Influence of integrated nutrient management on physico-chemical properties of soil, growth, flowering and yield of guava grown as a component crop in coconut-based cropping system

ABSTRACT

An experiment on integrated nutrient management in guava grown as a component crop in a coconut-based cropping system was conducted under the coastal condition of Odisha. Adoption of integrated nutrient management like the application of organic manures with or without NPK fertilizers resulted in improvement in the physico-chemical properties of soil, which was reflected in terms of pH, organic carbon content, available nitrogen, phosphorus and potash content. Among the different combination of integrated nutrient management applied in guava, the plant height, canopy spread, flushing intensity, yield and yield attributing parameters. The maximum available soil nitrogen, available phosphorus and available potassium contents were estimated to be maximum in the treatment applied with 50% RDF +50% N through vermicompost + FYM +bio fertilizer, while the soil pH was highest owing to application of 75% RDF + 25% N through vermicompost + FYM which was at par with results obtained with application of 75% RDF + 25% N through vermicompost and 75% RDF +25% N through vermicompost + FYM +bio fertilizer.

Keywords: Integrated Nutrient Management, Coconut based cropping system

1. INTRODUCTION

Coconut (*Cocos nucifera* L.) belonging to the family Arecaceae is one of the important plantation crops of Odisha. Coconut is predominantly grown as mono-cropping. However, mono-cropping of coconut goes against the practice of efficient utilization of natural resources (i.e. solar intensity, available soil nutrients etc.). It provides meagre income to the farmers even with an optimum planting density due to the large area under the plant canopy remaining unutilized. Therefore, coconut-based intercropping systems could be practised for the efficient utilization of natural resources and getting additional income on a sustainable basis. In coconut, the feeder roots are confined within a radius of 1.8m around its base [1]. In favourable conditions, about 4000 to 7000 roots are found in middle-aged palms. Hence, the active root zone is confined to approx. 25% of the available land area and the remaining area can be profitably exploited for the raising of intercrops or multi-tier crops [2].

The growth and canopy configuration of coconut palms supports various coconut-based cropping systems. The amount of light intercepted in a cropping system affects the growth, productivity, and biomass production of the crops involved. Shade-tolerant intercrops can thrive in diffused sunlight. A wide range of crops, including vegetables, fruits, flowers, and medicinal and aromatic plants, can be grown as intercrops in coconut gardens under irrigated or rain-fed conditions in different regions. Guava is particularly well suited as an intercrop in coconut plantations due to its small size, adaptability, and early

fruit-bearing habit. It is commonly grown as a sole crop, intercrop, or filler crop throughout the country. Providing the right amount of nutrition is crucial for the growth, productivity, and quality of fruit crops, whether grown alone or with other crops. It helps improve plant strength, flower bud development, and fruit formation. Using a combination of fertilizers, bio-fertilizers, organic manures, vermicompost, and crop residues can enhance soil fertility and increase crop yield [3].

The Integrated Nutrient Management application is an approach that is followed in many places in India, but the scheduling of nutrient application and method of application varies from place to place and crop to crop. Integrating organic substances with mineral nutrients can have a significant effect on the chemical, microbiological and physical properties of soil, which in turn supports plant growth [4]. Thus, keeping the above points in consideration, the present investigation was conducted with the main objective of studying the effect of INM on soil physico-chemical properties, growth and yield of guava grown as a component crop in a coconut-based cropping system.

2. MATERIAL AND METHODS

The present investigation was conducted in AICRP on Palms, Odisha University of Agriculture and Technology, Bhubaneswar, Odisha. The experiment was carried out in a 16-year-old coconut garden with Guava (cv. Arka Amulya), banana (cv. Poovan) & pineapple (cv. Queen) as component crops. The coconut crop (cv. Sakhigopal Local) was grown at a spacing of 7.5m x 7.5m. The soil of the experimental site is taxonomically described as loamy sand. The entire plot is divided into 3 blocks, based on nutrients provided. Loamy sand soil, with a pH of 5.51, 0.24 dSm^{-1} (EC) and 0.39% organic carbon content was found in the experimental plot. 165kg/ha of available nitrogen content, 36.09 kg/ha of Available phosphorus and 246.16 kg/ha of Available Potassium were found in the experimental plot before conducting the trial. The mean maximum and minimum temperature during the entire cropping season were found to be 32.65^0C and 22.22^0C, respectively with an annual rainfall of 199.21mm.

