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Studies on Impact of Organic and Inorganic Fertilizers on Growth, Yield and Quality of Guava (*Psidium guajava*) Allahabad Safeda under Sub Tropical Climatic Conditions

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ABSTRACT: The present investigation was carried out in the Farm Krishi Vigyan Kendra, Sangaria, Hanumangarh, Rajasthan during the month of July 2020 to March 2021. The experiment consists of 8 treatment combinations in a Randomized Block Design which are studied and replicate thrice in 5 × 5 m^2 spacing. Eight treatment combinations *viz.*, T_0 Control, T_1 90% RDF + 10% FYM /Tree, T_2 85% RDF + 15% FYM/Tree, T_3 80% RDF + 20 % FYM/Tree, T_4 75% RDF + 25% FYM /Tree, T_5 70% RDF + 30% FYM /Tree, T_6 65% RDF + 35% FYM/Tree and T_7 60% RDF + 40 % FYM/Tree were applied during the research work on Guava. The treatment was done at vegetative growth stage and harvesting stage was calculated in each treatment which were selected in each plant. From the above finding it may be concluded that treatment T_1 -90% RDF + 10% FYM/Tree recorded as best treatment in terms of better growth, yield and quality of 10 year old guava under sub tropical condition. This treatment can be considered most appropriate for integrated nutrient management of Guava in this region.

Keywords: Guava, Organic Fertilizers, Inorganic Fertilizers, yield and quality.

INTRODUCTION

Guava is the fourth most important fruit crop in India after Mango, Banana and Citrus. In India, guava occupies an area of 228.5 thousand hectares and production of 2.71 million tones has been achieved during 2017-18 with a productivity of 12.32 metric tonnes ha^{-1}. Its cultivation is common in India, which is concentrated mainly in Uttar Pradesh, Bihar, Madhya Pradesh, Maharashtra and Chhattisgarh. Chhattisgarh has covered an area of 15.6 thousand hectares with an annual production of 121300 metric tonnes and a productivity of 7.78 metric tonnes ha^{-1}. The low productivity of guava in the state as compared to national productivity may be due to less adoption of improved crop management technology in respect of planting system, nutrition, plant protection and irrigation etc. Among several other factors, probably nutrition is a key factor affecting the productivity of fruit trees. As guava tree removes large amount of nutrients from soil, balanced fertilization seems to be an important factor governing the productivity of guava trees. Imbalance use of chemical fertilizers is a common practice adopted by the farmers. Large scale use of chemical fertilizers causes problem of ground water and environmental pollution through leaching, volatilization, denitrification and wastage of nutrients through costly fertilizers. The disproportionate use of chemical fertilizers has widened soil imbalance in terms of NPK ratio. The occurrence of multi-nutrient deficiencies and overall decline in productive capacity of soil has been widely reported due to non- judicious fertilizer use.

The recent concept of integrated nutrient supply involving organic, inorganic and bio-fertilizers has developed to meet the growing need for nutrients under intensive cultivation. In integrated plant nutrition supply system, the basic goal is to maintain or possibly improve the soil fertility and plant nutrient supply to an optimum level for sustaining the desired crop productivity through optimization of the benefits from all possible sources of plant nutrients in an integrated manner. Guava is very hardy to soil and agro-climatic conditions and gives good response to manuring in terms of increasing fruit production and quality.

In recent days, consumers are becoming more and more health conscious and are ready to pay more price for organically grown quality fruits, due to its taste, appearance, more shelf life and richness in nutritive parameters. During last few years, the demand for organically grown fruits is increasing as compared to fruits produced from chemical farming systems.

