Environment and Ecology 41 (1B) : 522—531, January—March 2023
ISSN 0970-0420

Effect of Organic Amendments on Growth, Yield and Quality of Papaya (*Carica papaya* L.) cv Vinayak

Okram Bijaya Devi, Yumnam Somi Singh

Received 11 October 2022, Accepted 6 January 2023, Published on 6 March 2023

ABSTRACT

The present research on organic practices in papaya cultivation was carried out to assess the effect of organic amendments on growth, yield and quality of papaya (*Carica papaya* L.) during the year 2020-21 incorporating Farm Yard Manure, Vermicompost, Panchagavya and Amritpani with their different 15 combinations. The results revealed that among treatments, maximum values for the parameters like plant height, petiole length and plant spread were exhibited by T_{15} (75% RDF FYM + Vermicompost + 3% Panchagavya + Amritpani) and minimum values were recorded from T_0 (Control). Parameters such as number of flowers/node, fruit set % were recorded highest in T_{15} (75% RDF FYM + Vermicompost + 3% Panchagavya + Amritpani), while minimum value for these parameters were recorded under T_0 (Control). Days to first flowering, days to first fruiting, days from first flowering to fruit maturity were recorded significantly earlier under T_{15} (75% RDF FYM + Vermicompost + 3% Panchagavya + Amritpani). Fruit yield and quality parameters were also recorded. Similarly, mean maximum fruit weight, fruit length, fruit diameter, number of fruits, peel weight, pulp weight, pulp: peel ratio, number of seeds, reducing sugar, total reducing sugar, non-reducing sugar, vitamin C and TSS (^{0}Brix) were recorded under T_{15} (75% RDF FYM + Vermicompost + 3% Panchagavya + Amritpani) and the mean minimum value for these parameters were registered under T_0 (Control).

Keywords Papaya, Organic manures, Amritpani, Farm yard manure, Panchagavya.

INTRODUCTION

Organic manures may be defined as materials which are organic in origin, bulky and concentrated in nature and capable of supplying plant nutrients and improving soil physical environment having no definite chemical composition with low analytical value produced from animal, plant and other organic wastes and by products. Organic manure binds soil particles into structural units called aggregates. These aggregates help to maintain a loose, open, granular condition. Organic matter increased water-holding capacity of soil and reduced surface run off and erosion due to infiltration. Organic matter serves as a reservoir of chemical elements that are essential for plant growth. Most of the soil nitrogen occurs in organic combination. Also a considerable quantity of phosphorus and sulfur exist in organic forms upon decomposition, organic matter supplied the nutrients needed by growing plants, as well as many hormones and antibiotics.

Okram Bijaya Devi*[1], Yumnam Somi Singh[2]
[1]Research Scholar, [2]Assistant Professor,
Department of Horticulture, North- Eastern Hill University, Chasingre, Tura, Maghalaya 794002, India

Email : oiboyaima@gmail.com
*Corresponding author

Table 1. Vegetative parameters in papaya cv Vinayak as influenced by combined organic manure treatment. *DAT- Days after transplanting.

Treatments	Plant height (cm) (180 DAT)	Number of leaves (180 DAT)	Petiole length (cm) (180 DAT)	Plant spread (cm) (180 DAT)	
				East-West (EW)	North-South (NS)
T_0	43.660	6.333	10.853	38.520	30.530
T_1	51.720	7.667	23.133	50.777	62.947
T_2	55.700	9.333	23.800	59.907	56.150
T_3	53.703	8.333	19.140	59.250	55.690
T_4	54.830	8.333	23.157	68.403	68.477
T_5	47.047	7.667	20.847	57.250	58.480
T_6	55.740	8.333	23.400	58.280	65.363
T_7	63.270	12.667	23.043	69.907	73.323
T_8	56.273	11.000	22.460	71.020	69.660
T_9	53.270	9.000	23.830	61.320	59.047
T_{10}	63.570	12.333	21.577	68.693	71.977
T_{11}	55.513	10.333	23.807	70.777	72.777
T_{12}	53.607	8.667	21.633	55.660	56.093
T_{13}	53.427	9.667	19.083	66.007	54.317
T_{14}	54.790	9.333	22.110	70.080	70.758
T_{15}	64.807	13.333	25.967	71.473	74.793
T_{16}	55.677	9.333	23.890	66.110	66.017
CD (0.05)	7.837	2.212	2.403	9.935	9.659
SE (m)	2.708	0.764	0.830	3.433	3.338
SE (d)	3.830	1.081	1.174	4.855	4.721
CV (%)	8.514	13.920	6.577	9.506	9.217

T_0 (Control)
T_1 (25% RDF FYM + Vermicompost)
T_2 (50% RDF FYM + Vermicompost)
T_3 (75% RDF FYM + Vermicompost)
T_4 (100% RDF FYM + Vermicompost)
T_6 (50% RDF FYM + Vermicompost+ 3% Panchagavya)
T_7 (75% RDF FYM + Vermicompost + 3% Panchagavya)
T_8 (100% RDF FYM + Vermicompost+ 3% Panchagavya)
T_9 (25% RDF FYM + Vermicompost + 3% Amritpani)
T_{10} (50% RDF FYM + Vermicompost + 3% Amritpani)
T_{11} (75% RDF FYM + Vermicompost + 3% Amritpani)
T_{12} (100% RDF FYM + Vermicompost+ 3% Amritpani)
T_{13} (25% RDF FYM + Vermicompost+ 3% Panchagavya + Amritpani)
T_{14} (50% RDF FYM + Vermicompost+ 3% Panchagavya + Amritpani)
T_{15} (75% RDF FYM + Vermicompost + 3% Panchagavya + Amritpani)
T_{16} (100% RDF FYM + Vermicompost+ 3% Panchagavya +Amritpani)

Table 2. Fruit yield and yielding parameters as influenced by combined organic manure treatment in Papaya cv Vinayak.

