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Effect of integrated nutrient management on soil fertility status under guava crop (*Psidium guajava* L.) CV. Sardar cultivation

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Abstract
The present study entitled "Integrated Nutrient Management (INM) in Guava (*Psidium guajava* L.) cv. Sardar" was carried out to obtain more yields with superior quality fruits at Pasighat, Arunachal Pradesh, India. There are nine treatments were tested in this experiment. The highest nitrogen content was recorded in 260 g N + 320 g P + 156 g K + Azotobacter 30 g + Azospirillum 30 g + PSB 30 g (418.67 kg/ha) in T_7 and available soil nitrogen was recorded minimum in control (329.33 kg/ha). The highest phosphorus content was recorded in 260 g N + 320 g P + 156 g K + PSB 30g (59.64 kg/ha) in T_3 and minimum was recorded in control (31.01 kg/ha). The highest potassium content was recorded in 260g N + 320 g P + 156 g K + Azotobacter 30 g + Azospirillum 30 g + PSB 30 g (381.07 kg/ha) in T_7 and minimum was recorded in control (261.74 kg/ha). However, significant changes may occur after one year or so which needs further observations on the plants.

Keywords: PSB, potassium, guava, biofertilizers

Introduction

Guava known as "apple of the tropics" is one of the most important fruit crops of India and excels most other fruit trees in productivity, hardiness and adaptability. Guava is rich in vitamin C (260 mg/100 g), energy (51 calories/100 g edible portions), pectin, vitamin A, vitamins B_2 and minerals like phosphorus, calcium and iron (Mitra and Sanyal, 2004) [1]. In the state production and productivity of guava is quite low. Among the various factors affecting growth and productivity of the fruit tree, nutrient management is most important.

Keeping in mind of the above mentioned facts and realizing the need for production of superior fruit quality and maximum yield, the present study entitled "Integrated Nutrient Management (INM) in Guava (*Psidium guajava* L.) cv. Sardar" was carried out to obtain more yields with superior quality fruits at Pasighat, Arunachal Pradesh. Continuous use of inorganic fertilizers as source of nutrient in imbalanced proportion is also a problem, causing inefficiency, damage to the environment and in certain situations, harms the plants themselves and also to human being who consumes them (Shankar *et al*., 2002) [2]. Therefore, integrated nutrient management is the most appropriate approach for managing the nutrient input. This calls for moving away from chemical agriculture and embracing organic matter management, which improves all soil properties and brings nitrogen through organic manures. Organic manures like farmyard manure is bulky farmyard manure, which is a storehouse of major nutrients apart from containing considerable amount of macro and micro-nutrients. Secondly, the use of organic manures increases the organic matter content of the soil by increasing the water holding capacity. Biofertilizers on the other hand enrich the soil with beneficial micro-organisms; they have the ability to mobilize the nutritionally important elements from non-usable to usable form through biological processes resulting in enhanced production of various fruit crops (Dey *et al*., 2005) [3]. *Azotobacter* and *Azospirillum* are the alternative source for nitrogen enrichment in non-leguminous crops, which fixed atmospheric nitrogen (Kerni and Gupta, 1986) [4]. *Azospirillum* and VAM inoculation resulted in overall increase in plant growth, fruit yield and fruit quality which reasonably can be explained from the fact that *Azospirillum* and VAM contribute up to 20-30% N and 25-50% P_2O_5 respectively (Mohandas, 1996) [5] and guava being well responsive to application of manure and fertilizers (Rathore, 2001) [6] gave better plant growth, fruit yield and quality.

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) [7].

Materials and Methods

The details of materials used and methods followed in the present investigation on "Integrated Nutrient Management (INM) and biofertilizers in guava *(Psidium guajava* L.) cv. Sardar (L-49) planted at a spacing of 6m x 6m was carried out during February-August, 2014 in the Fruit Research Farm, Department of Fruit Science, College of Horticulture and Forestry, Central Agricultural University, Pasighat, Arunachal Pradesh (India) are described as below. The geographical location of the research farm is situated in the foothills of Eastern Himalayan range at an altitude of 153 m above mean sea level 28° 04' 43" N latitude and 95° 19' 26" E longitude.