MATERIALS AND METHODS

The investigation was conducted during 2020-2021 at the Farm krishi Vigyan Kendra, Sangaria, Hanumangarh, Rajasthan. Eight treatment combinations viz. T_0 Control, T_1 90% RDF + 10 % FYM Tree, T_2 85% RDF + 15 % FYM /Tree, T_3 80% RDF + 20 % FYM /Tree, T_4 75% RDF + 25 % FYM/Tree, T_5 70% RDF + 30 % FYM /Tree, T_6 65% RDF + 35 % FYM /Tree and T_7 60% RDF + 40 % FYM/Tree were applied were tried in the experiment was laid out in Factorial Randomized Block Design with three replication. All the facilities necessary for cultivation, including labour were made available in the department. Well rotten FYM@ 250 q ha^{-1} was applied at the time of field preparation. The field was fertilized to supply nitrogen at the rate of 120 kg ha^{-1} along with 60 kg ha^{-1} phosphorus and 50 kg ha^{-1} potash. The urea was applied in three equal doses. The treatment was done at vegetative growth stage. Ten healthy fruits were randomly selected from each tree at full maturity stage to record the various developmental parameters of the fruits. The test of significance among the treatment means was worked out by "F" test. The appropriate Standard Error of mean (S.Em.) was calculated in each case and the Critical Difference (C.D.) at five percent level of probability was worked out to compare two treatments means where the treatment effects were significant. Various observations were taken on growth parameters like number of fruit, weight of fresh fruit (g), fruit diameter (cm), fruit length (cm), fruit volume, fruit specific gravity; pulp Thickness (cm), Pulp weight (g), Yield per treatment (kg). (b) Chemical Characteristics—Total soluble solids, acidity, vitamin C, fruit length, pulp thickness and diameter were noted using hand refractometer was used for determination of TSS in °Brix. Instead of accuracy, fruit volume was weighed electronically by the scientific method and fruit weight, water weight, weight, transplant modification (kg) and number of scientific/kg.

RESULTS AND DISCUSSION

A. Growth Parameters

Influences of bio-fertilizer and different sources of organic manure and their combinations on days taken for first harvest, and subsequent second, third, and fourth harvesting are presented in Table 1. The maximum tertiary shoot length (3.58 cm) was recorded in T_1 -90% RDF + 10 % FYM/Tree followed by (3.51 cm with T_2 -85% RDF + 15% FYM/Tree and the minimum tertiary shoot length (2.13 cm) was recorded with T_7 -60% RDF + 40 % FYM/Tree. It was observed that improvement of vegetative characteristics was registered with integrated source of nutrient both from mineral fertilizers and organic manures. All the integrated nutrient management treatments exerted positive effect over other treatment where plant was given lower doses of chemical fertilizer and organic manures. The results are in confirmation by Dwivedi and Agnihotri (2018). The maximum shoot diameter (27.55 mm) was recorded with T_1 -90% RDF + 10 % FYM/Tree followed by 26.20 mm with T_2 -85% RDF + 15 % FYM/Tree with the treatment T_3 -80% RDF + 20 % FYM/Tree (25.84 mm) and the minimum shoot diameter (22.46 mm) was recorded with T_7 -60% RDF + 40% FYM/Tree. The maximum shoot diameter (mm) in combined treatment of 90% RDF + 10 % FYM/Tree may be due to the fact that there was more supplement of nutrients to the plants. NPK and FYM synergistically would have added more nitrogen and organic matters to plants, respectively. Similarly in the treatment with 85% RDF + 15% FYM/Tree also and therefore, there was statistically on par results for shoot diameter. The maximum number of leaves per shoot (7.02) was recorded with T_1 -90% RDF + 10 % FYM before harvesting followed by 6.76 with T_2 -85% RDF + 15% FYM/Tree with the treatment T_3 -80% RDF + 20 % FYM/Tree (6.53) number of leaves per shoot and the minimum number of leaves per shoot (5.23) was recorded with T_7 -60% RDF + 40 % FYM/Tree. The maximum number of leaves per shoot in T_1 may be due to the fact that there was more supplement of nutrients to the plants. NPK and FYM synergistically would have added more nitrogen and organic matters to plants, respectively. Similarly in T_2 also and therefore, there was statistically on par results for number of leaves per shoot. Maximum number of flower per shoot (612.53) at flowering time was recorded with T_1 -90% RDF + 10 % FYM/Tree followed by 608.79 with T_2 -85% RDF + 15 % FYM/Tree and the minimum number of flower per shoot (506.18) was recorded with T_7 -60% RDF + 40 % FYM/Tree. Significant increase in number of flower per shoot with the use of optimum dose of NPK and FYM may be attributed to increased metabolic uses of these nutrients in plants which seems to have promoted meristematic activities resulting in higher apical growth and expansion of photosynthetic surface. Similar findings were also reported by Maity *et al.,* (2006); Choudhary *et al.* (2017); Singh *et al.,* (2018); Verma *et al.,* (2019); Ramawatar *et al.,* (2020); Dheware *et al.,* (2020).

B. Yield Parameters

The maximum fruit setting (73.40%) at flowering time was recorded with T_1 -90% RDF + 10% FYM/Tree followed by 72.31% with T_0 -100% RDF (Control) and the minimum fruit setting (61.28%) was recorded with T_7 -60% RDF + 40 % FYM/Tree. The minimum fruit drop (26.6%) after flowering was taken in T_1 -90% RDF + 10 % FYM/Tree followed by 27.69% with T_0 -100% RDF (Control) closely the treatment T_2 -85% RDF + 15 % FYM/Tree (28.44%) and the maximum fruit drop (38.72%) was recorded with T_7 -60% RDF + 40 % FYM/Tree.

