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Impact of integrated nutrient management on yield and quality parameters of papaya (*Carica papaya* L.) Cv. Red Lady under net house

Aniket Kanwar, GD Sahu and HK Panigrahi

Abstract
The present investigation was conducted during the year 2018-19 at Research Farm of Centre of Excellence on Protected Cultivation and Precision Farming under net house, College of Agriculture (IGKV) Raipur (C.G.). The experiment was laid out in Randomized Complete Block Design (RCBD) with three replication and ten treatments. The treatment consists of ten different combination of organic manure and bio-fertilizers along with recommended dose of fertilizer. Result revealed that treatment T_8 (75% RDF + 10 kg Vermi-compost + 100 g *Azotobacter* +100 g PSB/Plant) showed highest number of fruits (78.33), fruit length (22.66 cm), fruit weight 1486 (g), yield per plant (71.32 kg), TSS (%) 14.26, minimum acidity (%) 0.13, total sugar (%) 10.31, reducing sugar(%) 8.82, ascorbic acid 52 (mg/100g).

Keywords: *Organic manure*, Azatobacter, PSB, fruit weight, TSS, total sugar

Introduction
Papaya *Carica papaya* L. belongs to family Caricaceae having 48 recognized species and among them, *Carica papaya* L. is only species grown for edible fruits (Chadha, 1992) [2]. Papaya is a polygamous plant with fundamental types of gender – pistillate, hermaphrodite and staminate where pistillate is stable in proportion to the rest form. Papaya is a evergreen plant with a hollow, unbranched, softwood stem. The leaves are very lengthy with petiole looks like palms. Papaya's nutritional and medicinal properties are well recognized for good source of vitamin C, along with high in sugar and pectin content. Papaya is originated in Mexico as a cross between two species of the genus Carica. It was brought from Malacca to India. In India it is grown in area 132.41 thousand hectare with production of 5667.06 thousand Metric ton (Anony. 2017) [1] Now it is cultivated in tropical and subtropical part of the word. quantities. To accomplish nutrient requirement for crop chemical fertilizer is mostly used.
Chemical fertilizer deteriorates the soil's physical, chemical and biological characteristics and, in turn, soil productivity. Since ancient times, the significance of organic manures in Indian agriculture has been recognized. It increases soil texture, composition, porosity, infiltration rate, aeration, microbial population and better root development with positive impacts on crop yield, quality and post-harvest characteristics. Integrated Nutrient Management relates to maintaining soil fertility and crop nutrient supply at an optimal rate of production by optimizing the advantages of all available organic, inorganic and biological component sources. Beneficial microbes increase nutrient availability, reduce disease, reduce nutrient losses, and help to degrade toxic compounds (Subba, 1998) [14].

Material and Methods
The present experiment was carried out during the year 2018-2019 under the net house of Centre of Excellence on Protected Cultivation and Precision farming, College of Agriculture, IGKV, Raipur (C.G.). The experiment was laid out in Randomized Complete Block Design (RCBD) with three replication and ten treatments. The treatment consist of ten different combination of organic manure and bio-fertilizers along with recommended dose of fertilizer i.e. T_0: RDF (200 N, 250 P_2O_5, 250 K_2O g/ Plant + Control, T_1: RDF + 20 kg FYM/plant, T_2: RDF + 10kg Vermi-compost /plant, T_3: RDF + 5 kg Neem Cake /plant, T_4: RDF +20 kg FYM/plant+ 100 g *Azotobacter* + 100g PSB /plant, T_5: RDF +10 kg Vermi-compost +100 g *Azotobacter* + 100g PSB /plant, T_6: RDF + 5 kg Neem cake +100 g *Azotobacter* + 100g PSB/Plant, T_7: 75% RDF + 20kg FYM/plant +100g *Azatobacter* +100 g PSB /plant, T_8: 75% RDF +10kg Vermi-compost +100 g *Azatobacter* +100 g PSB/plant, T_9: 75% RDF + 5 kg Neem Cake+100 g *Azotobacter* +100 g PSB /Plant. Papaya sapling were planted at spacing of 1.8 x 1.8 metre of spacing. Biofertilizer that is *Azatobacter* and phosphate solubilizing bacteria

were applied along with Vermicompost and FYM before transplanting. Number of fruits, fruit length, fruit breadth, fruit weight and yield per plant and quality parameters were recorded taking average of five plants and five fruits per treatment per replication and applying statistical procedure for comparison described by Gomez and Gomez, (1984) [4].