Representative soil samples were randomly collected from the experimental field. The collected soil samples were air dried, ground and passed through a 2 mm sieve and kept for laboratory analysis. The results of the soil analysis are mentioned in the given Table 1 below:

Table 1: Soil analysis results are given in the table below

Sl. No.	Particulars	Content	Method used
1.	Available Nitrogen (kg/ha)	374.96	Kjeldahl's method (Jackson, 1973) [13]
2.	Available Phosphorus (kg/ha)	47.37	Bray and Kurtz method (Jackson, 1973) [13]
3.	Available Potassium (kg/ha)	326.94	Flame photometric method (Jackson, 1973) [13]
4.	Organic Carbon (%)	1.39	Walkey and Black method (Jackson, 1973) [13]
5.	Soil pH	5.1	pH meter with glass electrode. (Jackson,1973) [13]

The experiment was laid out in Randomized Block Design (RBD) with three replication and nine treatments in 5 year old guava orchard of cv. L-49 year planted at a spacing of 6mx6m.

Treatment details

T_1 - 260 g N + 320 g P + 156 g K + *Azospirillum* 30g

T_2 - 130 g N+ 320 g P+ 156 g K + *Azospirillum* 30g

T_3 - 260 g N+ 320 g P + 156 g K + Phosphate Solubilizing Bacteria 30 g

T_4 - 260 g N+ 160 g P + 156 g K + Phosphate Solubilizing Bacteria 30g

T_5 - 260 g N + 320 g P +156 g K + *Azotobacter* 30 g

T_6 - 130 g N+ 160 g P + 156 g K + *Azotobacter* 30 g

T_7 - 260 g N + 320 g P + 156 g K + *Azotobacter* 30 g + *Azospirillum* 30 g + Phosphate Solubilizing Bacteria 30 g

T_8 - 130 g N + 160 g P + 156 g K + *Azotobacter* 30 g + *Azospirillum* 30g + Phosphate Solubilizing Bacteria 30 g

T_9 - Control (no fertilizer or inoculation)

Time and methods of application of fertilizers

Five year old uniform guava trees were selected for the experiment. Three trees were used for each treatment. The treatments tried were T_1 (260 g N + 320 g P + 156 g K + *Azospirillum* 30 g), T_2 (130 g N + 320 g P+ 156 g K + *Azospirillum* 30 g), T_3 (260 g N+ 320 g P + 156 g K + PSB 30 g), T_4 (260 g N + 160 g P + 156 g K + PSB 30 g), T_5 (260 g N + 320 g P +156 g K + *Azotobacter* 30 g), T_6 (130 g N+ 160 g P + 156 g K + *Azotobacter* 30 g), T_7 (60 g N + 320 g P + 156 g K + *Azotobacter* 30 g + *Azospirillum* 30 g + PSB 30 g), T_8 (130 g N + 160 g P + 156 g K + *Azotobacter* 30 g + *Azospirillum* 30 g + PSB 30 g) and T_9 - Control (no fertilizer or inoculation).

Full dose of phosphorus and potassium and half split dose of nitrogen in the form of urea, SSP and MOP were applied in last week of March before flowering and the remaining half split dose were applied one month after the first application. Biofertilizers (*Azospirillum*, *Azotobacter* and Phosphate Solubilising Bacteria) each at the rate of 30 g per plant were applied 15 days after the application of inorganic fertilizers along with FYM @ 4 kg per plant. The fertilizers were applied in the early morning hours on the trenches dug around the trees and light irrigation was given right after it.