Table 1: Effect of different Organic and Inorganic Fertilizers onon growth, flowering, yield and quality of guava.

Treatments	Tertiary shoot length (cm)	Shoot diameter (mm)	Number of leaves per shoot	No. of flower per Shoot	Fruit setting (%)	Fruit Drop (%)	No. of seed per fruit	Seed weight (g)	Pulp weight (g)	Pulp: Seed ratio	Number of fruit per tree	Fruit weight (g)	Fruit Yield (kg/ tree)	TSS (^{O}Brix)	Ascorbic acid (mg/ 100g)	Taste	Aroma	Shelf life (Days)
T_0	3.40	24.17	6.31	598.41	72.31	27.69	48.61	13.52	192.26	7.03	482	192.67	92.86	24.94	110.5	7.23	7.02	4.72
T_1	3.58	27.55	7.02	612.53	73.40	26.6	41.54	12.44	197.11	6.31	502	197.11	98.95	26.31	114.2	8.11	7.91	5.49
T_2	3.51	26.20	6.76	608.79	71.56	28.44	46.73	13.15	195.45	6.72	471	195.45	92.06	25.20	110.6	7.89	7.45	5.13
T_3	3.46	25.84	6.53	585.16	68.92	31.08	51.59	14.79	193.82	7.63	456	193.82	88.38	24.12	109.0	7.40	7.26	5.01
T_4	3.35	24.61	5.92	543.84	68.13	31.87	53.22	14.35	186.02	7.71	401	186.02	74.59	22.45	107.6	7.21	7.03	4.28
T_5	3.22	24.03	5.84	520.57	65.19	34.81	55.34	15.84	171.52	9.23	386	171.52	66.21	20.84	105.7	6.57	6.12	4.10
T_6	3.09	23.79	5.47	513.93	63.77	36.23	60.08	16.67	160.33	10.39	375	160.33	60.12	19.24	102.8	5.22	5.00	4.02
T_7	2.13	22.46	5.23	506.18	61.28	38.72	64.36	17.02	148.82	11.43	334	148.82	49.70	17.02	100.3	5.04	4.37	3.78
S.Ed(±)	0.02	0.33	0.03	0.02	0.04	0.06	0.02	0.01	0.015	0.02	1.25	2.64	0.29	0.04	0.07	0.03	0.03	0.02
CD at 5%	0.04	0.68	0.06	0.06	0.10	0.13	0.06	0.03	0.033	0.06	2.68	5.67	0.62	0.10	0.15	0.06	0.06	0.06

