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Effect of foliar application of different levels of gibberellic acid, 1-naphthalene acetic acid and their combinations on growth, yield and quality of papaya (*Carica papaya* L.) cv. Vinayak

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ABSTRACT

An experiment was conducted at Horticulture Farm, Department of Horticulture, NEHU Tura campus, Chasingre, Meghalaya during the year 2020-21 to evaluate the effect of foliar application of different levels of gibberellic acid, 1-naphthalene acetic acid and their combinations on growth, yield and quality of papaya (*Carica papaya* L.) cv. Vinayak. The results indicated that growth, yield and quality of the papaya fruits were significantly influenced by plant growth regulators studied. Among the treatments, the highest vegetative growth, yield attributing characters and quality were recorded with the treatment T_7 (RDF-Recommended Dose of Fertilizer + NAA 50 ppm + GA_3 50 ppm). Different vegetative parameters such as petiole length, number of leaves per plant, plant height and plant spread were recorded maximum value under the treatment T_7. T_7 took lowest days to first flowering, days to first fruiting and days from first flowering to fruit maturity. Treatment T_7 also showed superiority in different yield-attributing characteristics, such as number of flowers per node, fruit set percentage, number of fruits/plant, fruit length, fruit diameter and fruit weight. Quality parameters, such as TSS, ascorbic acid, total, reducing and non-reducing sugars of fruits, T_7 (RDF + NAA 50 ppm + GA_3 50 ppm), exhibited significantly maximum value.

1. Introduction

Plant growth regulators or phytohormones are organic substances produced naturally in higher plants, controlling growth or other physiological functions at a site remote from its place of production and active in minute quantity. Thimmann proposed the term *Phyto hormone* as these hormones are synthesized in plants. The plant hormones or regulators are the organic chemical compounds, which modify or regulate physiological processes in an appreciable measure in the plant when used in small concentration. They are readily absorbed and move rapidly through the tissues, when applied to different plant parts. These chemicals are specific in their action. They increases flower bud formation, inhibits flower bud formation, thinning by promotion of fruit/flower abscission, retards pre-harvest drop, improved fruit finish, improves fruit shape, vegetative growth control, increases fruit set, increases fruit red colour, advances fruit ripening, delays fruit ripening, enhances rooting, Suppresses growth of water sprouts, improves stress tolerance.

In present day agriculture, due to continuous application 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 resulting in multiple nutrient deficiencies (Katyal, 2000). Organic practice, in the long run, enhances organic carbon content and, thereby, sustainable yields in addition to quality improvement. Organic farming has been an outcome of the concerns over increasing contamination of food and consequent negative impacts on human health. The use of plant growth regulators has assumed an integral part of modern fruit production to improve the quality and production of fruits, and it has resulted in outstanding achievements in a number of fruit crops with regard to improvements in yield and quality (Jain and Dashora, 2011). Occasionally, they are needed to be supplemented exogenously for additional stimulus for plants such as papaya, which require quick responses for increased growth, fruit set and yield (Singh and Singh 2009). It would be therefore worthwhile to improve the yield and quality of fruit crops by foliar application of plant growth regulators. The

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different plant growth regulators like 1-Naphthalene acetic acid (NAA) and Gibberellic acid (GA_3) have been found important to alter the growth, yield and quality parameters of papaya fruit. Plants treated with NAA flowered about 6 days earlier than those in the control treatment, while plants treated with GA_3 flowered about 20 days earlier than those in the control in papaya (Subhadrabandhu *et al.,* 1997). Foliar application of GA_3 (25 ppm and 50 ppm), NAA (50, and 100 ppm), TIBA (25 ppm and 50 ppm), Ethrel (300 ppm and 500 ppm) and MH (200 ppm and 500 ppm) at 45 days after transplanting showed increased in plant height and internodal length of papaya by NAA, GA_3 and Ethrel, while decreased by MH and TIBA (Ghanta and Mitra, 1998).