The study was mostly undertaken in guava grown as a component crop in the coconut plantation.

The details of the treatments are as follows:

75% RDF + 25% N through Vermicompost (T1)
75% RDF + 25% N through Vermicompost + FYM (1:1) (T2)
75% RDF +25% N through Vermicompost + FYM +Bio fertilizer (1:1:1) (T3)
50% RDF +50% N through Vermicompost (T4)
50% RDF +50% N through Vermicompost + FYM (1:1) (T5)
50% RDF +50% N through Vermicompost + FYM +Bio fertilizer (1:1:1) (T6)
100% N through Vermicompost (T7)
100% N through Vermicompost + FYM (1:1) (T8)
100% N through Vermicompost + FYM +Bio fertilizer (1:1:1) (T9)
The experiment was planned in Randomized Block Design, with 9 treatments replicated thrice. The statistical analysis was carried out as per the standard protocol suggested by [5].

The growth parameters as plant height were recorded from the tree base to the tip of the crown using marked PVC pipe. Observations were recorded twice, once at the beginning and the other at the end of the respective *bahar*. The increase in plant height was expressed in cm. Another important growth parameter, Canopy spread is the horizontal distance measured in two directions, i.e., from North- South and East-West. It was measured with the help of a marked PVC pipe at the beginning and the end of the respective *bahar*. The

increment in canopy spread was expressed in cm. To measure flushing intensity, four secondary branches in four directions of the plant canopy, i.e., East, West, North and South, were selected and tagged randomly. On these branches, a number of tertiary branches was counted at the beginning and end of respective *bahar* throughout the growing season. The average number of tertiary shoots per plant was calculated.

The total number of flowers present on tagged shoots (5 in each direction i.e., East, West, North and South) were calculated and the average number of flowers per shoot was estimated. While, to record data on the fruit set, the total number of flowers was counted on each tagged shoot and thereafter, the fruit set at 21 days after anthesis was computed using the following formula and expressed in percentage.

$$\text{Fruit set (\%)} = \frac{\text{Number of fruits set}}{\text{Total number of flowers}} \text{X } 100$$

Moreover, for recording fruit retention, a total number of set fruits (21 days after anthesis) and retained fruits (at the time of harvesting) were counted on tagged shoots. Thereafter, the percent of fruit retention was calculated using the following formula and expressed in percentage.

$$\text{Fruit retention (\%)} = \frac{\text{Total number of fruits retained at maturity}}{\text{Total number of fruits set}} X100$$

To measure the yield of guava, fruits were harvested at full maturity in the morning hours. At each harvest, fruits were weighed and counted to find out the yield and number of fruits. Yield was expressed in kg/tree. Average fruit weight was computed by dividing the fruit yield by the number of fruits.

The soil physico-chemical properties as influenced by INM in guava grown as a component crop in a coconut-based cropping system were determined at the end of the experiment. Random soil samples were taken using soil auger from each treatment plot at a depth of 0-30cm.

The samples were air dried under shade after thorough mixing and sieved to pass through a 2mm sieve for analysis. The organic carbon, pH and electrical conductivity of the soil samples were measured using the Walkey and Black method [6], Systronics pH meter [6] and electrical conductivity meter [6]. Available nitrogen (N), phosphorus (P) and potassium (K) contents of soil were estimated by the alkaline permanganate method [7], Bray's extractant spectrophotometry method [6], and flame photometer method [6], respectively.

3. RESULTS AND DISCUSSION

3.1. EFFECT OF INM ON INCREMENT IN GROWTH PARAMETERS OF GUAVA GROWN AS A COMPONENT CROP IN COCONUT-BASED CROPPING SYSTEM

Data on plant height increment in both the *bahar*, i.e., *mrig bahar* and *hasth bahar* were reflected in Fig 1. The highest increment in plant height (32.96 cm) was observed in 50 % RDF + 50% N through Vermicompost + FYM +Bio fertilizer (T_6) which was statistically on par with T_5 :50 % RDF + 50% N through Vermicompost + FYM (31.15 cm) and T_4: 50% RDF + 50% through vermicompost (30.79 cm) and the lowest increment (18.12 cm) was noticed in 100% N through Vermicompost + FYM (T_8) in *mrig bahar*.