Result and Discussion

Among the all treatment maximum number of fruits (74.33) was observed under treatment T_8 (75% RDF + 10 kg Vermi-compost + 100 g *Azotobacter* +100 g PSB/Plant), which is followed by T_9 & T_7 which had 74.33 & 71.00 number of fruits. Minimum number of fruits have been registered in T0 (RDF + Control) that is 50. The increased in number of fruits might be attributed due to the fact that, increasing levels of nutrients in assimilating area of crop due to which the rate of dry matter production was enhanced. The above results are in conformity with the findings of Dalal *et al*. (2004) [3] in sapota. Reddy *et al.* (2013) [9].

Maximum fruit length (22.66) was observed under treatment T_8 (75% RDF + 10 kg Vermi-compost + 100 g *Azotobacter* +100 g PSB/Plant), which is followed by T_9 & T_7 which had 19.33 & 21.33 fruits length. Minimum fruits length was registered in T0 (RDF + Control) that is 16 cm. Superior physical fruit quality may be due to fact that, organic manures and microbial fertilizers enhances the nutrient availability, also these nitrogen fixers are known for accumulation of dry matter and their translocation as well as favour synthesis of different growth regulators. The above findings are in accordance with Patel *et al.* (2010) [7] in sapota and Srivastava in papaya (2008) [12].

Among the all treatment maximum fruit weight (1486) was observed under treatment T_8 (75% RDF + 10 kg Vermi-compost + 100 g *Azotobacter* +100 g PSB/Plant), which is followed by T_7 & T_9 which had 1423.33 & 1340.00 fruit weight. Treatments like T_1 & T_2 and T_4 & T_5 and T_5 & T_9 and T_1 & T_6 which showed 1210 & 1190 and 1273.33 & 1340 and 1316.66 &1340 and 1210 &1243.33gram fruits weight respectively was at par with each other. Minimum fruit weight has been registered in T0 (RDF + Control) that is 946.66 which is followed by T_3 that is 1030 gram. The increased in weight of fruits might be attributed due to the fact that, increasing levels of nutrients in assimilating area of crop due to which the rate of dry matter production was enhanced. Similarly, due to rational partitioning of dry matter to economic sink, the yield attributes were improved. The above results are in conformity with the findings of Dalal *et al.* (2004) [3], Srinu *et al*. (2017) [13].

Maximum yield (71.32 kg) per plant was observed under treatment T_8 (75% RDF + 10 kg Vermi-compost + 100 g *Azotobacter* +100 g PSB/Plant), which is followed by T_7 & T_9 which had 67.86 & 66.93 kg of yield. Minimum fruit weight has been noted in T0 (RDF + Control) that is 45 kg. Under the impact of bio-fertilizers, vermicompost, and inorganic fertilizers, the presence of a favourable nutritional climate had a positive influence on vegetative and reproductive development, which ultimately led to higher production. This result is close finding with Reddy *et al.* (2013) [9].

Quality Parameters

Maximum total soluble solid % (14.26) was observed under treatment T_8 which is followed by T_6 which had 13.83 total soluble solid %. Minimum total solid percent has been noted in T0 (RDF + Control) that is 11.40 which is followed by T_1 (12.30). The maximum acidity per cent (0.186) was noticed under control (T_0). The treatment is T_8 (75% RDF + 10 kg Vermi-compost + 100 g *Azotobacter* +100 g PSB/Plant), recorded minimum per cent of acidity (0.133). This might be due to the influence of boron and zinc in conversion of acid into sugar and their derivatives by the reaction of glycolytic pathway.

The treatment is T_8 (75% RDF + 10 kg Vermi-compost + 100 g *Azotobacter* +100 g PSB/Plant), recorded 10.31% of total sugar which was maximum. The minimum Total sugar % (7.55) was noticed under control (T_0). Application of nitrogen fixing bacteria with lower dose of inorganic fertilizers might have exhibited regulatory role on the absorption and translocation of various metabolites, in which carbohydrates are most important which affects the quality of fruits. During ripening of fruits the carbohydrates reserves of the root and stem are drawn upon heavily and hydrolyzed into sugars hence results in better fruit quality. The results are in accordance in with Ram *et al*. (2007) [8] in guava, Madhavi *et al*. (2008) [5] in mango. Patel *et al*. (2010) [7] in sapota.

The maximum reducing % was found under treatment is T_8 (75% RDF + 10 kg Vermi-compost + 100 g *Azotobacter* +100 g PSB/Plant), recorded 8.82% of reducing sugar. The minimum reducing sugar % (6.40) was noticed under control (T_0). It may be due to the addition of organic manure supplements that provide ample nutrients, moisture and growth promoting substances that enhance plant metabolism and hormonal activity and promote the production of more photosynthates stored in fruit in the form of starch and carbohydrates. The result was close agreement with Srinu *et al.* (2017) [13].