2. Materials and Methods

The present experiment on the effect of foliar application of different levels of gibberellic acid, 1-naphthalene acetic acid and their combinations on growth, yield and quality of papaya (*Carica papaya* L.) cv. Vinayak was conducted at Horticulture Farm, Department of Horticulture, NEHU Tura campus, Chasingre, Meghalaya during the year 2020-2021. VNR variety Vinayak was purchased online from Porwal Hybrid Seeds and Biotech, Luchnow, Utter Pradesh. The seedlings were raised in polybags of 20X15 cm size under nursery house. The land selected for the experiment was ploughed and harrowed twice to bring it to a fine tilt and levelled. The pits of 50 X 50 X 50 cm size were dug at a spacing of 2.4 m x 2.4 m. The pits were left exposed and filled back with top soil, recommended dose of fertilizer (RDF) of FYM and vermicompost were mixed thoroughly before planting. When the seedlings were 45 days old, they were transplanted. Irrigation was scheduled thrice in a week as per the water requirement of the crop and weather condition. For the current experiment, FYM i.e 20 kg per plant per year: Vermicompost i.e 2kg per plant per year were used as RDF for papaya in place of inorganic NPK and applied (in three split doses) as basal dose, two months after planting and first fruit set). The desired concentrations of plant growth regulators were prepared by measuring a known quantity and dissolving them in small quantity of ethanol and making up the volume by the addition of distilled water. The prepared growth regulator solutions were sprayed with the help of sprayer at the interval of 45^{th}, 75^{th} and 105^{th} days after the transplanting of papaya seedlings.

The experiment was outlaid with sixteen treatments in a Randomized Block Design (RBD) and replicated thrice. The treatments which were given during the experiment included T_0 (RDF + Control -water spray), T_1(RDF + NAA 50 ppm), T_2 (RDF + NAA 75 ppm), T_3 (RDF + NAA 100 ppm, T_4 (RDF + GA_3 50 ppm), T_5 (RDF + GA_3 75 ppm), T_6 (RDF + GA_3 100 ppm), T_7 (RDF + NAA 50 ppm + GA_3 50 ppm), T_8 (RDF + NAA 50 ppm + GA_3 75 ppm), T_9 (RDF + NAA 50 ppm + GA_3 100 ppm), T_{10} (RDF + NAA 75 ppm + GA_3 50 ppm), T_{11} (RDF + NAA 75 ppm + GA_3 75 ppm), T_{12} (RDF + NAA 75 ppm + GA_3 100 ppm), T_{13} (RDF + NAA 100 ppm + GA_3 50 ppm), T_{14} (RDF + NAA 100 ppm + GA_3 75 ppm) and T_{15} (RDF + NAA 100 ppm + GA_3 100 ppm). The observations were recorded on five randomly selected plants of each treatment for each replication on growth parameters yield and yielding parameters and quality attributes. The data recorded were analysed using the statistical procedure as described by Gomez and Gomez (1984). Randomized Block Design analysis was done using Statistical Software Package for Agricultural Research Workers (OPSTAT) (Sheoran *et al.,* 1998). Differences at the level of $p \leq 0.05$ were considered significant.

3. Results and discussion

Growth parameters

Plant growth regulators GA_3 and NAA exhibited significant effect on petiole length, number of leaves per plant, plant height and plant spread of papaya plants (Table 1). Among the treatments, maximum (24.55cm) petiole length and number of leaves (17.33) were recorded with the application of RDF + NAA 50 ppm + GA_3 50 ppm (T_7) which was significantly superior over the rest of the treatments, whereas minimum (19.38cm) petiole length and number of leaves(10.333) were recorded under control (T_0). Similarly, the highest plant height (67.82cm) was exhibited by plants applied with RDF + NAA 50 ppm + GA_3 50 ppm (T_7) which was found to be statistically at par with T_6 (64.16cm), T_8 (63.61cm), T_{12} (63.98cm), T_{13}(59.41cm) and T_{15}(57.01cm), while the lowest plant height (50.53cm) was exhibited by control (T_0). Application with RDF + NAA 50 ppm + GA_3 50 ppm (T_7) resulted in plant with maximum east-west and north-south spread (75.87cm and 77.15 cm respectively). Treatment T_7 was observed to be statistically at par with T_4 (65.08cm), T_{10} (70.62cm) and T_{13} (67.55cm). For the east-west and the north-south spread, T_7 was noticed to be at par with T_{10} (75.09cm), meanwhile the minimum east-west (27.39cm) and north-south (42.35cm) spread were recorded in T_0 (control). The results of current research is in conformation with the findings of Kumar and Prasad (1998) that 50 ppm GA_3 promoted number of leaves, height of plant and plant spread as compared to control and 25 ppm GA_3 in the tune of papaya growth and corroborated with results reported by Ghanta and Mitra (1998).