Treatments	Days to first flowering	Number of flowers/ node	Days to first fruiting	Days from first flowering to fruit maturity	Fruit set %
T_0	164.667	4.333	168.000	131.667	37.323
T_1	154.000	5.333	163.667	131.667	40.380
T_2	150.333	4.667	160.000	129.667	45.577
T_3	154.000	5.333	158.667	129.333	46.497
T_4	156.667	5.667	155.667	128.667	44.897
T_5	155.000	5.667	163.000	128.667	47.813
T_6	156.000	6.333	162.667	126.333	47.150
T_7	137.667	8.333	147.333	124.000	55.150
T_8	157.000	8.333	148.000	126.667	47.203
T_9	147.667	6.333	156.000	127.667	44.167
T_{10}	142.333	9.000	163.667	124.333	47.260
T_{11}	147.667	7.333	155.000	126.667	49.513
T_{12}	154.333	6.333	161.333	126.667	46.223
T_{13}	150.333	7.000	155.333	127.000	45.983
T_{14}	151.333	7.333	160.333	126.333	50.063
T_{15}	135.000	9.667	143.000	123.000	56.277
T_{16}	152.333	7.333	159.333	126.333	50.293
CD (0.05)	11.570	2.010	11.827	3.064	5.778
SE (m)	3.998	0.695	4.087	1.059	1.997
SE (d)	5.654	0.982	5.780	1.498	2.824
CV (%)	4.587	17.888	4.489	1.440	7.333

T_0 (Control)
T_1 (25% RDF FYM + Vermicompost)
T_2 (50% RDF FYM + Vermicompost)
T_3 (75% RDF FYM + Vermicompost)
T_4 (100% RDF FYM + Vermicompost)
T_6 (50% RDF FYM + Vermicompost+ 3% Panchagavya)
T_7 (75% RDF FYM + Vermicompost + 3% Panchagavya)
T_8 (100% RDF FYM + Vermicompost+ 3% Panchagavya)
T_9 (25% RDF FYM + Vermicompost + 3% Amritpani)
T_{10} (50% RDF FYM + Vermicompost + 3% Amritpani)
T_{11} (75% RDF FYM + Vermicompost + 3% Amritpani)
T_{12} (100% RDF FYM + Vermicompost+ 3% Amritpani)
T_{13} (25% RDF FYM + Vermicompost+ 3% Panchagavya + Amritpani)
T_{14} (50% RDF FYM + Vermicompost+ 3% Panchagavya + Amritpani)
T_{15} (75% RDF FYM + Vermicompost + 3% Panchagavya + Amritpani)
T_{16} (100% RDF FYM + Vermicompost+ 3% Panchagavya +Amritpani

In present day agriculture, due to continuous use of inorganic fertilizers with minimum or no use of organic manures, the cultivable lands are rapidly depleted in organic carbon content and becoming unfertile and exerting multiple nutrient deficiencies. Also the application of organics have positive role in

Table 3a. Yield attributing characters as influenced by combined organic manure treatment in Papaya cv Vinayak.

Treatments	Fruit weight (kg)	Fruit length (cm)	Fruit diameter (cm)	No. of fruits
T_0	1.429	23.253	9.960	18.333
T_1	1.516	26.900	10.107	20.333
T_2	1.527	26.409	10.800	22.667
T_3	1.500	25.287	10.577	24.333
T_4	1.606	27.137	11.007	24.000
T_5	1.488	28.909	10.873	26.333
T_6	1.684	26.214	11.037	27.333
T_7	1.855	30.369	12.240	30.333
T_8	1.592	26.736	10.923	28.333
T_9	1.512	25.080	10.923	25.333
T_{10}	1.608	26.283	11.160	27.667
T_{11}	1.715	30.891	12.200	30.000
T_{12}	1.471	25.754	10.837	26.667
T_{13}	1.717	25.869	11.020	25.667
T_{14}	1.627	30.129	11.537	29.000
T_{15}	1.929	31.170	13.043	31.667
T_{16}	1.580	28.020	11.740	28.333
CD (0.05)	0.251	2.307	0.700	3.326
SE (m)	0.087	0.797	0.242	1.149
SE (d)	0.123	1.127	0.342	1.625
CV (%)	9.327	5.055	3.752	7.583

T_0 (Control)
T_1 (25% RDF FYM + Vermicompost)
T_2 (50% RDF FYM + Vermicompost)
T_3 (75% RDF FYM + Vermicompost)
T_4 (100% RDF FYM + Vermicompost)
T_6 (50% RDF FYM + Vermicompost+ 3% Panchagavya)
T_7 (75% RDF FYM + Vermicompost + 3% Panchagavya)
T_8 (100% RDF FYM + Vermicompost+ 3% Panchagavya)
T_9 (25% RDF FYM + Vermicompost + 3% Amritpani)
T_{10} (50% RDF FYM + Vermicompost + 3% Amritpani)
T_{11} (75% RDF FYM + Vermicompost + 3% Amritpani)
T_{12} (100% RDF FYM + Vermicompost+ 3% Amritpani)
T_{13} (25% RDF FYM + Vermicompost+ 3% Panchagavya + Amritpani)
T_{14} (50% RDF FYM + Vermicompost+ 3% Panchagavya + Amritpani)
T_{15} (75% RDF FYM + Vermicompost + 3% Panchagavya + Amritpani)
T_{16} (100% RDF FYM + Vermicompost+ 3% Panchagavya +Amritpani)

Table 3b. Yield attributing characters as influenced by combined organic manure treatment in Papaya cv Vinayak. *NS–Non significant.