Similarly, in *Hasth bahar*, the same treatment 50% RDF+ 50% N through Vermicompost + FYM+ Biofertilizer (T_6) was effective in increasing maximum plant height (22.27 cm) which was at par with T_4: 50% RDF+ 50% N through Vermicompost (21.59 cm)

and T_5: 50% RDF+ 50% N through Vermicompost +FYM (21.55 cm) and the lowest increase was in T_8: 100% N through Vermicompost + FYM (8.10 cm).

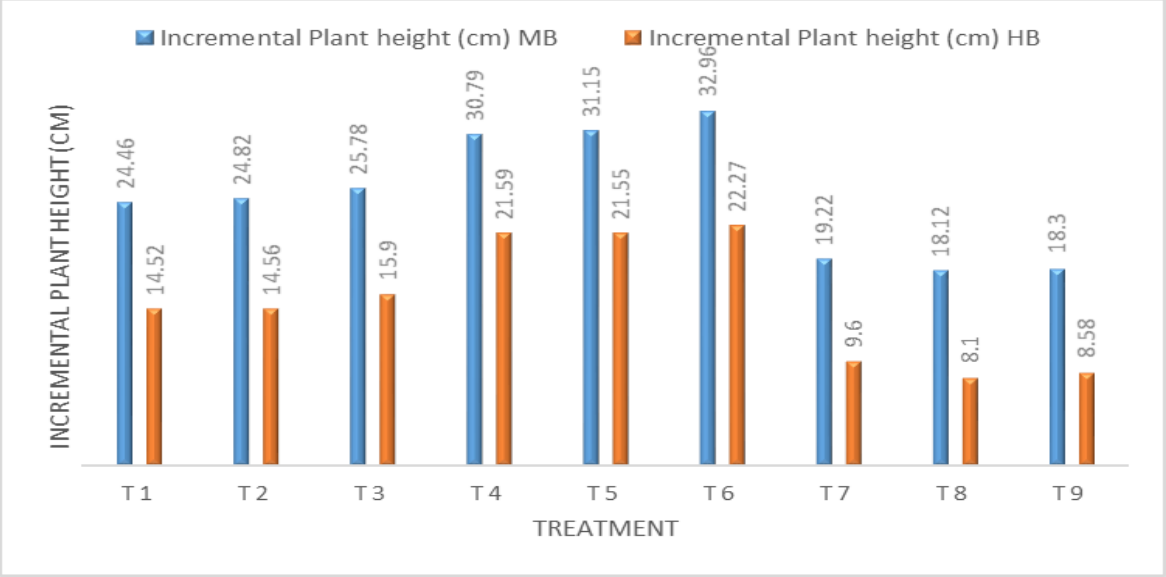


Fig. 1. Effect of INM on incremental plant height in *mrig bahar* and *hasth bahar* crop of guava

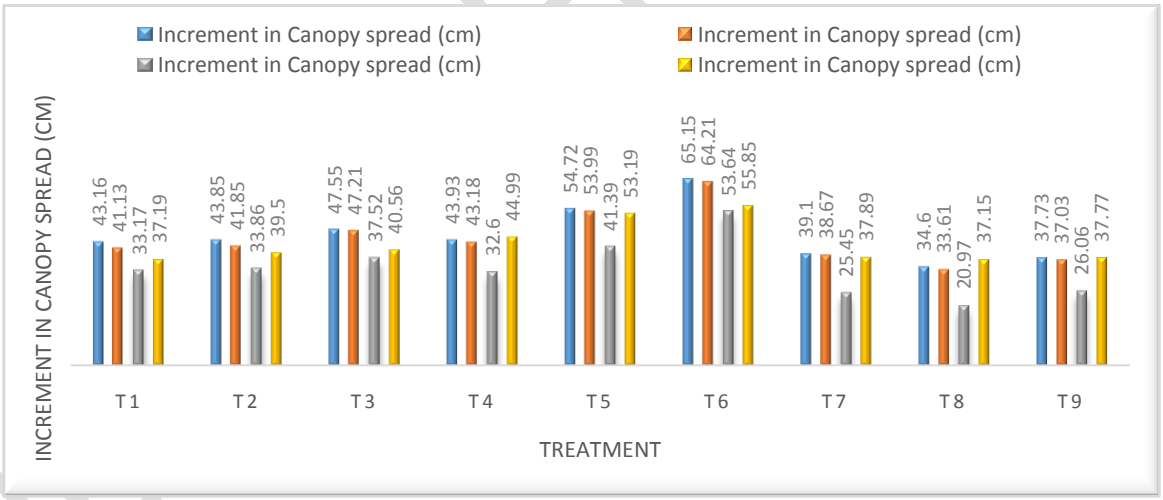


Fig. 2. Effect of INM on incremental canopy spread (E-W, N-S) in *mrig bahar* and *hasth bahar* crop

