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). 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.

Keywords

Guava, Yield, Quality, Economics, Biofertilizer

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, alkalinisation, 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 (12.07⁰Brix), 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} + Azotobacter150gm + 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).

| 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 + 150g 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**                                       | 125.61             | 1000                 | 125610                 | 18021                       | 87589               | 3.3               |
| **T2 - 100% Recommended dose of NPK + 10kg Vermicompost**                   | 125.9              | 1000                 | 125900                 | 36461                       | 89439               | 3.44              |
| **T3 - 100% Recommended dose of NPK + 50kg FYM**                            | 144.69             | 1000                 | 144680                 | 43871                       | 100809              | 3.19              |
| **T4 - 100% Recommended dose of NPK + 10kg Vermicompost + 150g Azotobacter + 100g PSB** | 147.78             | 1000                 | 147780                 | 41861                       | 105919              | 3.53              |
| **T5 - 100% Recommended dose of NPK + 50kg FYM + 150g Azotobacter + 100g PSB** | 121.33             | 1000                 | 121340                 | 37084                       | 84256               | 3.27              |
| **T6 - 75% Recommended dose of NPK + 10kg Vermicompost**                    | 137.24             | 1000                 | 137240                 | 42934                       | 94306               | 3.19              |
| **T7 - 75% Recommended dose of NPK + 10kg Vermicompost + 150g Azotobacter + 100g PSB** | 124.42             | 1000                 | 124420                 | 35524                       | 88896               | 3.5               |
| **T8 - 75% Recommended dose of NPK + 50 kg FYM**                            | 138.46             | 1000                 | 138460                 | 41374                       | 97086               | 3.34              |
| **T9 - 75% Recommended dose of NPK + 50 kg FYM + 150g Azotobacter + 100g PSB** | 119.74             | 1000                 | 119740                 | 36142                       | 83598               | 3.31              |
| **T10 - 50% Recommended dose of NPK + 10kg Vermicompost**                   | 118.87             | 1000                 | 118870                 | 34582                       | 84288               | 3.43              |
| **T11 - 50% Recommended dose of NPK + 50kg FYM**                            | 128.02             | 1000                 | 128020                 | 41992                       | 86028               | 3.04              |
| **T12 - 50% Recommended dose of NPK + 10kg Vermicompost + 150g 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 reported 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 biofertilizers (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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