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Effect of Integrated Nutrient Management on Growth and Yield of Papaya (*Carica papaya* L)

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ABSTRACT: Papaya is a popular and important fruit crop in this present world for its delicious taste, nutritional value, and medicinal properties and also considered as "Heavy feeder crop" because of its quick development, continuous fruiting habit, and high fruit yield, which sets it apart from other fruit crops in terms of nutrition. For this to determine the actual combination of organic and inorganic nutrient for better growth and yield of papaya farming, a field experiment was conducted at a farmers' field in Kalchini, Alipurduar, West Bengal, between the years of 2018–19 and 2019–20. The experiment consisted of 5 factors (control, biofertilizer + FYM, vermicompost + biofertilizer, boron + FYM, zinc + FYM), 4 Treatments (Control, RDF of NPK, 50% RDF, and 75% RDF), and was replicated three times. The data was statistically analyzed using a randomized full block design. With RDF of NPK + vermicompost + biofertilizer, the maximum growth-related parameters, including plant height (293.930 cm), plant girth (50.475 cm), and total number of leaves (57.500), were observed. In terms of yield characteristics, RDF of NPK + vermicompost + biofertilizer was shown to be superior to other treatments *viz.* total number of fruits (38.725), fruit set percentage (73.29), total yield (59.47 kg ha^{-1}), fruit weight (1.67 kg), minimum days taken to fruit initiation (121.82). For the above stated parameter treatment 75% RDF of NPK+ vermicompost + biofertilizer was statistically at per with each other.

Keywords: Papaya, Integrated nutrient management, Growth, Yield.

INTRODUCTION

In recent times, papaya (*Carica papaya* L.) has gained the popularity as a fruit crop because of its delicious flavour, nutritional value, and therapeutic benefits. Papaya belongs to Caricaceae family and has 48 species in total. It is originated in Tropical America and is a tropical fruit that is commonly produced in the tropics and subtropics Arvind *et al*. (2013); Yograj *et al*. (2014). It is still regarded as a garden crop despite its enormous size and productivity. However, in recent years, papaya's importance as a commercial fruit crop has increased because of its therapeutic and nutritional properties, as well as because of its quick and consistent yielding behaviour, which gives growers early income. Papaya is frequently referred to as the "Heavy feeder crop" because of quick growth grows, continuous flowering and fruiting, and how much fruit it produces compared to other fruit crops. In order to maintain the health of the plant and the soil and to provide a lucrative harvest, timely and effective manuring of young and mature plants is absolutely necessary. Because papaya requires a lot of nutrients continuously, using a lot of chemically prepared fertilizers on its own is not only non practical, but also expensive for the poor farmers because the bulk of them are small and marginal ones. Aside from that, the usage of chemical fertilizers has led to an increase in multi-nutrient deficits, nutrient imbalances, and a decline in soil health and production over time (Singh and Varu 2013). Integrated nutrition management may be a viable option in this regard. The main goal of integrated plant nutrient management is to use both organic and inorganic nutrients, as well as other micronutrients, in a more rational way to better understand and evaluate the interactions of different nutrients, as well as to lower production costs by using less inorganic fertilizer. Keeping this in view, the present investigation was conducted to study the effect of integrated nutrient management practices on growth and yield of papaya and to evaluate the ideal treatment combination for the same.

MATERIALS AND METHODS

The current field study was carried out during 2018-19 and 2019-20 at farmers field in Kalchini, Alipurduar,

West Bengal, which is a part of the Terai-Dooars agro climatic region with an EC of 0.26 ds m^{-1} and a pH of 5.8, the experimental soil comprised 0.5 percent organic carbon, 184.4 kg ha^{-1} nitrogen, 190 kg ha^{-1} phosphorus, and 191 kg ha^{-1} potassium. A three-replication randomized complete block design was used to set up the experiment. The current study included 20 distinct treatments, each with a different nutritional amount, *i.e.* T_0F_0 (control), T_0F_1 (control + biofertilizer + FYM), T_0F_2 (control + vermicompost + biofertilizer)), T_0F_3(control + boron + FYM), T_0F_4(control + zinc + FYM), T_1F_0(RDF of NPK + control), T_1F_1(RDF of NPK + biofertilizer + FYM), T_1F_2(RDF of NPK + vermicompost + biofertilizer), T_1F_3 (RDF of NPK + boron + FYM), T_1F_4 (RDF of NPK+ zinc + FYM), T_2F_0 (50% of RDF + control), T_2F_1 (50% of RDF + biofertilizer + FYM), T_2F_2 (50% of RDF + vermicompost + biofertilizer), T_2F_3 (50% of RDF + boron + FYM), T_2F_4 (50% of RDF + zinc + FYM), T_3F_0 (75% of RDF + control), T_3F_1 (75% of RDF + biofertilizer + FYM), T_3F_2 (75% of RDF + vermicompost + biofertilizer), T_3F_3 (75% of RDF + boron + FYM), T_3F_4 (75% of RDF + zinc + FYM). Because of its widespread acceptance among farmers, the cultivar C.V. Red Fort was chosen for the experiment and bought from a local market. With medium-sized plants, this is a medium-sized F_1 hybrid. The fruits are oval in shape and the flesh is a dark reddish orange colour. They are sweet and have a lovely flavour. The young saplings were transplanted to the main field at a spacing of 2m×1.8m during the first week of July. Urea, Single Super Phosphate, and Murate of Potash were applied to the plant in the form of Urea, SSP, and MOP. During field preparation, 1/3 of the fertilizer was applied during pit filling. The remaining are divided in half and applied at a 45days interval. When using Factor F_1 as a bio-fertilizer, azotobactor is well mixed with PSB and 100gm of the mixture is applied to the pit during field preparation. During field preparation, FYM used @20 kg $plant^{-1}$. During the field preparation for Factor F_3, vermicompost was applied at a rate of 5 kg $plant^{-1}$. In the case of micronutrient application, combine the required amounts of Zn and B with water and thoroughly apply to the plants. The micronutrient application procedure was carried out in the evening. The data on yield related attributes was statistically examined.