Experimental Results

Physico-chemical properties of soil

1. Available Nitrogen (kg/ha)

The data presented on Table 2 and Figure 1 revealed that the available nitrogen content of soil varied significantly within the treatments. The highest nitrogen content was recorded in 260 g N + 320 g P + 156 g K + *Azotobacter* 30 g + *Azospirillum* 30 g + PSB 30 g (418.67 kg/ha) and followed by 130 g N + 160 g P + 156 g K + *Azotobacter* 30 g + *Azospirillum* 30 g + PSB 30 g (414.77 kg/ha) where as available soil nitrogen was recorded minimum in control (329.33 kg/ha).

Table 2: Physico-chemical properties of soil

Treatments	Available Nitrogen (kg/ha)	Available Phosphorus (kg/ha)	Available Potassium (kg/ha)	Organic Carbon (%)	pH
T1	406.53	45.25	366.66	1.42	5.3
T2	360.18	44.11	289.26	1.38	5.1
T3	359.30	59.64	314.22	1.35	5.0
T4	343.74	50.61	287.86	1.33	5.2
T5	384.81	48.29	348.27	1.40	4.7
T6	357.25	36.88	322.02	1.34	5.2
T7	418.67	57.16	381.07	1.54	5.0
T8	414.77	53.40	371.29	1.45	4.9
T9	329.33	31.01	261.74	1.31	5.6
S Ed±	28.18	8.10	27.41	0.06	0.36
CD at 5%	68.5	17.2	58.1	0.12	NS

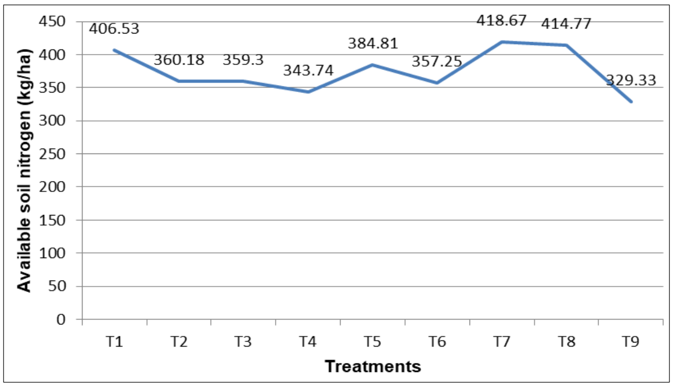

Fig 1: Available soil nitrogen (kg/ha)

2. Available Phosphorus

The data presented on Table 2 and Figure 2 revealed that the available phosphorus content of soil varied significantly within the treatments. The highest phosphorus content was recorded in 260 g N + 320 g P + 156 g K + PSB 30 g (59.64 kg/ha) followed by treatment 260 g N + 320 g P + 156 g K + *Azotobacter* 30 g + *Azospirillum* 30 g + PSB 30 g (57.16 kg/ha) and minimum was recorded in control (31.01 kg/ha).

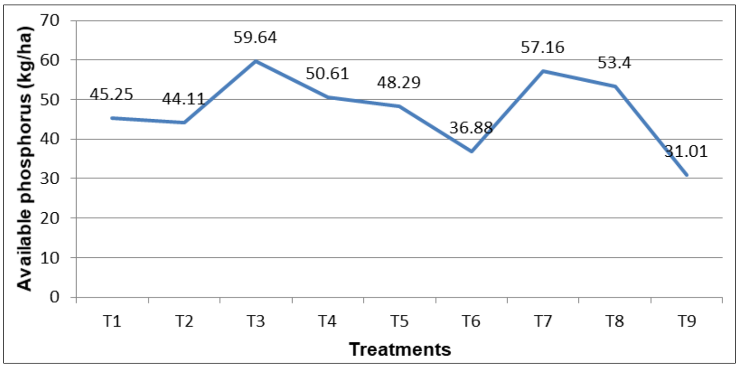

Fig 2: Available soil phosphorus (kg/ha)

3. Available Potassium (kg/ha)

The data presented on Table 2 and Figure 3 revealed that the available potassium content of soil varied significantly within the treatments. The result was found highest potassium content was recorded in 260 g N + 320 g P + 156 g K + *Azotobacter* 30 g + *Azospirillum* 30 g + PSB 30 g (381.07 kg/ha) which was followed by treatment 130 g N + 160 g P + 156 g K + *Azotobacter* 30 g + *Azospirillum* 30 g + PSB 30 g (371.29 kg/ha) and 260 g N + 320 g P + 156 g K + *Azospirillum* 30 g (366.66 kg/ha) and minimum was recorded in control (261.74 kg/ha).

