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Effect of Integrated Nutrient Management on Fruit Characters and Economics of Papaya (*Carica papaya* L.) Cv. Red Lady

Srinu, B.[1*], Manohar Rao, A.[2], Veenajoshi, K.[3]

[1&3]Deportment of Fruit Science, College of Horticulture, Sri Konda Laxman Telangana State Horticulture University, Rajendranagar, Hyderabad-30.

[2]Deportment of Horticulture, College of Agriculture, P.J.T.S.A.U, Rajendranagar, Hyderabad-30

*Corresponding Author E-mail: srinu.chowhan@gmail.com

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ABSTRACT

The field experiment was conducted during 2014 - 15 and 2015 - 16 at College of Agriculture College, Department of Horticulture, Hyderabad the effect of integrated nutrient management on fruit characters and economics of papaya cv. red lady. The experiment laid out RBD design with ten treatments including organic, inorganic and bio fertilizers were comprised with three replications. The results revealed that the application of T_9 - 75% RDF + 10 kg VC + 100g Azotobacter +100g PSB plant^{-1}. The higher number of fruits per plant (32.98 and 31.45), Fruit length (27.23 cm and 25.45 cm), Fruit weight (2018.00 g and 1840.24 g), Pulp thickness (2.66 cm and 2.02 cm), Fruit yield (31.34 kg plant^{-1} and 32.10 kg plant^{-1}) during both years respectively and T_9 treatment recorded higher B: C ratio (2.15). Hence, integrated nutrient management practices have been found to be an ideal option for improve growth of fruit characters and soil fertility.

Keywords*: Bio- fertilizers, Fruit length, Fruit weight, INM, Pulp thickness.*

INTRODUCTION

Papaya (*Carica papaya L.*) also called papaw or pawpaw, is a quick growing, typically singled stemmed, short lived, perennial herb. It belongs to family Caricaceae is an important fruit crop among fruit crops and attained unprecedented popularity in recent years, due to largely its ease of cultivation, quick returns, and adoptability to diverse soil and climate conditions. It is now distributed throughout tropical and subtropical regions of the world. It is a highly problematic, complicated and interesting fruit crop from botanical, genetical, cytogenetical and horticultural points of view. Papaya is indigenous to South Mexico and Costa Rica. It was introduced to India from Malacca. It is cultivated throughout the tropics both for fresh fruits and papain. In India it is grown in area of 133 lakh ha with a production of 5699 M.T.[5].

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MATERIALS AND METHODS

The experiment was conducted at College of Agriculture, P.J.T.S.A.U, Deportment of horticulture experimental field Rajendranagar, Hyderabad during the period of 2014-2015 and 2015-2016. The experiment laid out Randomized Block Design with ten treatments and three replications. The treatments comprised likewise, T_1 - RDF (200 N: 200 P_2O_5: 250 K_2O g/plant), T_2 - RDF + 20 kg FYM plant^{-1}, T_3 - RDF + 10 kg vermicompost plant^{-1},T_4 - RDF + 5 kg Neem cake plant^{-1}, T_5 - RDF + 20 kg FYM plant^{-1} + 100g *Azotobacter* + 100g *PSB* plant^{-1}, T_6 - RDF + 10 kg VC + 100g *Azotobacter* +100g *PSB* plant^{-1}, T_7 - RDF + 5 kg NC + 100g *Azotobacter* +100g *PSB* plant^{-1}, T_8 - 75% RDF + 20 kg FYM plant^{-1} + 100g *Azotobacter* + 100g *PSB* plant^{-1}, T_9 - 75% RDF + 10 kg VC +100g *Azotobacter* +100g *PSB* plant^{-1}, T_{10} - 75% RDF+ 5 kg NC +100g *Azotobacter* + 100g *PSB* plant^{-1}. The seedlings of papaya were transplanted in the field adopting a spacing of 2.5 × 2.5 m. The vegetative parameters like higher number of fruits per plant, fruit length, fruit weight, pulp thickness, Fruit yield (kg plant^{-1}) and BC ratio were analyzed statistically.