Flowering and fruiting parameters

The application of different level of GA_3 and NAA and their combination significantly influenced on days to first flowering and days to fruit maturity of papaya

cv. Vinayak (Table 2). Minimum days (162.33days) taken for first flowering from transplanting was recorded in T_7 which was observed to be at par with T_4 (163.67days), T_{10} (174.33days) and T_{14} (180.00days), while the maximum days (205.33days) was recorded under T_0 (control). As for the days to fruit maturity from transplanting, T_7 took minimum number of days (121.00days) which was statistically at par with treatments T_{10} (122.67days) and T_{13} (124.00days), whereas T_0 (control) took the maximum days (133.67days) to fruit maturity. The data recorded on number of flower per node, days to first fruiting and fruit set percentage were found to be non-significant. However, the plants treated with RDF + NAA 50 ppm + GA_3 50 ppm (T_7) showed highest number of flower per node (74.00) followed by T_8 (58.67) and T_5 (58.00), meanwhile lowest number of flower per node (39.33) was recorded under T_0 (control). Similarly, the maximum fruit set per cent (59.15%) was obtained with the application of RDF + NAA 50 ppm + GA_3 50 ppm (T_7) while the minimum (38.740%) for this parameter was recorded under T_0 (control). Among the treatments, minimum number of days (182.33days) taken for first fruiting was exhibited by T_7 and the maximum days (234.00days) taken for first fruiting was exhibited by T_0 (control). These results are conferred with the reports by Goswami *et al.* (2013) that application of NAA at 50 ppm was found effective in increasing number of hermaphrodite flower, earlier in first flowering and fruit setting in pomegranate cv. Sinduri and in close conformity with that of Bhujbal *et al*. (2013) in sapota who reported that the application of NAA (40ppm) produced significantly minimum number of days for flower initiation.

Fruit yield and yielding attributes

The effects of different level and combinations of GA_3 and NAA on fruit length, fruit weight, fruit diameter and number of fruits per plant in papaya cv. Vinayak were found statistically significant (Table 3.a). Among the various treatments, the maximum fruit length (31.28cm) was recorded with the application of RDF + NAA 50 ppm + GA_3 50 ppm (T_7) which was noticed to be statistically at par with T_{10} (30.49cm), while the minimum fruit length (23.84cm) was recorded in T_0 (control). Similarly, plants treated with RDF + NAA 50 ppm + GA_3 50 ppm (T_7) exhibited the maximum fruit weight (2.03kgs) which was statistically at par with T_{10} (1.92kgs), whereas the minimum mean fruit weight (1.34kgs) was exhibited by T_0 (control). Treatment T_7 exhibited the highest fruit diameter (15.81cm) which was found to be at par with T_4 (14.42cm), T_8 (14.44cm), T_{10} (15.33cm), T_{13} (14.80cm) and T_{15} (14.60cm) and T_0 (control) exhibited the lowest fruit diameter (10.25cm). Among the various treatments, the highest mean (31.33) for the number of fruits per plant was noticed under T_7 which was observed to be at par with T_4 (29.33) and T_{10} (29.67), meanwhile the lowest number of fruits per plant (19.67) was recorded in T_0 (control). These results are conferred from the findings suggested by Kumar and Prasad (1997) and Nicolaescu (2009) in papaya and guava respectively and those of Ramkrishna *et al.* (2002) and Vishwakarma *et al.* (2000).