Fig 2 depicts the effect of INM on the canopy spread (in E-W and N-S) increment in both the *bahar*, i.e. *mrig bahar* and *hasth bahar*. In *mrig bahar,* 50% RDF + 50% N through Vermicompost + FYM + Biofertilizer (T_6) was significantly superior over other treatments

concerning increase in canopy spread (53.64 cm) in N-S direction. However, the lowest increment (20.97 cm) was observed in T_8: 100% N through Vermicompost + FYM for the same character. While, in *hasth bahar*, the highest increment in canopy spread (55.85 cm) was observed in 50% RDF + 50% N through Vermicompost + FYM + Biofertilizer (T_6) which was at par with T_5: 50% RDF+ 50 % N through Vermicompost + FYM (53.19 cm) and T_4: 50% RDF+ 50 % N through Vermicompost (44.99 cm) and the lowest increment of 37.15 cm was recorded in T_8: 100% N through Vermicompost + FYM in the N-S direction.

In E-W direction, the highest increment i.e. 65.15 cm in plant canopy spread for the *mrig bahar* was observed in 50% RDF + 50% N through Vermicompost + FYM + Bio fertilizer (T_6) and the lowest increase in canopy spread (34.60 cm) was in T_8: 100% N through Vermicompost + FYM. While, in *hasth bahar*, the highest increment of 64.21 cm was observed in 50% RDF + 50% N through Vermicompost + FYM + Biofertilizer (T_6) and the lowest increment of 33.61 cm was noticed in T_8: 100% N through Vermicompost + FYM in the E-W direction.

The data about the flushing intensity in both the *bahar* are depicted in Fig-3. The maximum flushing intensity (8.31 shoots/branch) was observed in 50% RDF + 50% N through Vermicompost + FYM + Biofertilizer (T_6) and the minimum flushing intensity (4.94 shoots/branch) in T_7: 100% N through Vermicompost for the *mrig bahar*. While, in *hasth bahar*, the maximum flushing intensity of 8.11 shoots/branch was observed in 50% RDF + 50% N through Vermicompost + FYM + Bio fertilizer (T_6) and the minimum flushing intensity of 3.94 shoots/branch was observed in T_7: 100% N through Vermicompost.