RESULTS AND DISCUSSION

The data pertaining to number of fruits per plant is presented in Table 1. During 2014 - 2015, higher number of fruits per plant was recorded in the treatment T_9 - 75% RDF + 10 kg VC + 100g *Azotobacter* + 100g *PSB* plant^{-1} (32.98) as compared to other treatments and it was followed by T_8 treatment (30.26). Significantly lower number of fruits per plant was recorded in T_4 treatment (22.71) and it was followed by T_2 treatment (24.50). During 2015 - 2016, T_9 - 75% RDF +10 kg VC + 100g *Azotobacter* + 100g *PSB* plant^{-1} recorded higher number of fruits per plant (31.45) and which was followed by T_7 treatment. T_1 treatment (21.41) recorded significantly lower number of fruits per plant and which was on par with T_2 and T_3 treatment. The significance response of *Azotobactor*, organic manure with part supplementation with inorganic fertilizers had positively and significantly influenced the yield attributes. It is well known that efficiency of bioagent can be well exploited with the use of organic manure with inorganic fertilizers[12] which might have improved the yield parameters by better availability and uptake of nutrient by plant roots and enhancing the source - sink relationship by increasing the movement of carbohydrates from the leaves to the fruits. Similar findings have been reported by Yadav[14], Srivastava[11].

Higher fruit length (Table 1) was recorded in the T_9 treatment (27.23 cm) as compared to other treatments and it was followed by T_1 (25.21 cm) and T_5 (24.93 cm). Significantly lower fruit length was observed in T_4 (20.18 cm) and it was at par with T_2 (21.09 cm). During 2015 - 2016, T_9 recorded higher fruit length (25.45 cm) and which was on par with T_5 treatment. T_2 treatment (17.84 cm) recorded significantly lower fruit length and which was on par with T_4 treatment. The notable improvement with respect to growth parameter with use of bio fertilizers, organic manures and inorganic fertilizers may be attributed to sufficient availability of nitrogen, phosphorus, potassium and other essential nutrients. Besides, *Azotobacter* is also associated with the production of growth promoting substance, antifungal compounds and cytokinins which in turn might have lead to better root development, better transport and uptake of nutrients which resulted in increasing growth parameters. This might have helped in increasing the fruit characters like fruit length. Results are in close conformity with the findings of Singh[10], Yadav[14] and Srivastava[11].

Lower fruit weight was recorded in (Table 1) the T_5 treatment (1630.89 g) as compared to other treatments and it was on par with T_3 treatment (1632.50 g). Significantly higher fruit weight was observed in T_9 - 75% RDF + 10 kg VC + 100g *Azotobacter* + 100g *PSB* plant^{-1} (2018.00 g) and it was at par with T_8 treatment (1954.03 g) and T_6 treatment (1949.87 g). During 2015-2016, T_9 treatment recorded higher fruit weight (1840.24 g) and which was on par with T_8 treatment (1769.67g). T_4 treatment recorded significantly lower fruit weight (1281.67 g). Lower pulp thickness was recorded in (Table 2) the T_7 treatment (1.69 cm) as compared to other treatments and it was on par with T_4 treatment (1.73 cm) and T_{10} treatment (1.79 cm). Significantly higher pulp thickness was observed in T_9 treatment (2.66 cm) and it was at par with T_8 treatment (2.57cm) and T_2 treatment (2.27 cm). During 2015 - 2016, T_9 treatment recorded higher pulp thickness (2.02 cm) and which was on par with T_8 treatment (1.86 cm). T_7 treatment (1.07 cm) recorded significantly lower pulp thickness and which was on par with T_1 and T_6 treatment. Application of organic manures, bio fertilizers along with major nutrients increased the growth parameters like. Growth parameter especially leaves play an important role in photosynthesis (metabolites) and this might have paved way for increases higher fruit weight. The results also in close conformity with the findings of Ravishanker *et al.*[7] and Chaudhri *et al*.[4] in papaya.