RESULT AND DISCUSSION

Persual data revealed that integrated nutrient management practices had a good impact on the growth and yield of freshly harvested fruits. The growth related parameter *viz.* plant height, plant grith, number of leaves was responded significantly in reference with integrated nutrient management practices. Maximum Plant height (293.930cm), plant grith (50.475cm), total number of leaves (57.00) of papaya plant was recorded highest under RDF of NPK + vermicompost + biofertilizer. The combination of inorganic fertilizers, organic manure, vermicompost, and biofertilizers that provide nutrients to the plant in the right proportion and amount at the right time may have helped improve soil aeration, which may have contributed to the maximum improvement of the growth-related parameters. Nayyer *et al.* (2014) in banana, Srivastava *et al.* (2014) in papaya, Tripathi *et al.* (2013) in Isabgol, Mishra and Tripathi (2011) backed with the findings described above. Results for organic nutrient management, including vermicompost and bio fertiliser, were almost equal according to Chaudhary *et al.* (2004). They found that the amplification of growth characters like Plant grith, plant height, total number of leaves may be caused by the presence of growth-promoting molecules like auxins and cytokinins, which aid in cell division and cell elongation.

The interplay of organic, inorganic, biofertilizers, and micronutrients on the overall number of blooms on papaya plants was favorable. The reproductive stage data showed that there was significant variability amongst the treatments. The overall number of fruits was higher in the RDF made up of NPK+ vermicompost + biofertilizer. The plants that received the aforementioned treatments produced the most fruits when fed. The above findings are closely in line with Srinu *et al.* (2017) in papaya, Gupta and Tripathi (2012) in strawberry cv. Chandler, Tripathi *et al.* (2015a) inaonla and Katiyar *et al.* (2012) in ber. The use of biofertilizers in conjunction with vermicompost and chemical fertilizers may have a positive impact on the development of inflorescences, which may lead to higher nutrient levels in the crop's assimilating area and an increase in the rate of dry matter production, which is positively correlated with the number of flowers and fruits set. A sufficient food supply and the induction of growth hormones increased cell division and cell elongation, which led to an increase in the number of flowers and fruits. In addition to total flower and fruit, fruit set percentage was also successfully replied to in terms of integrated nutrient management techniques. Maximum fruit set percentage was likewise noted under the same treatment combination, according the experiment's findings. This kind of observation might have been made because more flowers and fruits were generated, increasing the proportion of fruit set. Vermicompost, various chemical fertilizers, and bio fertilizer may have all contributed in this regard. Tripathi (2012) in strawberry cv. and Srinu *et al.* (2017) in papaya Chandler made comparable discoveries.

Early fruiting is a considerably more important criterion that can help producers start making money right away. The number of days needed for fruit to form during the growth period varied among treatments. According to research data, there was a significant difference between comprehensive nutrition management strategies and the number of days it took for the first

fruits to begin to appear. Less time was needed for the plants treated with RDF of NPK + vermicompost + biofertilizer to reach fruit development. Early blooming and the simultaneous transport of growth factors like cytokinin to the auxiliary bud, which breaks apical dominance, may be caused by an improved net absorption rate and better development. These factors may also contribute to the production of enough endogenous metabolites. In banana, Hazarika and Ansari (2010); Nayyer *et al.* (2014); Srinu *et al.* (2017) in papaya, and Gupta and Tripathi (2012) in strawberry cv. Chandler, Hazarika and Ansari (2010); Nayyer *et al.* (2014).