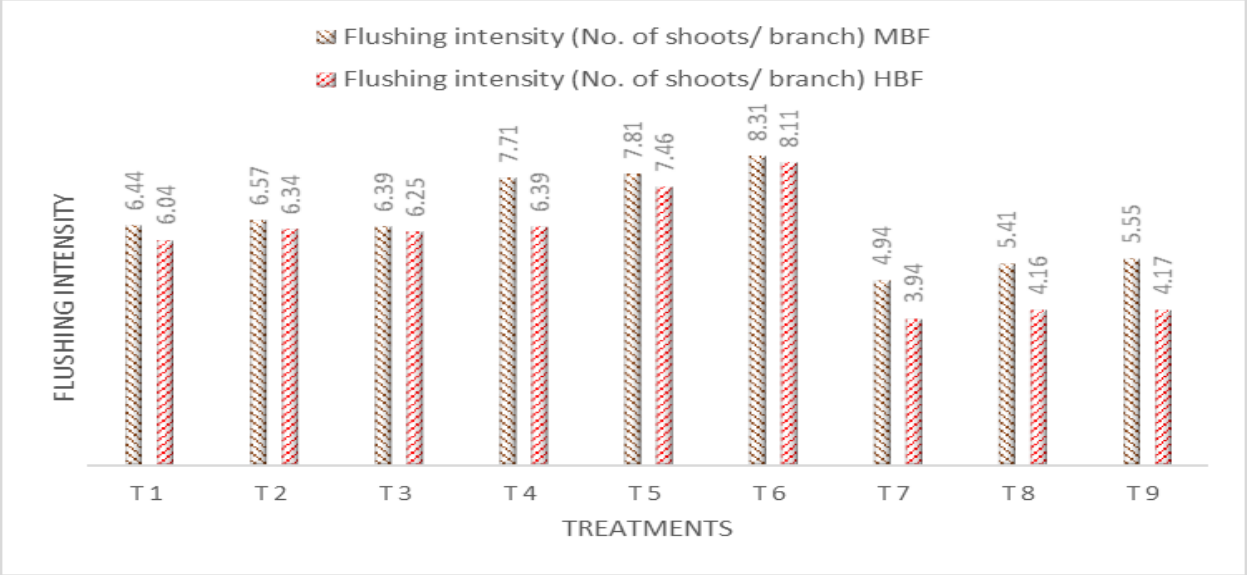


Fig. 3. Effect of INM on flushing intensity of guava in *mrig bahar* and *hasth bahar*

Treatment T_6: 50% RDF +50% N through Vermicompost + FYM +Bio fertilizer was found to induce better vegetative growth compared to other treatments in both mrig and hasth bahar. The combination of bio fertilizers with inorganic fertilizers, FYM, and vermicompost had a positive impact on vegetative growth parameters due to phosphorus mobilization from the soil to the plant system and increased nitrogen availability from both inorganic and organic sources. The timely availability of nutrients triggered higher metabolic

activities, leading to the production of more photosynthates and a higher growth rate in perennial guava trees.

The application of NPK (50, 20, 50g) + 5kg vermicompost enriched with biofertilizers resulted in the highest increase in vegetative growth in terms of plant height and canopy spread [8,9]. This increase may also be due to the build-up of colonies from biofertilizers and the application of FYM along with vermicompost, which enriched soil conditions while inorganic nutrients enhanced growth. Similar findings related with the impact of vermicompost along with FYM and inorganic fertilizers on vegetative growth were also observed [10,11,12,13,14,15,16,17,18,19] in guava.

3.2. EFFECT OF INM ON REPRODUCTIVE PARAMETERS OF GUAVA GROWN AS A COMPONENT CROP IN COCONUT-BASED CROPPING SYSTEM

There was a significant variation among the reproductive parameters of guava in both *mrig* and *hasth bahar* which is reflected in Table 1. The highest number of flowers/shoots (15.07 and 17.00) was observed in 50 % RDF + 50 % N through Vermicompost + FYM +Bio fertilizer (T_6) which was significantly superior to rest eight treatments during *mrig bahar* and *hasth bahar* respectively. However, the lowest number of flowers/shoot (8.91 and 10.99) was recorded in 100% N through Vermicompost (T_7) in *mrig bahar* and *hasth bahar* respectively.

In terms of fruit set (%), significant variation was observed. In *mrig bahar* crop, the maximum fruit set (70.32 %) was observed in 50 % RDF + 50 % N through Vermicompost + FYM +Bio fertilizer (T_6) while the minimum, i.e. 62.75 % fruit set was observed in 100% N through Vermicompost (T_7). In the case of *hasth bahar* crop, the maximum fruit set (68.48 %) and minimum (61.98 %) were recorded in 50 % RDF + 50 % N through Vermicompost + FYM +Bio fertilizer (T_6) and 100% N through Vermicompost (T_7) respectively.

In *mrig bahar* crop, the maximum fruit retention of 69.57 % was observed in 50 % RDF + 50 % N through Vermicompost + FYM +Bio fertilizer (T_6) and minimum fruit retention of 56.12 % in 100% N through Vermicompost +FYM (T_8). While, in case of *hasth bahar* crop, the maximum fruit retention was 67.18 % as observed in 50 % RDF + 50 % N through Vermicompost + FYM +Bio fertilizer (T_6) and the minimum retention (55.09 %)was in 100% N through Vermicompost +FYM (T_8).