The treatments were significantly differed as influenced by different level and combinations of GA_3 and NAA with respect to peel weight (gm), pulp weight (gm), pulp: peel ratio and number of seeds (Table3.b). Among the treatments, the maximum peel weight (161.86gm) was recorded with the application of RDF + NAA 75 ppm + GA_3 50 ppm (T_{10}) which was found to be at par with T_1 (157.83g), T_2 (152.86g), T_5 (157.49g), T_6 (152.08g), T_7 (159.18g), T_8 (155.01g), T_{11} (156.49g) and T_{12} (155.12g), meanwhile the minimum peel weight (g) was recorded in T_0 (control). The plants treated with RDF + NAA 50 ppm + GA_3 50 ppm (T_7) showed maximum pulp weight (1,744.27g) which was statistically at par with T_{10} (1,630.35g) and the minimum pulp weight (1,081.80g) was recorded under T_0 (control). The maximum pulp: peel ratio was noticed in plants applied with RDF + NAA 50 ppm + GA_3 50 ppm (T_7) which was statistically at par with T_4 (10.39%), T_{10} (10.07%) and T_{13} (9.92%), while the minimum pulp: peel ratio (7.64%) was recorded in control (T_0). Similarly, the highest number of seeds (601.67) was obtained with the application of RDF + NAA 50 ppm + GA_3 50 ppm (T_7) which was noticed to be at par with T_{10} (530.00), whereas lowest number of seeds (259.00) was recorded in T_0 (control). These results are conferred with the findings of Goswami *et al.* (2013) that application of NAA at 50 ppm was found effective in increasing number of fruits per tree, fruit weight and yield in pomegranate cv. Sinduri and also in conformity suggested by Lal *et al.* (2013) that the application of 50 ppm GA_3 registered maximum fruit length (9.8 cm), fruit girth (10.23 cm), fruit weight (182 g), fruit volume (178.3 cc), minimum fruit drop per cent (38.8) and yield (37.1 kg/plant) in guava.

Quality attributes

Quality attributes such as total sugar (%), reducing sugar (%), non-reducing sugar (%), TSS (^{0}Brix) and vitamin C (mg/100 g) were markedly improved by different level and combinations of GA_3 and NAA over control in papaya cv. Vinayak (Table 4). The lowest acidity was recorded with the treatment of RDF + NAA 50 ppm + GA_3 50 ppm (T_7) which was found statistically at par with T_4 (0.187%), T_5 (0.187%), T_6 (0.187%), T_8 (0.180%), T_9 (0.187%), T_{11} (0.180%), T_{12} (0.180%) and T_{13} (0.187%), meanwhile the highest acidity (0.233%) was recorded under T_0 (control). The highest total sugar content (7.68%) was obtained with the application of RDF + NAA 50 ppm + GA_3 50 ppm (T_7) which was found to be at par with T_8 (7.36%), T_9 (7.00%), T_{10} (7.32%), T_{12} (7.13%) and T_{13} (7.00%), whereas the lowest mean total

sugar content was obtained from T_0 (4.76%). Similarly, T_7 exhibited the highest reducing sugar content (6.29%) which was statistically at par with T_3 (5.77%), T_6 (5.65%), T_8 (6.01%), T_9 (6.15%), T_{10} (5.84%), T_{12} (6.02%), T_{13} (5.61%), T_{14} (5.90%) and T_{15} (5.69%), while the lowest mean reducing sugar content was exhibited by T_0 (4.76%). It is evident from result that the maximum non-reducing sugar was recorded (1.48%) under T_{10} which was observed to be at par with T_2 (1.14%), T_4 (1.32%), T_7 (1.43%), T_8 (1.36%), T_{11} (1.37%) and T_{13} (1.39%), meanwhile the minimum non-reducing sugar (0.57%) was recorded in T_0 (control). Among the treatments, the highest TSS content (9.20^0 Brix) was recorded in T_7 which was statistically at par with T_4 (9.00^0 Brix), T_8 (9.13^0 Brix), T_{10} (9.13^0 Brix) and T_{13} (9.13^0 Brix), while the lowest TSS content (8.53^0 Brix) was recorded under T_0 (control). Similarly, the highest mean ascorbic acid (56.80 mg/100 g) was recorded with the application of RDF + NAA 50 ppm + GA_3 50 ppm (T_7) which was noted to be at par with T_4 (55.200mg/100 g), T_8 (54.80mg/100 g), T_{10} (56.40mg/100 g), T_{11} (55.60mg/100 g), T_{13} (56.40mg/100 g) and T_{14} (54.80mg/100 g), whereas the lowest mean ascorbic acid (48.40 mg/100 g) was noted in T_0 (control). These results confirmed the findings of Mitra *et al.* (2000) that 50ppm, GA_3 noted superior than control, 25 ppm and 100 ppm from the pulp and peel ratio, TSS (10%) and ascorbic acid point of view in papaya fruits and in close conformity with that of Gill and Bal (2013) that the tree sprayed with 50 ppm NAA and 30 ppm GA_3 obtained higher content of total soluble solids, while acidity content of Indian Jujube was recorded minimum under the same treatments.