According to the results of the above experiment, plants treated with RDF of NPK + vermicompost + biofertilizer produced the highest fruit yield (59.47 kg ha^{-1}), fruit weight (1.67 kg), These findings are closely supported by of Nayyer *et al.* (2014) in banana, Gupta and Tripathi (2012) in strawberry, Katiyar *et al.* (2012) in ber, Kumar *et al.* (2015) in Guava, Ravishankar *et al.* (2010); Kanwar *et al.* (2020) in papaya. The outcomes mentioned above could be attributable to increased vermicompost, biofertilizers, and chemical fertilizers used in the right amounts to produce more fruit. Additionally, the nitrogen-fixing abilities of vermicompost and the phosphorus-solubilizing capabilities of biofertilizers may boost the availability of nitrogen and phosphorus to plants as well as their translocation, which helps to raise the fruit weight as well as the overall fruit output.

Table 1: Effect of integrated nutrient management on yield of papaya.

Treatment	Days taken to First fruit Initiation	Fruit set percentage	Total Fruit	Fruit weight	Total Yield
T_0F_0	176.65^{a}	53.49^{g}	18.77^{h}	1.17^{g}	28.10^{i}
T_0F_1	165.80^{cd}	57.52^{def}	22.26^{gh}	1.24^{efg}	33.38^{fgh}
T_0F_2	168.44^{bc}	56.13^{efg}	23.32^{fgh}	1.23^{fg}	29.20^{hi}
T0F3	157.89^{ef}	56.110^{efg}	25.13^{efg}	1.34^{defg}	35.18^{efg}
T0F4	170.71^{b}	55.10^{fg}	20.89	1.28^{efg}	28.87^{hi}
T1F0	161.75^{de}	58.17^{def}	30.00^{cd}	1.31^{defg}	39.75^{de}
T1F1	140.88^{jk}	63.01^{bc}	30.65^{cd}	1.53^{abcd}	53.52^{b}
T1F2	121.82^{n}	73.29^{a}	38.72^{a}	1.67^{a}	59.47^{a}
T1F3	138.13^{kl}	62.85^{bc}	32.26^{bc}	1.42^{bcdef}	43.13^{d}
T1F4	134.52^{l}	65.69^{b}	27.26^{de}	1.59^{abc}	33.44^{fgh}
T2F0	151.83^{gh}	57.82^{def}	22.62^{gh}	1.26^{efg}	29.91^{hi}
T2F1	158.90^{ef}	57.10^{defg}	23.50^{fgh}	1.38^{cdefg}	37.71^{ef}
T2F2	167.62^{bc}	54.79^{fg}	24.01^{efgh}	1.35^{defg}	31.14^{ghi}
T2F3	155.19^{fg}	57.96^{def}	25.22^{efg}	1.39^{cdefg}	40.31^{de}
T2F4	161.49^{de}	58.09^{def}	24.26^{efgh}	1.33^{defg}	31.91^{ghi}
T3F0	144.02^{ij}	60.11^{cd}	25.09^{efg}	1.39^{cdefg}	39.10^{de}
T3F1	148.13^{hi}	60.00^{cde}	26.61^{ef}	1.45^{bcdef}	48.83^{c}
T3F2	129.24^{m}	72.10^{a}	34.66^{b}	1.64^{ab}	56.66^{ab}
T3F3	149.06^{h}	64.18^{b}	30.21^{cd}	1.48^{abcde}	55.34^{ab}
T3F4	170.73^{b}	58.48^{def}	24.00^{efgh}	1.37^{cdefg}	39.45^{de}
SEM	1.54	1.18	1.118	0.07	1.63
CD(p=0.05)	4.35	3.33	3.148	0.19	4.59
CV(%)	2.46	4.83	10.340	12.25	10.05

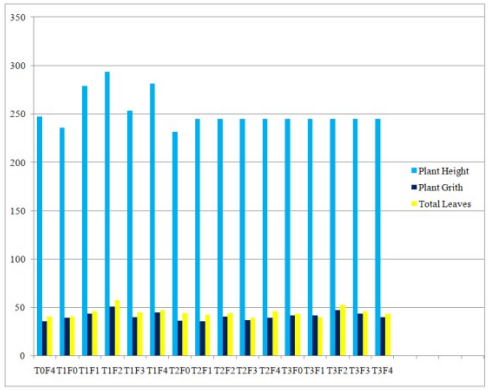

Fig. 1. Effect of integrated nutrient management on growth of papaya.

CONCLUSION

According to the experimental results from the aforementioned field trial, the recommended fertilizer dose of 200: 200: 250 g $plant^{-1}$ $year^{-1}$, vermicompost at 5 kg $plant^{-1}$, and 100 g of well-mixed PSB and azotobactor was found to be superior in nearly every growth and yield related feature. It was also demonstrated that 100 g of well-mixed PSB and

azotobactor and 75% RDF + vermicompost @ 5 kg plant^{-1} were equivalent to the aforementioned treatments.

Conflict of Interest. None.

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