Treatments	Peel weight (g)	Pulp weight (g)	Pulp : peel ratio	Number of seeds
T_0	144.734	1,097.407	6.923	302.333
T_1	159.763	1,241.040	8.613	328.333
T_2	152.591	1,382.330	9.100	342.333
T_3	154.663	1,245.703	8.053	341.667
T_4	153.566	1,432.470	9.320	429.000
T_5	153.619	1,232.277	8.040	373.667
T_6	147.630	1,456.763	9.917	383.667
T_7	162.034	1,542.800	9.530	569.667
T_8	155.112	1,327.177	8.563	397.667
T_9	154.226	1,249.503	8.093	428.667
T_{10}	163.822	1,325.767	8.127	382.000
T_{11}	161.666	1,398.087	8.637	523.000
T_{12}	137.595	1,241.467	9.010	434.000
T_{13}	155.198	1,370.437	8.880	457.000
T_{14}	162.356	1,362.783	8.413	480.667
T_{15}	169.123	1,653.587	10.153	618.000
T_{16}	162.920	1,448.347	8.583	462.333
CD (0.05)	NS	190.945	1.387	69.978
SE (m)	-	65.985	0.479	24.182
SE (d)	-	93.317	0.678	34.199
CV (%)	-	8.445	9.537	9.816

T_0 (Control)
T1 (25% RDF FYM + Vermicompost)
T_2 (50% RDF FYM + Vermicompost)
T_3 (75% RDF FYM + Vermicompost
T_4 (100% RDF FYM + Vermicompost)
T_6 (50% RDF FYM + Vermicompost+ 3% Panchagavya)
T_7 (75% RDF FYM + Vermicompost + 3% Panchagavya)
T_8 (100% RDF FYM + Vermicompost+ 3% Panchagavya)
T_9 (25% RDF FYM + Vermicompost + 3% Amritpani)
T_{10} (50% RDF FYM + Vermicompost + 3% Amritpani)
T_{11} (75% RDF FYM + Vermicompost + 3% Amritpani)
T_{12} (100% RDF FYM + Vermicompost+ 3% Amritpani)
T_{13} (25% RDF FYM + Vermicompost+ 3% Panchagavya + Amritpani)
T_{14} (50% RDF FYM + Vermicompost+ 3% Panchagavya + Amritpani)
T_{15} (75% RDF FYM + Vermicompost + 3% Panchagavya + Amritpani)
T_{16} (100% RDF FYM + Vermicompost+ 3% Panchagavya +Amritpani)

efficient crop growth and yield enhancement. Organic farming is becoming increasingly popular, with a rapidly growing global demand for organic products. Organic practices, in the long run, improve organic carbon content and, thereby, sustainable yields in addition to improvement in quality. Shivakumar *et al.* (2012) reported papaya yield being increase by 10.2% in organic practices, compared to that under 100% recommended dose of fertilizers. Fruits, often eaten raw, are more vulnerable to contamination with chem-

Table 4. Quality parameters in Papaya cv Vinayak as influenced by combined organic manures treatment. *NS- Non- significant.

Treatments	Titrable acidity (%)	Reducing sugar (%)	Total reducing sugar (%)	Non-reducing sugar (%)	Vitamin C (mg/ 100 g)	TSS (^{0}Brix)
T_0	0.233	4.730	5.233	0.713	49.200	8.467
T_1	0.213	4.903	5.767	0.863	49.600	8.533
T_2	0.213	5.363	6.243	0.880	49.600	8.667
T_3	0.193	5.077	6.000	0.923	52.000	8.867
T_4	0.173	5.153	5.957	0.803	50.000	8.733
T_5	0.187	5.207	6.483	1.283	50.400	8.733
T_6	0.200	5.567	6.253	0.670	53.200	8.933
T_7	0.187	5.903	6.903	1.000	55.600	9.067
T_8	0.187	5.443	6.457	1.013	52.000	8.867
T_9	0.200	5.447	6.607	1.160	50.000	8.800
T_{10}	0.187	5.570	7.127	1.557	53.200	8.933
T_{11}	0.193	5.420	6.467	1.047	55.600	8.933
T_{12}	0.200	5.777	6.777	1.000	52.000	8.867
T_{13}	0.193	5.197	6.253	1.057	50.800	8.800
T_{14}	0.200	5.293	6.193	0.900	54.000	8.933
T_{15}	0.167	5.957	7.457	1.410	52.800	9.133
T_{16}	0.187	5.793	6.830	1.040	52.000	9.067
CD (0.05)	NS	0.573	0.534	0.459	2.062	0.168
SE (m)	-	0.198	0.185	0.159	0.712	0.058
SE (d)	-	0.280	0.261	0.224	1.008	0.082
CV (%)	-	6.354	4.987	26.960	2.378	1.135