Table 1. Effect of INM on flowering and fruiting characteristics of *mrig* and *hasth bahar* guava grown as a component crop in coconut-based cropping system

Treatment	No. of flowers/ shoot		Fruit set (%)		Fruit retention (%)	
	MB	HB	MB	HB	MB	HB
T_1: 75% RDF + 25% N through Vermicompost	9.74	12.05	67.30	67.01	60.85	59.99
T_2: 75% RDF + 25% N through Vermicompost + FYM	9.93	12.25	67.34	67.06	63.19	60.20
T_3: 75% RDF +25% N through Vermicompost + FYM +Bio fertilizer	10.00	12.33	67.28	67.14	65.88	63.15
T_4: 50% RDF +50% N through Vermicompost	10.21	12.64	68.34	67.26	67.99	65.79
T_5: 50% RDF +50% N through Vermicompost + FYM	11.09	12.66	68.36	67.34	69.21	64.65
T_6: 50% RDF +50% N through	15.07	17.00	70.32	68.48	69.57	67.18

Vermicompost + FYM +Bio fertilizer						
T_7: 100% N through Vermicompost	8.91	10.99	62.75	61.98	57.98	55.88
T_8: 100% N through Vermicompost + FYM	9.29	11.46	66.20	62.37	56.12	55.09
T_9: 100% N through Vermicompost + FYM +Bio fertilizer	9.82	11.79	64.22	63.98	56.99	55.78
SE(m)±	0.67	0.78	1.37	1.38	1.33	1.47
CD (P= 0.05)	2.09	2.41	4.18	4.22	4.06	4.48

MB= *Mrig bahar*, HB= *Hasth bahar*

These results may be due to the integrated application of RDF with vermicompost, FYM, and biofertilizers, which increased the production of photosynthates and vegetative growth, leading to increased accumulation of carbohydrates needed for better reproductive growth. This was reflected in T_6: 50% RDF +50% N through Vermicompost + FYM +Bio fertilizer, which resulted in an increased number of flowers per shoot, fruit set, and fruit retention in trees. FYM conditions the soil properly and enhances nutrient availability. Vermicompost promotes plant hormone activity and releases chemical exudates due to biological activity in the soil. It has higher porosity, aeration, drainage, and nutrient absorption and retention capacity for a longer duration, influencing the reproductive traits of guava plants and resulting in maximum fruit set, number of flowers, and fruit retention.

Similar results were reported in guava [11,20,21]. Biofertilizers enhance nutrient use efficiency and promote hormonal activity, reducing flower and fruit drop caused by hormonal imbalance. This results in the highest flowering, fruit set, and fruit retention percentages. These results were in line with the findings of several other scientists [22,23] in guava.

3.3 EFFECT OF INM ON YIELD PARAMETERS OF GUAVA GROWN AS A COMPONENT CROP IN COCONUT-BASED CROPPING SYSTEM

Figure 4 depicts that the maximum number of fruits/plant (136.18, 142.40) was estimated in T_6: 50% RDF +50% N through Vermicompost + FYM +Bio fertilizer, While, the minimum number of fruits/plant (91.76, 83.58) in T_8: 100% N through Vermicompost + FYM in both *mrig* and *hasth bahar*.

The average fruit weight is depicted clearly in Figure 4. The maximum average fruit weight (120.19 g, 110.07 g) was estimated in T_6: 50% RDF +50% N through Vermicompost + FYM +Bio fertilizer, While, the minimum fruit weight (93.33 g, 100.99 g) in T_7: 100% N through Vermicompost n both *mrig* and *hasth bahar*.

The maximum yield (14.99 kg/plant and 13.15 kg/plant) was estimated in T_6 (50% RDF + 50% N through Vermicompost + FYM +Bio fertilizer) and the minimum yield (9.30 kg/plant and 7.31 kg/plant) was estimated in T_8 (100% N through Vermicompost + FYM) in *mrig* and *hasth bahar* respectively. This data is depicted in Table 2.

The total yield/plant was also estimated as highest (28.14 kg/plant) in 50% RDF + 50 % N through Vermicompost + FYM +Bio fertilizer(T_6) and the lowest (16.61 kg/plant) was estimated in 100% N through Vermicompost + FYM (T_8).

Table2. Effect of INM on yield (kg/plant) in both *mrig* and *hasth bahar*

Treatment	No. of fruits/plant		Fruit weight (g/fruit)		Yield (kg/plant)		
	MBC	HBC	MBC	HBC	MBC	HBC	Total yield

