recorded in To (100% recommended dose of NPK). Maximum Cost : Benefit ratio (1:3.53) was recorded in T4 (100%recommended dose of NPK + 50kg FYM + 150g Azotobacter + 100g PSB) and minimum Cost : Benefit ratio (1:2.84) was recorded in To (100% recommended dose of NPK).The highest (276.03 q ha-1) total yield was observed in soil application at 10 kg ha-1 of ZnSO4+Borax+CuSO4 along with RDF while, lowest (212.12 q ha-1) total yield was recorded in Control (Aske *et al.,* 2017).The highest fresh weight(137.59 g/m2) and yield per hectare (13.73q/ha) was recorded in fenugreek under treatment 50 kg P2O5 per hectare and highest yield per plot (0.294 kg) was recorded in treatment 30kgP2O5 per hectare whereas lowest yield was obtained where there was no application of phosphorous and inoculation of biofrtilizers (Shiurkar *et al.,* 2016a). The highest cost benefit ratio was obtained in fenugreek with the treatment 50 kg P2O5 per ha + Rhizobium + PSB (Shiurkar *et al.,* 2016b).

It can be concluded that treatment T5(100% recommended dose of NPK, 50kg FYM + 150g Azotobacter +- 100g PSB) recorded as best treatment in terms of better growth, yield and quality of guava. This treatment can be considered most appropriate for integrated nutrient management of guava in this region which is economic with a benefits cost ratio of (1:3.53).

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