T_0 (Control)
T_1 (25% RDF FYM + Vermicompost)
T_2 (50% RDF FYM + Vermicompost)
T_3 (75% RDF FYM + Vermicompost)
T_4 (100% RDF FYM + Vermicompost)
T_6 (50% RDF FYM + Vermicompost+ 3% Panchagavya)
T_7 (75% RDF FYM + Vermicompost + 3% Panchagavya)
T_8 (100% RDF FYM + Vermicompost+ 3% Panchagavya)
T_9 (25% RDF FYM + Vermicompost + 3% Amritpani)
T_{10} (50% RDF FYM + Vermicompost + 3% Amritpani)
T_{11} (75% RDF FYM + Vermicompost + 3% Amritpani)
T_{12} (100% RDF FYM + Vermicompost+ 3% Amritpani)
T_{13} (25% RDF FYM + Vermicompost+ 3% Panchagavya + Amritpani)
T_{14} (50% RDF FYM + Vermicompost+ 3% Panchagavya + Amritpani)
T_{15} (75% RDF FYM + Vermicompost + 3% Panchagavya + Amritpani)
T_{16} (100% RDF FYM + Vermicompost+ 3% Panchagavya +Amritpani)

icals due to their residual toxicity compared to cereals and pulses. Papaya responds well to such production systems compared to other perennial fruit crops. Being shallow rooted, papaya readily benefits from organic amendment and soil microflora which play a major role in growth, and productivity and soil health. India ranks first (Food and Agricultural Organization 2020-21) among papaya producing countries of the world with production of 5,221.67 thousand tonnes (National Horticultural Board 2021-22).

MATERIALS AND METHODS

The present research entitled "Effect of Organic Amendments on Growth, Yield and Quality of Papaya (*Carica papaya* L.) cv Vinayak" was carried out during the year 2020-21 at Horticulture Farm, Department of Horticulture, NEHU Tura campus, Chasingre, Meghalaya. The experiment was evaluated through seventeen treatments in a Randomized Block Design (RBD) with three replications. The treatments included T_0 (Control), T_1 (25% RDF FYM + Vermicompost), T_2 (50% RDF FYM + Vermicompost), T_3 (75% RDF FYM + Vermicompost), T_4 (100% RDF FYM + Vermicompost), T_5 (25% RDF FYM + Vermicompost+ 3% Panchagavya), T_6 (50% RDF FYM + Vermicompost+ 3% Panchagavya), T_7 (75% RDF FYM + Vermicompost + 3% Panchagavya), T_8 (100% RDF FYM + Vermicompost+ 3% Panchagavya), T_9 (25% RDF FYM + Vermicompost + 3% Amritpani), T_{10} (50% RDF FYM + Vermicompost + 3% Amritpani), T_{11} (75% RDF FYM + Vermicompost + 3% Amritpani), T_{12} (100% RDF FYM + Vermicompost+ 3% Amritpani), T_{13} (25% RDF FYM + Vermicompost+ 3% Panchagavya + Amritpani), T_{14} (50% RDF FYM + Vermicompost+ 3% Panchagavya + Amritpani), T_{15} (75% RDF FYM + Vermicompost + 3% Panchagavya + Amritpani) and T_{16} (100% RDF FYM + Vermicompost+ 3% Panchagavya +Amritpani). The respective amount of FYM, Vermicompost, Panchagavya and Amritpani were applied in three split doses as basal dose, two months after planting and one at first fruit set. Growth parameters (180 DAT- days after transplanting), yield attributing parameters and quality parameters were recorded.

RESULTS AND DISCUSSION

Vegetative parameters

Observation for vegetative parameters such as plant height, petiole length, number of leaves and plant

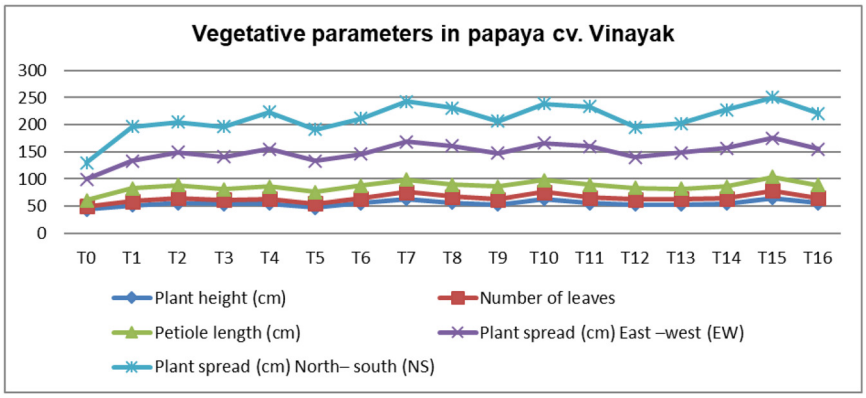

Fig. 1. Vegetative parameters namely plant height (cm), petiole length (cm), number of leaves and plant spread (cm- north-south and east-west) in Papaya cv Vinayak at 180 days after transplanting as influenced by combined organic manure treatment. Horizontal lines represent the standard deviation of the means of three replicates in each treatment. Each horizontal line indicates a significant difference between treatment groups at $p \leq 0.05$.

T_0 (Control)
T_1 (25% RDF FYM + Vermicompost)
T_2 (50% RDF FYM + Vermicompost)
T_3 (75% RDF FYM + Vermicompost)
T_4 (100% RDF FYM + Vermicompost)
T_6 (50% RDF FYM + Vermicompost+ 3% Panchagavya)
T_7 (75% RDF FYM + Vermicompost + 3% Panchagavya)
T_8 (100% RDF FYM + Vermicompost+ 3% Panchagavya)
T_9 (25% RDF FYM + Vermicompost + 3% Amritpani)
T_{10} (50% RDF FYM + Vermicompost + 3% Amritpani)
T_{11} (75% RDF FYM + Vermicompost + 3% Amritpani)
T_{12} (100% RDF FYM + Vermicompost+ 3% Amritpani)
T_{13} (25% RDF FYM + Vermicompost+ 3% Panchagavya + Amritpani)
T_{14} (50% RDF FYM + Vermicompost+ 3% Panchagavya + Amritpani)
T_{15} (75% RDF FYM + Vermicompost + 3% Panchagavya + Amritpani)
T_{16} (100% RDF FYM + Vermicompost+ 3% Panchagavya +Amritpani)