T_1: 75% RDF + 25% N through Vermicompost	105.15	117.08	112.04	104.99	11.04	10.33	21.37
T_2: 75% RDF + 25% N through Vermicompost + FYM	113.42	120.48	118.77	108.71	12.33	10.40	22.73
T_3: 75% RDF +25% N through Vermicompost + FYM +Bio fertilizer	124.64	133.07	120.14	109.91	13.70	11.66	25.36
T_4: 50% RDF +50% N through Vermicompost	129.6	135.36	114.10	104.01	13.48	11.49	24.97
T_5: 50% RDF +50% N through Vermicompost + FYM	132.64	139.42	114.82	104.79	13.90	11.90	25.80
T_6: 50% RDF +50% N through Vermicompost + FYM +Bio fertilizer	136.18	142.40	120.19	110.07	14.99	13.15	28.14
T_7: 100% N through Vermicompost	95.35	93.51	93.33	100.99	9.63	7.97	17.60
T_8: 100% N through Vermicompost + FYM	91.76	83.58	101.11	101.35	9.30	7.31	16.61
T_9: 100% N through Vermicompost + FYM +Bio fertilizer	98.63	87.08	104.33	101.99	10.06	7.79	17.85
SE(m)±	1.33	1.80	1.63	1.40	1.28	1.24	1.41
CD (P= 0.05)	4.07	5.49	4.96	4.29	3.92	3.79	4.27

MBC= *Mrig bahar* crop, HBC= *Hasth bahar* crop

This result may be due to a better nutritional environment developed by the application of both organic manure along inorganic fertilizers, which resulted in improved soil physico-chemical and biological activities. Integrated application of different fertilizers, organic manures and bio-fertilizers enhanced the vegetative growth character, number of fruits and yield in guava cv. Sardar [24]. The influence of INM on guava cv. Sardar under HDP i.e. with the combined application of 50 kg FYM + 50% RDF of NPK + 250g *Azotobacter* recorded maximum fruit yield/plant (28.95kg) [17].

Application of 10kg vermicompost + 50% RDF + 20g *Azotobacter* plant gave a maximum yield of 44.25 kg/plant [20]. The highest number of fruits and yield (283 and 40.11 kg/tree respectively) were observed in guava cv. Allahabad Safeda with 20kg FYM inoculated with *Azotobacter* [25]. The integrated use of 50 % NPK (RDF) + 25 kg FYM + 5 kg vermicompost per tree resulted in the highest number of fruits per tree, fruit weight and highest yield per tree [18].

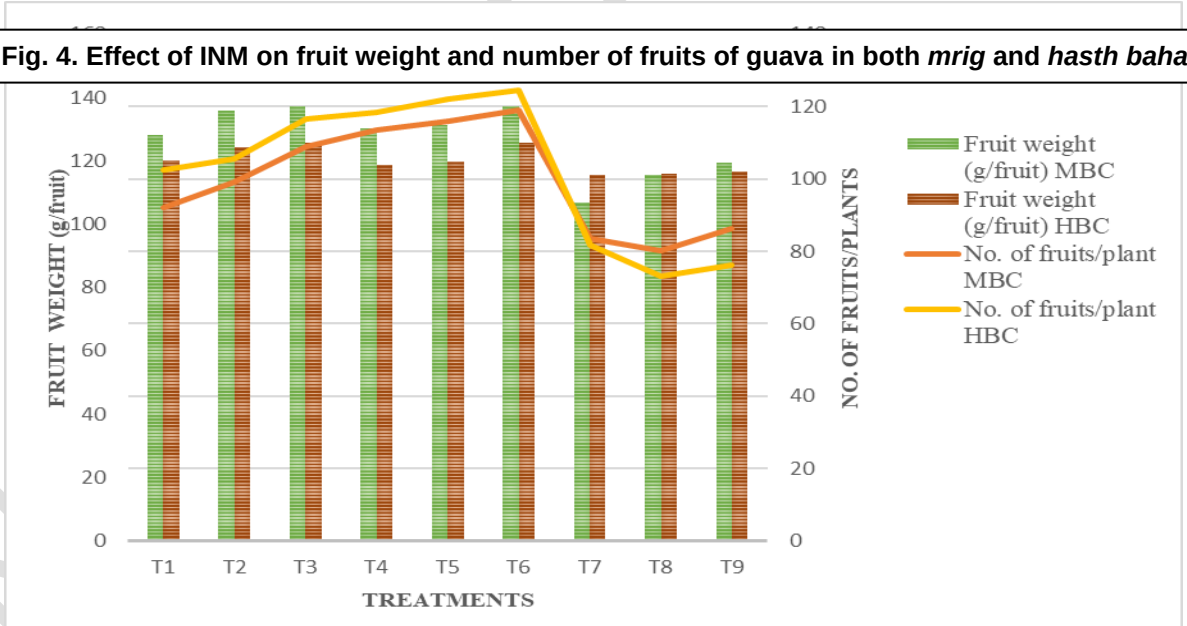
3.4. PHYSICO-CHEMICAL PARAMETERS OF SOIL AS INFLUENCED BY INM IN GUAVA GROWN AS A COMPONENT CROP IN A COCONUT-BASED CROPPING SYSTEM