The minimum fruit drop (%) pertaining to T_1 -90% RDF + 10% FYM/Tree may be due to supply of more nutrients to the plants. At the same time addition of biofertilizers certainly would have helped in more absorption of plant nutrients. The maximum fruit retention (71.19%) after flowering time was recorded with T_1 -90% RDF + 10% FYM/Tree followed by 70.35% with T_0 -100% RDF (Control) and then T_2 -85% RDF + 15% FYM/Tree (69.34%) the minimum fruit retention (58.41%) was recorded with T_7 -60% RDF + 40 % FYM/Tree. The maximum fruit volume (157.79 ml) after harvest was recorded with T_1 -90% RDF + 10% FYM/Tree followed by 153.84 ml with T_2 -85% RDF + 15% FYM/Tree and then allied treatment T_0 -100% RDF (CONTROL) 151.61 ml the minimum fruit volume (139.58ml) was recorded with T_7 -60% RDF + 40% FYM/Tree. The minimum 41.54 number of seed per fruit after harvest was recorded with T_1 -90% RDF + 10% FYM/Tree followed by 46.73 with T_2 -85% RDF + 15% FYM/Tree and the maximum 64.36 number of seed per fruit was recorded with T_7 -60% RDF + 40% FYM/Tree. Maximum seed weight (g) after harvest was recorded with T_1 -90% RDF + 10% FYM / Tree followed by 153.84 with T_2 -85% RDF + 15% FYM/Tree and the minimum seed weight (g) was recorded with T_7 -60% RDF + 40% FYM/Tree. Maximum pulp weight (197.11g) after harvest was recorded with T_1 -90% RDF + 10% FYM/Tree harvest followed by 195.45g with T_2 -85% RDF + 15% FYM/Tree and the minimum pulp weight (148.82g) was recorded with T_7-60% RDF + 40% FYM/Tree. The minimum pulp : seed ratio (6.31) after harvest was taken in T_1 -90% RDF + 10% FYM/Tree followed by by (6.72) with T_2 -85% RDF + 15 % FYM/Tree and the maximum pulp : seed ratio (11.43) was recorded with T_7 -60% RDF + 40% FYM/Tree. Maximum (502) number of fruit per tree after harvest was recorded with T_1 -90% RDF + 10% FYM/Tree followed by (482) with T_0 -100% RDF (Control) and the minimum (334) number of fruit per tree was recorded with T_7 -60% RDF + 40% FYM/Tree. Maximum fruit weight (197.11 g) after harvest was recorded in treatment T_1 -90% RDF + 10 % FYM/Tree followed by 195.45 with T_2 -85% RDF + 15% FYM/Tree and the minimum fruit weight (148.82g) was recorded with T_7 -60% RDF + 40 % FYM/Tree. It might be due to increased and prolonged availability of nutrients from integrated use of NPK and FYM, which ultimately resulted in rapid cell multiplication and cell elongation under sufficient nutrient supply. The results were in accordance with those reported by Dwivedi *et al.*, (2018). The maximum fruit yield (98.95 kg/tree) after harvest was recorded with T_1 -90% RDF + 10% FYM /Tree followed by 92.86 kg/Tree with T_0 -100% RDF (CONTROL) and the minimum fruit yield (49.70kg/tree) was recorded with T_7 -60% RDF + 40% FYM/Tree. Maximum TSS (26.31°Brix) after harvest was recorded in T_1 -90% RDF + 10% FYM/Tree followed by 25.20°Brix with T_2 -85% RDF + 15 % FYM/Tree and the minimum TSS (17.02°Brix) was recorded with T_7 -60% RDF + 40 % FYM/Tree. Minimum acidity (8.26 %) was recorded in T_1 -90% RDF + 10 % FYM/Tree followed by 8.30 % with T_2 -85% RDF + 15% FYM/Tree and the maximum acidity (8.62%) was recorded with T_7 -60% RDF + 40% FYM/Tree. Maximum Ascorbic acid (114.2 mg/100g) after harvest was recorded in T_1 -90% RDF + 10% FYM/Tree followed by 110.6 mg/100g with T_2 -85% RDF + 15 % FYM/ Tree and the minimum Ascorbic acid (100.3mg/100g) was recorded with T_7 -60% RDF + 40 % FYM/Tree. Maximum taste score 8.11/10 after harvest was recorded with T_1 -90% RDF + 10 % FYM/Tree followed by 7.89/10 with T_2 -85% RDF + 15% FYM/Tree and the minimum taste 5.04/10 was recorded with T_7 -60% RDF + 40 % FY/Tree. FYM and NPK contain micronutrients which help in proper development of fruits and fruit quality as well. Maximum aroma 7.91/10 after harvest was recorded with T_1 -90% RDF + 10 % FYM/Tree followed 7.45/10 with T_2 -85% RDF + 15 % FYM/Tree and the minimum aroma 4.37/10 was recorded with T_7 -60% RDF + 40% FYM/Tree. The increase in taste could be due to application of FYM in combination with NPK fertilizers might be attributed to the increased availability of micronutrients that involve in photo synthesis, FYM containing amino acids (which are precursor for the biosynthesis of glucosinolates) and

increased conversion of taste content. Maximum shelf life (5.49 days) after harvest was recorded with T_1-90% RDF + 10% FYM/Tree followed by 5.13 days with T_2 - 85% RDF + 15% FYM/Tree and the minimum shelf life (3.78 Days) was recorded with T_7 -60% RDF + 40 % FYM/Tree. The increase in these yield attributing characters due to application of balanced nutrients application made higher nutrients available to plant and leading to higher accumulation of net photo-syntheses (as a result more translocation of photo-syntheses from source to sink) with combined dose of NPK and FYM with the treatment T_1-90% RDF + 10% FYM/Tree availability of sources for prolonged time. Thus, better proliferation of root and uptake of nutrient enhanced fruit setting. These results are in agreement with the findings of Binepal *et al.,* (2013); Choudhary *et al.,* (2017); Gupta *et al.,* (2019); Kumar *et al.,* (2019); Singh *et al.,* (2020).

CONCLUSION

It is concluded from the experiment that treatment T_1 (90% RDF +10% FYM) followed by T_2 (85% RDF + 15 % FYM) was found superior in terms of growth and higher yield and quality factors. In this investigation the treatment T_1 (90% RDF +10% FYM) was found suitable for cultivation of guava orchard which gives production of 92.86 kg of fruits per tree.

Conflict of Interest: Nil.

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