spread were taken at 180 days after transplanting and influenced significantly by varied organic combination treatments (Table 1 and Fig. 1). Among the treatments, plant height was observed to be maximum (64.807 cm) in T_{15} (75% RDF FYM + Vermicompost + 3% Panchagavya + Amritpani) which was statistically at par with T_7-75% RDF FYM + Vermicompost + 3% Panchagavya (63.270 cm) and T_{10}-50% RDF FYM + Vermicompost + 3% Amritpani (63.570 cm), whereas the minimum (43.660 cm) was exhibited by T_0 (Control). As for the mean number of leaves per plant, the highest value (13.333) was exhibited by T_{15} which was found to be statistically at par with T_7-75% RDF FYM + Vermicompost + 3% Panchagavya (12.667), T_8-100% RDF FYM + Vermicompost+ 3% Panchagavy (11.000) and T_{10}-50% RDF FYM + Vermicompost + 3% Amritpani (12.333), while the minimum value (5.667) for this parameter was registered in T_0 (Control). Maximum mean petiole length (25.967cm) was recorded under the treatment T_{15} which was statistically at par with T_9-25% RDF FYM + Vermicompost + 3% Amritpani (23.830 cm), T_{11}-75% RDF FYM + Vermicompost + 3% Amritpani (23.807 cm) and T_{16}-100% RDF FYM + Vermicompost+3% Panchagavya +Amritpani (23.890 cm), meanwhile the minimum value (10.853 cm) for this parameter was recorded in T_0 (Control). Similarly, the maximum mean plant spread (EW-71.473 cm, NS-74.793 cm) was registered in T_{15} whereas the minimum plant spread (EW-38.520 cm, NS 30.530 cm) was recorded in T_0 (Control). The findings of current investigation are in agreement with that of Reddy e*t al.* (2013) where they reported that in papaya cv Surya, crop growth was better with 75% recommended dose of fertilizer applied as farm yard manure + vermicompost, which was significantly superior that in 100% recommended dose of fertilizer and no manure/fertilizer treatment and in conformation with that of Nanaso and Pawar (2020) in sweet orange (*Citrus sinensis* (L.) Osbeck) cv Mosambi.

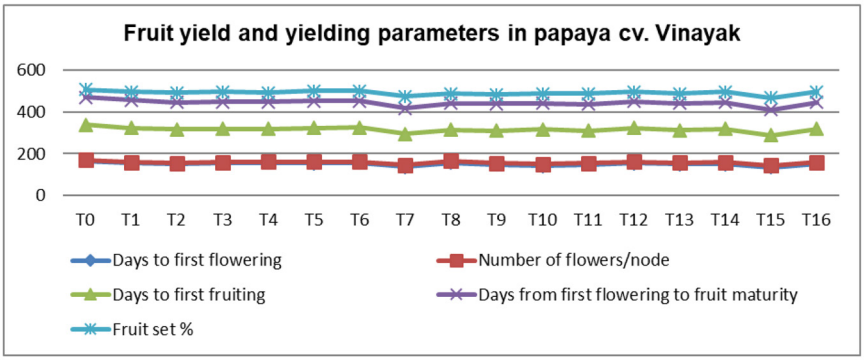

Fig. 2. Fruit yield and yielding parameters such as days to first flowering (day), days to first fruiting (day), fruit set (%), number of flower per node and days to first flowering to fruit maturity (day) as influenced by combined organic manure treatment in Papaya cv Vinayak. Horizontal lines represent the standard deviation of the means of three replicates in each treatment. Each horizontal line indicates a significant difference between treatment groups at $p \leq 0.05$.

T_0 (Control)
T_1 (25% RDF FYM + Vermicompost)
T_2 (50% RDF FYM + Vermicompost)
T_3 (75% RDF FYM + Vermicompost)
T_4 (100% RDF FYM + Vermicompost)
T_6 (50% RDF FYM + Vermicompost+ 3% Panchagavya)
T_7 (75% RDF FYM + Vermicompost + 3% Panchagavya)
T_8 (100% RDF FYM + Vermicompost+ 3% Panchagavya)
T_9 (25% RDF FYM + Vermicompost + 3% Amritpani)
T_{10} (50% RDF FYM + Vermicompost + 3% Amritpani)
T_{11} (75% RDF FYM + Vermicompost + 3% Amritpani)
T_{12} (100% RDF FYM + Vermicompost+ 3% Amritpani)
T_{13} (25% RDF FYM + Vermicompost+ 3% Panchagavya + Amritpani)
T_{14} (50% RDF FYM + Vermicompost+ 3% Panchagavya + Amritpani)
T_{15} (75% RDF FYM + Vermicompost + 3% Panchagavya + Amritpani)
T_{16} (100% RDF FYM + Vermicompost+ 3% Panchagavya +Amritpani)