Integration of cropping systems with nutrient management practices has a significant impact on the physico-chemical properties of soil. The data presented in Table 3 revealed that the application of 75% RDF + 25% N through Vermicompost + FYM (T_2) in guava basins recorded a higher soil pH (5.51) which was at par with T_1: 75% RDF + 25% N through Vermicompost (5.47) and T_3: 75% RDF + 25% N through Vermicompost (5.49).

Table 3. Effect of INM on physico-chemical parameters of soil as influenced by guava grown as a component crop in coconut-based cropping system

Treatment	pH (1:2)	Organic Carbon (g kg^{-1})	EC (dSm^{-1})	Available Nitrogen (Kg ha^{-1})	Available Phosphorus (Kg ha^{-1})	Available Potassium (Kg ha^{-1})
T_1: 75% RDF + 25% N through Vermicompost	5.47	4.62	0.21	262.77	35.08	157.48
T_2: 75% RDF + 25% N through Vermicompost + FYM	5.51	4.41	0.23	259.30	37.58	160.67
T_3: 75% RDF +25% N through Vermicompost + FYM +Bio fertilizer	5.49	4.59	0.22	261.07	38.53	155.89

Fig. 4. Effect of INM on fruit weight and number of fruits of guava in both *mrig* and *hasth bahar*



T_4: 50% RDF +50% N through Vermicompost	5.11	5.22	0.24	255.47	33.12	148.27
T_5: 50% RDF +50% N through Vermicompost + FYM	5.15	5.18	0.25	251.83	34.91	144.23

T_6: 50% RDF +50% N through Vermicompost + FYM +Bio fertilizer	5.13	5.33	0.26	261.29	38.66	162.32
T_7: 100% N through Vermicompost	5.02	5.31	0.19	241.07	31.69	145.40
T_8: 100% N through Vermicompost + FYM	5.01	5.29	0.20	238.80	31.49	143.65
T_9: 100% N through Vermicompost + FYM +Bio fertilizer	5.00	5.32	0.17	245.13	30.33	146.40
SE(m)±	0.08	0.03	0.02	3.44	2.21	2.72
CD (P= 0.05)	0.29	0.14	0.05	10.43	6.71	8.24

The other soil parameters such as organic carbon content (5.33 g kg^{-1}), electrical conductivity (0.26 dSm^{-1}), available nitrogen (261.29 kg ha^{-1}), available phosphorus (38.66 kg ha^{-1}) and available potassium contents (162.32 kg ha^{-1}) were estimated as maximum in the 50 % RDF + 50 % N through Vermicompost + FYM+ Biofertilizers (T_6) at the end of the experiment.

The increased availability of NPK nutrients owing to the application of 50 % RDF + 50 % N through Vermicompost + FYM+ Biofertilizers (T_6) might be due to the positive impact of biofertilizers with organic manures and inorganic fertilizers. This combination might have enhanced the physical condition of soil, and better root development. The increased microbial population might be also due to the incorporation of organic manures in the soil, which enhanced the organic carbon source in the soil. Moreover, the application of organic fertilizers such as Vermicompost and Biofertilizers enhanced the acidic condition, as during vermicomposting the organic matter is converted to Ammonium form. These ammonium forms are further broken down by the soil microbes (mineralization) followed by nitrification, thereby resulting in acidic pH. The results were in line with several scientists [23, 26, 27, 28] in guava.

4. CONCLUSION

The results of the study indicated that there is significant improvement in the physico-chemical properties of soil as influenced by INM in guava grown as a component crop in coconut-based cropping system. Among different combinations of nutrient management applied in guava, the maximum available nitrogen, potassium and phosphorus content were estimated at 50 % RDF + 50 % N through Vermicompost + FYM + Biofertilizer (T_6). Similarly, the highest value in respect of growth parameters like plant height, canopy spread, flushing intensity, yield, and yield attributing parameters were observed in plants treated with 50 % N through Vermicompost + FYM + Biofertilizer (T_6).

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