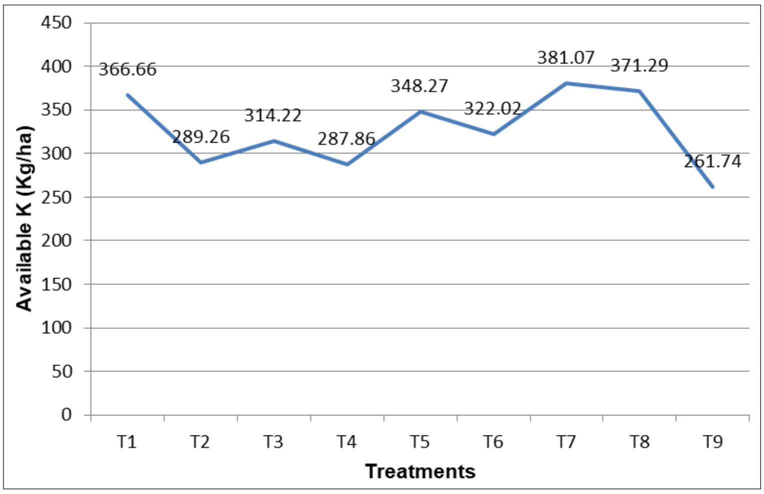

Fig 3: Available soil potassium (kg/ha)

4. Organic Carbon

The data presented on Table 2 and Figure 4 revealed that the organic carbon content of soil varied significantly within the treatments. The highest organic carbon content was recorded in 260 g N + 320 g P + 156 g K + *Azotobacter* 30 g + *Azospirillum* 30 g + PSB 30 g (1.54%) followed by 130 g N + 160 g P + 156 g K + Azotobacter 30 g + *Azospirillum* 30 g + PSB 30 g (1.45%) and 260 g N + 320 g P + 156 g K + *Azospirillum* 30 g (1.42%) where as minimum was recorded in control (1.31%).

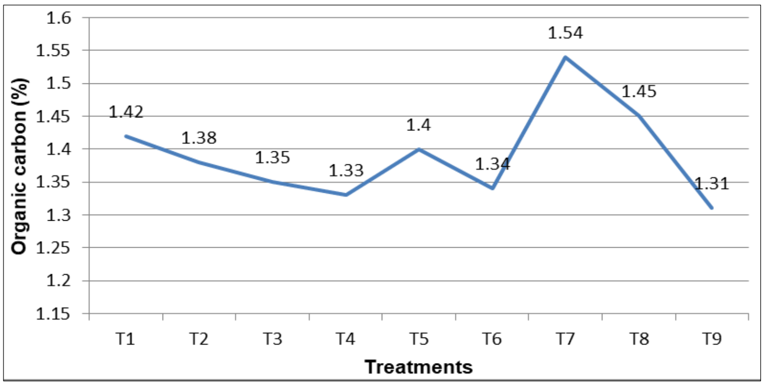

Fig 4: Organic carbon (%)

5. Soil pH

The data presented on the Table 2 and Figure 5 revealed that there is no significant variation among the treatments on the soil pH condition. However, highest value was recorded in control (5.6) and minimum was recorded in 260 g N + 320 g P +156 g K + *Azotobacter* 30 g (4.7) followed by 130 g N + 160 g P + 156 g K + *Azotobacter* 30 g + *Azospirillum* 30 g + PSB 30 g (4.9).