Flowering and fruiting parameters

Statistically significant differences were observed in treatments recorded for flowering and fruiting parameters such as days to first flowering, number of flowers/node, days to first fruiting, days from first flowering to fruit maturity and fruit set % due to various organic combination treatments (Table 2 and Fig. 2). The number of days taken for first flowering from transplanting was recorded minimum (135.000 days) in T_{15} (75% RDF FYM + Vermicompost + 3% Panchagavya + Amritpani) which was observed statistically at par with T_7-75% RDF FYM + Vermicompost + 3% Panchagavya (137.667 days) and T_{10}-50% RDF FYM + Vermicompost + 3% Amritpani (142.333 days), while the maximum days (164.667 days) taken was registered under the treatment T_0 (Control). As for the mean highest (9.667) number of flowers/node was observed in T_{15} which was statistically at par with T_7 (8.333) and T_8-100% RDF FYM + Vermicompost+ 3% Panchagavya (8.333), meanwhile the mean lowest (4.333) flower per node was recorded under the treatment T_0 (Control). The treatment T_{15} took the minimum (143.00 days) number of days taken for first fruiting from flowering followed by T_7 (147.333 days) and T_8 (148.000 days) which were found to be statistically at par, whereas T_0 (Control) took maximum period (168.000 days) for first fruiting. Similarly, the minimum and maximum days to fruit maturity from first flowering were also exhibited by T_{15} and T_0 (control) with 123.000 and 131.667 days respectively. The treatments T_7 (124.000 days), T_{10} (124.333 days) and T_{15} (123.000 days) were recorded statistically at par for days taken for fruit maturity. The mean highest (56.277 %) fruit set % was registered under T_{15} which was found to be statistically at par with T_7 (55.150 days), while the lowest fruit set % (37.323 %) was recorded from T_0 (control). The findings of current investigations are in conformity with that of Nanaso and Pawar (2020) in Sweet Orange and Singh *et al.* (2022) in Strawberry.

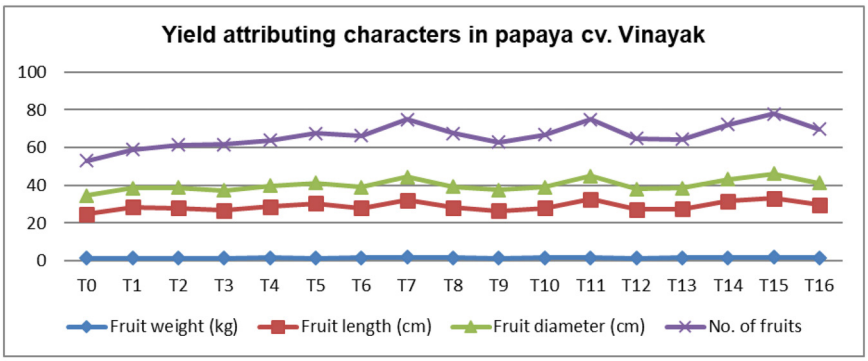

Fig. 3a. Yield attributing characters such as fruit weight (kg), fruit length (cm), fruit diameter (cm) and number of fruits as influenced by combined organic manure treatment in Papaya cv Vinayak. Horizontal lines represent the standard deviation of the means of three replicates in each treatment. Each horizontal line indicates a significant difference between treatment groups at $p \leq 0.05$.

T_0 (Control)
T_1 (25% RDF FYM + Vermicompost)
T_2 (50% RDF FYM + Vermicompost)
T_3 (75% RDF FYM + Vermicompost)
T_4 (100% RDF FYM + Vermicompost)
T_6 (50% RDF FYM + Vermicompost+ 3% Panchagavya)
T_7 (75% RDF FYM + Vermicompost + 3% Panchagavya)
T_8 (100% RDF FYM + Vermicompost+ 3% Panchagavya)
T_9 (25% RDF FYM + Vermicompost + 3% Amritpani)
T_{10} (50% RDF FYM + Vermicompost + 3% Amritpani)
T_{11} (75% RDF FYM + Vermicompost + 3% Amritpani)
T_{12} (100% RDF FYM + Vermicompost+ 3% Amritpani)
T_{13} (25% RDF FYM + Vermicompost+ 3% Panchagavya + Amritpani)
T_{14} (50% RDF FYM + Vermicompost+ 3% Panchagavya + Amritpani)
T_{15} (75% RDF FYM + Vermicompost + 3% Panchagavya + Amritpani)
T_{16} (100% RDF FYM + Vermicompost+ 3% Panchagavya +Amritpani)

Fruit yield and yielding parameters

Fruit weight, fruit length, fruit diameter and number of fruits were differed significantly due to combined organic manures treatment (Table 3a and Fig. 3a). Among the treatments, T_{15} (75% RDF FYM + Vermicompost + 3% Panchagavya + Amritpani) in Papaya cv Vinayak gave maximum fruit weight (1.930 kg) followed by T_7 (1.855kg), T_{13} (1.717 kg), T_{11} (1.715kg) and T_6 (1.684 kg) which were statistically at par, meanwhile the mean minimum values for fruit weight (1.430 kg) was recorded under T_0 (control). Treatment T_{15} exhibited highest fruit length (31.170 cm) which was at par with T_5 (28.909 cm), T_7 (30.369 cm), T_{11} (30.891 cm) and T_{14} (30.129 cm), while T_0-control (23.253 cm) exhibited the lowest fruit length. Significantly highest fruit diameter (13.040 cm) was recorded in T_{15} which was superior over the rest of the treatments and lowest fruit diameter (9.960 cm) in T_0 (control). Number of fruits per plant was significantly higher in T_{15} (31.670 nos.) which was at par with T_7 (30.333nos.), T_{11} (30.000 nos.) and T_{14} (29.000 nos), whereas the lowest number of fruits per plant (18.330 nos.) was recorded under T_0 (control).