The data pertaining to fruit yield at presented in (Table 2). During 2014 - 2015, higher fruit yield was recorded in the T_9 treatment (31.34 kg plant^{-1}) as compared to other treatments and it was followed by T_{10} (29.62 kg plant^{-1}). Significantly lower fruit yield was recorded in T_1 treatment (20.49 kg plant^{-1}) and it was followed by T_2 treatment (22.63 kg plant^{-1}). During 2015 - 2016, T_9 - 75% RDF + 10 kg VC + 100g *Azotobacter* + 100g *PSB* plant^{-1} recorded higher fruit yield (32.10 kg plant^{-1}) which was followed by T_8 treatment (30.14 kg plant^{-1}) and which was on par with T_{10} (29.95 kg plant^{-1}). T_1 treatment (20.82 kg plant^{-1}) recorded significantly lower fruit yield and which was followed by T_2 treatment (22.26 kg plant^{-1}). Higher fruit yield (t. ha^{-1}) in papaya was realized due to increase in fruit number and fruit weight per plant. Higher yield response owing to application of organics ascribed to improved physical, chemical and biological properties of soil resulting in better supply of plant nutrients, which turn led to good crop growth and yield[9]. The higher fruit yield/plant might be due to increased fruit length, breadth and circumference, fruit number, fruit weight and volume of fruit with application of organic manures in combination with chemical fertilizers as against the straight fertilizer application.

Benefit and cost ratio of various treatments (Table 3) shows maximum net returns in treatment T_9 - 75% RDF + 10kg VC + 100g *Azotobacter* + 100g *PSB* plant^{-1} (3,46,565) and BCR (2.15), followed by treatment T_{10} - 75% RDF + 5kg NC + 100g *Azotobacter* +100g *PSB* plant^{-1} (3,10,615) and T_6 - RDF+ 10 kg VC+100g *Azotobacter* + 100g *PSB* plant^{-1} (2,72,260) However, Minimum net returns were recorded in T_1 treatment (Rs/- 1, 72,560) and low Benefit-Cost ratio (1.09). These results are in conformity with results reported by Shivakumar[9] and Yadav *et al.*[13] in papaya and Ray and Yadav[8], Anon.[1], Bhavidoddi[3], Patel[6] and Bhalerao *et al*.[2] in banana.

Table 1: Effect of integrated nutrient management on fruit characters of papaya cv. Red Lady

Treatments	Number of fruits per plant		Fruit length (cm)		Fruit weight (g)	
	2014 - 15	2015 - 16	2014 - 15	2015 - 16	2014 - 15	2015 - 16
T_1 - RDF (200 N: 200 P_2O_5: 250 K_2O g/plant)	22.71	21.41	25.21	22.45	1719.67	1645.00
T_2 - RDF + 20 kg FYM plant^{-1}	24.50	21.71	21.09	17.84	1775.33	1710.67
T_3 - RDF + 10kg Vermicompost plant^{-1}	25.70	22.47	23.25	22.07	1632.50	1631.67
T_4 - RDF + 5 kg Neem cake plant^{-1}	28.19	25.97	20.18	18.21	1666.03	1281.67
T_5 - RDF + 20 kg FYM plant^{-1} + 100g *Azotobacter* + 100g *PSB* plant^{-1}	27.66	25.86	24.93	23.97	1630.89	1524.00
T_6 - RDF + 10 kg VC + 100g *Azotobacter* + 100g *PSB* plant^{-1}	29.42	27.54	23.17	20.55	1949.87	1514.00
T_7 - RDF + 5kg NC + 100g *Azotobacter* + 100g *PSB* plant^{-1}	29.38	28.00	21.67	20.47	1912.00	1678.00
T_8 - 75% RDF + 20 kg FYM plant^{-1} + 100g *Azotobacter* + 100g *PSB* plant^{-1}	30.26	25.78	23.99	22.50	1954.03	1769.67
T_9 -75% RDF + 10 kg VC + 100g *Azotobacter* + 100g *PSB* plant^{-1}	32.98	31.45	27.23	25.45	2018.00	1840.24
T_{10} - 75% RDF + 5 kg NC + 100g *Azotobacter* + 100g *PSB* plant^{-1}	30.10	27.52	21.73	20.74	1850.33	1649.99
SE.m ±	0.50	0.51	0.40	0.64	38.93	37.99
CD at 5%	1.48	1.49	1.18	1.89	114.18	111.42