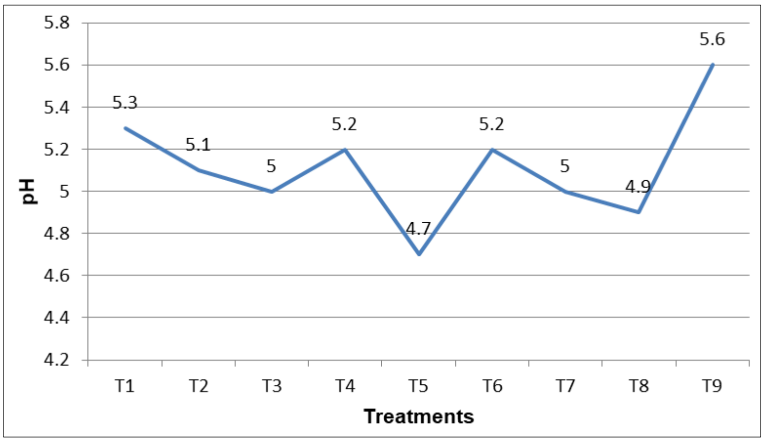

Fig 5: Soil pH

Discussion

The effect of various treatments on available nitrogen, phosphorus, potassium and organic carbon content has been observed. The maximum available nitrogen (418.67 kg/ha), potassium (381.07 kg/ha) and organic carbon (1.54%) were noticed with the application of 260 g N + 320 g P + 156 g K + *Azotobacter* 30 g + *Azospirillum* 30 g + Phosphate Solubilising Bacteria 30g (T_7) and maximum phosphorus (59.64 kg/ha) in 260 g N+ 320 g P + 156 g K + PSB 30 g. The different levels of inorganic and biofertilizers had shown variations in different soil properties. The available nitrogen status in post-harvest soils increased successively with increasing nitrogen levels which was due to integration of organic and inorganic sources and also due to increased microbial activity which could have stimulated the nitrification process. A Build Up of nitrogen and organic carbon in soil with different nitrogen sources and levels combined with biofertilizers has also been reported by Mishra *et al*. (2011) [8]. The increase in the availability of P may be attributed to the production of organic acids which acted as a chelating agent and thereby, releases P to the soil solution and making it in available form for the trees due to the application of PSB. These findings are in agreement with the findings of Naik and Hari Babu (2007) [9] and Sharma *et al.* (2009) [10]. The enhanced availability of K may be due to the combined application of inorganic fertilizers and biofertilizers. These observations are in par with the findings of Sahu *et al.* (2014) [11].

Summary and conclusion

A field experiment was undertaken during February- August, 2014 at the Experimental Farm, College of Horticulture and Forestry, Pasighat, Arunachal Pradesh to study the Integrated Nutrient Management (INM) in Guava (*Psidium guajava* L.) cv. Sardar. The salient features emerged out from the present investigation are summarized below.

Regarding Physico-chemical properties of soil, maximum available nitrogen (418.67 kg/ha), available potassium (381.07 kg/ha) and organic carbon (1.54%) was recorded with 260 g N + 320 g P + 156 g K + *Azotobacter* 30 g + *Azospirillum* 30 g + PSB 30 g and maximum available phosphorus (59.64 kg/ha) was recorded under 260 g N+ 320 g P + 156 g K + PSB 30 g and there was no significant variation regarding soil pH.

From the result of the present study, it can be concluded that different treatments of inorganic fertilizer and biofertilizers significantly increased the plant height and canopy spread. Regarding Physico-chemical properties of soil, 260 g N + 320 g P + 156 g K + Azotobacter 30 g + Azospirillium 30 g + PSB 30 g (T7) and 260 g N+ 320 g P + 156 g K + PSB 30 g (T3) proved the most effective in increasing the soil nutrient availability status of guava.

Future scope of research

1. The present investigation can be continued for more years with multilocational trial which may give confirmation of the results.
2. In depth study on the role of biofertilizers in improving growth, yield and quality parameters may be the future scope for improvement in guava production.
3. Winter guava to be promoted under Pasighat (Arunachal Pradesh) condition.

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