The data pertaining to peel weight was found non-significant (Table 3b and Fig. 3b). However, the highest (169.123 g) peel weight was recorded in T_{15} and lowest mean (144.734 g) pulp weight i.e. gm was exhibited by T_0 (control). The data recorded on pulp weight (g) was found significantly highest in T_{15} (1,653.587 g) which was observed to be statically at par with T_7 (1,542.800 g), meanwhile the minimum mean value (1,097.407 g) was recorded under T_0 (control). The treatment T_{15} exhibited the highest (10.153%) pulp : peel ratio followed by T_6 (9.917%), T_7 (9.530%), T_4 (9.320%), T_2 (9.100%), T_{12} (9.010%) and T_{13} (8.880%) which were found to be at par, whereas the lowest pulp : peel ratio (6.923%) was recorded under T_0 (control). The number of seeds was differed significantly among the treatments. The highest number of seeds of 618.000 was recorded in plants applied with 75% RDF FYM + Vermicompost + 3% Panchagavya (T_{15}) which was on par with 75% RDF

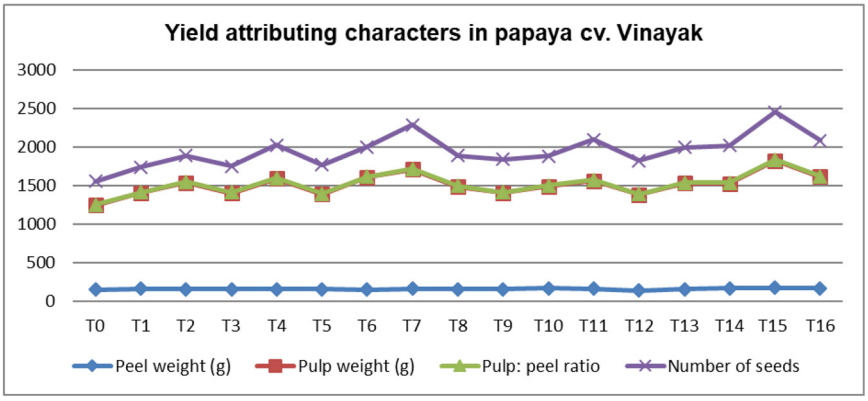

Fig. 3b. Yield attributing characters namely pulp weight (g), pulp:peel ratio and number of seeds as influenced by combined organic manure treatment in Papaya cv Vinayak except peel weight (g) which showed non-significant. Horizontal lines represent the standard deviation of the means of three replicates in each treatment. Each horizontal line indicates a significant difference between treatment groups at $p \leq 0.05$.

T_0 (Control)
T_1 (25% RDF FYM + Vermicompost)
T_2 (50% RDF FYM + Vermicompost)
T_3 (75% RDF FYM + Vermicompost)
T_4 (100% RDF FYM + Vermicompost)
T_6 (50% RDF FYM + Vermicompost+ 3% Panchagavya)
T_7 (75% RDF FYM + Vermicompost + 3% Panchagavya)
T_8 (100% RDF FYM + Vermicompost+ 3% Panchagavya)
T_9 (25% RDF FYM + Vermicompost + 3% Amritpani)
T_{10} (50% RDF FYM + Vermicompost + 3% Amritpani)
T_{11} (75% RDF FYM + Vermicompost + 3% Amritpani)
T_{12} (100% RDF FYM + Vermicompost+ 3% Amritpani)
T_{13} (25% RDF FYM + Vermicompost+ 3% Panchagavya + Amritpani)
T_{14} (50% RDF FYM + Vermicompost+ 3% Panchagavya + Amritpani)
T_{15} (75% RDF FYM + Vermicompost + 3% Panchagavya + Amritpani)
T_{16} (100% RDF FYM + Vermicompost+ 3% Panchagavya +Amritpani)

FYM + Vermicompost + 3% Panchagavya (T_7), while the lowest number of seeds i.e. 302.333 was recorded in T_0 (control). The results of the present investigation are in agreement with the findings of Reddy *et al.* (2013) where they reported that in papaya cv Surya, fruit yield and yielding parameters were higher with 75% recommended dose of fertilizer applied as farm yard manure + vermicompost, which was significantly superior that in 100% recommended dose of fertilizer and no manure/fertilizer treatment. Similar result was reported by Shivakumar *et al.* (2012) in papaya cvs Coorg Honey Dew and Surya respectively.

Quality parameters

Significant influences on reducing sugar, total reducing sugar, non-reducing sugar, Vitamin C, TSS were noticed with regard to different combined organic manures treatment (Table 4 and Fig. 4). However, statistically non- significant were noticed in treatments tested for titrable acidity. The maximum titrable acidity of 0.233% was recorded in fruits of plants applied with no organic manures (T_0-control), while the minimum of 0.167% was recorded in fruits of plants applied with 75% RDF FYM + Vermicompost + 3% Panchagavya + Amritpani (T_{15}). The mean highest value (5.957%) recorded for reducing sugar (%) was under T_{15} followed by T_7 (5.903%), T_{12} (5.777%), T_{16} (5.793%), T_{10} (5.570%), T_6 (5.567%), T_9 (5.447%), T_8 (5.443%) and T_{11} (5.420%) which were noticed to be statistically at par, whereas the mean lowest value (4.730%) for reducing sugar (%) was registered in T_0 (control). Among the various organic combination treatments, T_{15} recorded maximum (7.457%) total reducing sugar (%) which was at par with T_{10} (7.127%), meanwhile the lowest mean (5.233%) for total reducing sugar (%) was exhibited by T_0 (control). Unlike total reducing sugar (%), the maximum mean for the non- reducing sugar (1.557%) was exhibited by T_{10} which was found to be at par with T_5 (1.283%), T_9 (1.160%) and T_{15} (1.410%) whereas the mean minimum value (0.713%) for this parameter was