Table 2: Effect of integrated nutrient management on fruit characters of papaya cv. Red Lady

Treatments	Pulp thickness (cm)		Fruit yield (Kg plant^{-1})	
	2014 - 15	2015 - 16	2014 - 15	2015-16
T_1 - RDF (200 N: 200 P_2O_5: 250 K_2O g/plant)	2.07	1.27	20.49	20.82
T_2 - RDF + 20 kg FYM plant^{-1}	2.27	1.55	22.63	22.26
T_3 - RDF + 10kg Vermicompost plant^{-1}	2.07	1.64	23.66	23.70
T_4 - RDF + 5 kg Neem cake plant^{-1}	1.73	1.66	24.64	24.69
T_5 - RDF + 20 kg FYM plant^{-1} + 100g *Azotobacter* + 100g *PSB* plant^{-1}	1.90	1.35	25.75	25.80
T_6 - RDF + 10 kg VC + 100g *Azotobacter* + 100g *PSB* plant^{-1}	1.92	1.16	26.70	26.79
T_7 - RDF + 5kg NC + 100g *Azotobacter* + 100g *PSB* plant^{-1}	1.69	1.07	27.71	27.82
T_8 - 75% RDF + 20 kg FYM plant^{-1} + 100g *Azotobacter* + 100g *PSB* plant^{-1}	2.57	1.86	29.47	30.14
T_9 -75% RDF + 10 kg VC + 100g *Azotobacter* + 100g *PSB* plant^{-1}	2.66	2.02	31.34	32.10
T_{10} - 75% RDF + 5 kg NC + 100g *Azotobacter* + 100g *PSB* plant^{-1}	1.79	1.57	29.62	29.95
SE.m. ±	0.16	0.08	0.34	0.41
CD at 5%	0.46	0.23	1.01	1.19

Table 3: Effect of integrated nutrient management on Benefit Cost ratio of papaya cv. Red Lady

Treatments	Fruit Yield (tha^{-1})	Cost of treatment (tha^{-1})	Other expenditures (ha^{-1})	Total expenditure (ha^{-1})	Total returns (ha^{-1})	Net returns (ha^{-1})	BCR
T_1	20.66	112500	45500	158000	330560	172560	1.09
T_2	22.45	120900	45500	166400	359200	192800	1.16
T_3	23.68	115600	45500	161100	378880	217780	1.35
T_4	24.67	114635	45500	160135	394720	234585	1.46
T_5	25.77	120560	45500	166060	412320	246260	1.48
T_6	26.74	110080	45500	155580	427840	272260	1.75
T_7	27.76	124200	45500	169700	444160	274460	1.62
T_8	29.81	140735	45500	186235	476960	290725	1.56
T_9	31.72	115455	45500	160955	507520	346565	2.15
T_{10}	29.79	120525	45500	166025	476640	310615	1.87

CONCLUSION

Higher number of fruits per plant, fruit length, fruit weight, pulp thickness and fruit yield (kg plant^{-1}) was recorded in T_9 - 75% RDF + 10kg VC +100g *Azotobacter* + 100g *PSB* plant^{-1} during both the years. Benefit and cost ratio of various treatments shows maximum net returns in treatment T_9 - 75% RDF + 10kg VC + 100g *Azotobacter* + 100g *PSB* plant^{-1} (3,46,565) and Benefit and cost ratio (2.15).

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