The treatment T_8 recorded maximum ascorbic acid (52.00 mg/100 g) followed by the treatments T_7 & T_9 having 50 and 48.83 mg of ascorbic acid per 100gram of pulp. The minimum ascorbic acid (40.66) was noticed under control (T_0).

It is due to ripening of fruits where fruits change its physical, physiological and biochemical changes that is conversion of starch into soluble sugars present findings are in close conformity with Shivakumar (2010) [11], Yadav *et al.* (2011) in papaya.

Table 1: Effect of Integrated Nutrient Management on yield parameters of papaya cv. Red Lady under net house

	Treatments	Number of fruits	Fruit length (cm)	fruit weight (g)	Yield per plant (kg)
T_0	RDF + Control	50.00^{i}	16.00^{f}	946.66^{i}	45.00^{f}
T_1	RDF + 20 kg FYM/plant	56.00^{h}	16.66^{f}	1210.00^{fg}	53.83^{e}
T_2	RDF + 10 kg Vermicompost /plant	58.00^{g}	17.00^{ef}	1190.00^{g}	55.66^{e}
T_3	RDF + 5 kg Neem Cake /plant	55.33^{h}	16.33^{f}	1030.00^{h}	53.16^{e}
T_4	RDF + 20 kg FYM/plant + 100 g *Azotobacter*+ 100g PSB /plant	60.66^{f}	21.33^{b}	1273.33^{de}	57.26^{d}
T_5	RDF + 10 kg Vermicompost +100g *Azotobacter* + 100g PSB /plant	64.66^{d}	18.00^{c}	1316.67^{cd}	61.15^{c}
T_6	RDF + 5 kg Neem cake + 100 g *Azotobacter* + 100 g PSB/Plant	62.66^{e}	19.16^{cd}	1243.33^{ef}	65.34^{b}
T_7	75% RDF + 20 kg FYM /plant + 100 g *Azatobacter* +100 g PSB /plant	71.00^{c}	21.33^{b}	1423.33^{b}	67.86^{b}
T_8	75% RDF + 10 kg Vermicompost + 100 g *Azatobacter* +100 g PSB/plant	78.33^{a}	22.66^{a}	1486.00^{a}	71.32^{a}

T_9	75% RDF + 5 kg Neem Cake +100 g *Azotobacter* +100 g PSB /Plant	74.33[b]	19.33[c]	1340.00[c]	66.93[b]
	SE(m)±	0.34	0.44	15.47	1.23
	CD at 5%	1.03	1.30	45.96	3.66

Table 2: Effect of Integrated Nutrient Management on quality parameters of papaya cv. Red Lady under net house

Treatment	TSS (%)	acidity (%)	Total sugar (%)	Reducing sugars (%)	Ascorbic acid (mg/100g)
T_0	11.40[h]	0.18[a]	7.55[i]	6.40[i]	40.66[g]
T_1	12.30[g]	0.17[b]	8.25[h]	7.16[h]	43.66[f]
T_2	12.63[f]	0.17[b]	8.56[g]	7.31[g]	43.83[f]
T_3	12.76[f]	0.15[cde]	8.99[f]	7.48[f]	44.66[f]
T_4	13.46[cd]	0.17[b]	9.13[e]	7.70[e]	46.00[e]
T_5	13.70[bc]	0.16[bc]	9.38[d]	8.18[d]	47.33[d]
T_6	13.83[b]	0.16[bcd]	9.60[c]	8.31[cd]	47.50[d]
T_7	13.30[de]	0.14[e]	9.96[b]	8.48[b]	50.00[b]
T_8	14.26[a]	0.13[f]	10.31[a]	8.82[a]	52.00[a]
T_9	13.16[e]	0.15[de]	10.04[b]	8.43[bc]	48.83[c]
SE(m)±	0.06	1.08	0.05	0.02	0.33
CD at 5%	0.25	0.01	0.10	0.14	1.15

Conclusions

From the present finding it can be concluded that the yields attributing parameters like number of fruits per plant, Fruits length, fruits weights and yields per kg of plant was maximum in treatment T_8 also for quality parameters like TSS, Total sugar, reducing sugar were maximum in treatment T_8 (75% RDF + 10 kg Vermi-compost + 100 g *Azotobacter* +100 g PSB/Plant).

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