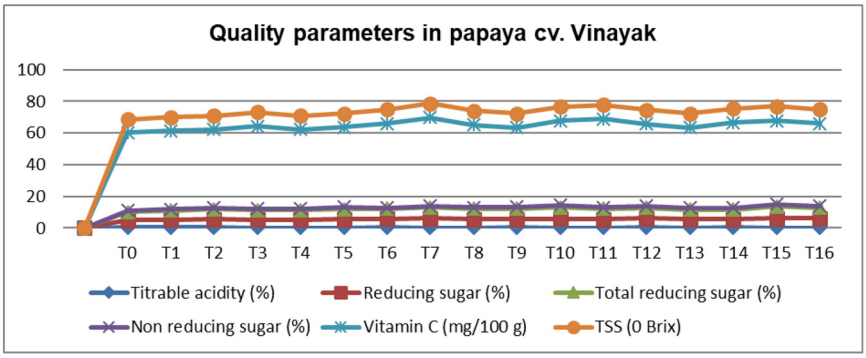

Fig. 4. Quality parameters such as reducing sugar (%), total reducing sugar (%), non-reducing sugar (%), vitamin C (mg/100g) and TSS (^{0}Brix) in Papaya cv Vinayak as influenced by combined organic manures treatment except titrable acidity (%) which showed non-significant. Horizontal lines represent the standard deviation of the means of three replicates in each treatment. Each horizontal line indicates a significant difference between treatment groups at $p \leq 0.05$.

T_0 (Control)
T_1 (25% RDF FYM + Vermicompost)
T_2 (50% RDF FYM + Vermicompost)
T_3 (75% RDF FYM + Vermicompost)
T_4 (100% RDF FYM + Vermicompost)
T_6 (50% RDF FYM + Vermicompost+ 3% Panchagavya)
T_7 (75% RDF FYM + Vermicompost + 3% Panchagavya)
T_8 (100% RDF FYM + Vermicompost+ 3% Panchagavya)
T_9 (25% RDF FYM + Vermicompost + 3% Amritpani)
T_{10} (50% RDF FYM + Vermicompost + 3% Amritpani)
T_{11} (75% RDF FYM + Vermicompost + 3% Amritpani)
T_{12} (100% RDF FYM + Vermicompost+ 3% Amritpani)
T_{13} (25% RDF FYM + Vermicompost+ 3% Panchagavya + Amritpani)
T_{14} (50% RDF FYM + Vermicompost+ 3% Panchagavya + Amritpani)
T_{15} (75% RDF FYM + Vermicompost + 3% Panchagavya + Amritpani)
T_{16} (100% RDF FYM + Vermicompost+ 3% Panchagavya +Amritpani)

exhibited by T_0 (control). The treatments were also tested for vitamin C content. Among the treatments, T_{15} exhibited highest (55.600 mg/100 g) vitamin C content and T_{15}, T_{14} (54.000 mg/100 g) and T_7 (55.600 mg/100g) which were statistically at par, while the lowest (49.200 mg/100 g) vitamin C content was registered under T_0 (control). Similarly, the highest TSS content was registered in plants treated with 75% RDF FYM + Vermicompost + 3% Panchagavya + Amritpani (T_{15}) with the value of (9.133 ^{0}Brix) which was statistically at par with T_7 (9.067 ^{0}Brix) and T_{16} (9.067 ^{0}Brix), meanwhile the lowest TSS recorded was in T_0 (control) with the value of 8.467 ^{0}Brix. The result findings of current research were in close conformity with the results of Nanaso and Pawar (2020) in citrus that TSS (10.05 ^{0}Brix), reducing sugars (4.42 %), non-reducing sugars (3.36 %), total sugars (7.78 %) and ascorbic acid (55.90 mg/100 ml juice) were recorded in treatment T_4 i.e. 75% Vermicompost (On N-equivalent basis of RDF) + *Trichoderma harzianum* (30 - 40 ml/plant) + Azadirachtin (1 % at 3 - 4 ml/liter as spray) + *Pseudomonas fluorescence* (30 - 40 ml/plant and similar results were recorded that of Singh *et al.* (2022) in Strawberry and Shivakumar *et al.* (2012) in papaya cvs Coorg Honey Dew and Surya respectively.

CONCLUSION

From the above results we can conclude that the plants applied with 75% RDF FYM + Vermicompost + 3% Panchagavya + Amritpani (T_{15}) showed better performance with desirable growth, yield and quality parameters compared to other organic applications. Thus, the treatment T_{15} can be recommended for the commercial cultivation of papaya cv Vinayak.

ACKNOWLEDGMENT

The authors wish to express our gratitude to Department of Horticulture, NEHU, Tura, Meghalaya, for the assistance and kind co-operation during the course of research work.

REFERENCES

Nanaso GM, Panwar PS (2020) Studies on use of organic manures and biofertilizers on growth, yield and quality in Sweet Orange (*Citrus sinensis* (L.) Osbeck) cv Mosambi. MSc thesis, MPKV, Rahuri. https://krishikosh. egranth.ac. in/handle/1/5810157148.

National Horticulture Board (2020-2021) Database 2021-22 (1st Adv Estimate). Gurgaon, India.

Reddy YTN, Reju MK, Ganeshmurthy AN, Pannerselvam P, Prasad SRS (2013) Influence of organic practices on growth and fruit yield in papaya cv Surya. *J Hort Sci* 8 (2) : 246—248.

Shivakumar BS, Dharmatti PR, Renukaswamy NS (2012) Influence of organic manures and their combination with FYM on fruit yield and economics of papaya cultivation. *Ind Hort* J 2 : 13—15.

Singh AM, Nayyer MA, Singh A, Rai D, Singh AP, Ankur Rai A (2022) Effect of FYM and vermicompost on growth and yield on strawberry (Fragaria×ananassa Duch.) cv Camarosa. *Phar Innov J* 11(6S) : 1803—1806.