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5. Conclusion

From the above result the following conclusion can be drawn that the foliar application of RDF + NAA 50 ppm + GA_3 50 ppm (T_7) can be recommended in papaya cv. Vinayak which showed significantly positive effect on growth, yield and quality attributing parameters over the rest of the treatments.

6. Conflict of interest

The authors declare that there is no conflict of interest. The submitted research paper is my original work and no part of it has been published anywhere else in the past.

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Table 1. Growth characteristics in Papaya cv. Vinayak as influenced by different level and combinations of GA_3 and NAA

Treatment	Petiole length (cm)	Number of leaves	Plant height (cm)	Plant spread (cm)	
				East- west	North-south
T_0	19.38	10.33	50.53	27.39	42.35
T_1	21.44	13.33	53.03	39.98	44.08
T_2	20.68	11.67	52.22	46.22	46.35
T_3	16.72	12.00	53.39	47.09	47.19
T_4	23.08	12.00	55.26	65.08	62.74
T_5	21.09	14.00	48.26	54.21	61.64
T_6	23.74	10.33	64.16	52.10	57.22
T_7	24.55	17.33	67.82	75.87	77.15
T_8	21.99	13.33	63.61	59.23	61.96
T_9	23.22	14.67	55.94	50.21	57.71
T_{10}	20.13	11.67	56.76	70.62	75.09
T_{11}	20.42	9.67	54.22	57.61	58.78
T_{12}	22.59	11.67	63.98	60.03	59.84
T_{13}	17.39	11.33	59.41	67.55	66.54
T_{14}	18.68	12.67	55.60	54.72	56.76
T_{15}	19.46	11.33	57.01	59.65	57.60
C.D. (0.05)	4.52	NS	10.50	12.29	9.51
SE(m)	1.56	1.59	3.62	4.23	3.28
SE(d)	2.20	-	5.12	5.99	4.63
C.V. (%)	12.90	-	11.01	13.22	9.73

*NS- Non-significant

T_0 (RDF + Control -water spray)
T_1 (RDF + NAA 50 ppm)
T_2 (RDF + NAA 75 ppm)
T_3 (RDF + NAA 100 ppm)
T_4 (RDF + GA_3 50 ppm)
T_5 (RDF + GA_3 75 ppm)
T_6 (RDF + GA_3 100 ppm)
T_7 (RDF + NAA 50 ppm + GA_3 50 ppm)
T_8 (RDF + NAA 50 ppm + GA_3 75 ppm)
T_9 (RDF + NAA 50 ppm + GA_3 100 ppm)
T_{10} (RDF + NAA 75 ppm + GA_3 50 ppm)
T_{11} (RDF + NAA 75 ppm + GA_3 75 ppm)
T_{12} (RDF + NAA 75 ppm + GA_3 100 ppm)
T_{13} (RDF + NAA 100 ppm + GA_3 50 ppm)
T_{14} (RDF + NAA 100 ppm + GA_3 75 ppm)
T_{15} (RDF + NAA 100 ppm + GA_3 100 ppm)

Table 2. Flowering and fruiting parameters as influenced by different level and combinations of GA_3 and NAA in Papaya cv. Vinayak

Treatment	Days to first flowering	Number of flowers per plant	Days to first fruiting	Days from first flowering to fruit maturity	Fruit set %
T_0	205.33	39.33	234.00	133.67	38.74(6.28)
T_1	204.67	56.00	215.67	132.33	42.74(6.60)
T_2	197.33	52.00	218.00	133.00	43.47(6.65)
T_3	203.67	47.33	218.67	132.00	42.98(6.62)
T_4	163.67	49.00	215.00	126.00	47.97(6.99)
T_5	195.00	58.67	222.33	130.33	47.70(6.97)
T_6	194.00	47.33	201.33	127.67	48.08(7.00)
T_7	162.33	74.00	182.33	121.00	59.15(7.72)
T_8	195.33	58.00	215.00	128.00	47.34(6.94)
T_9	205.33	42.33	204.00	129.33	49.72(7.08)
T_{10}	174.33	57.67	198.33	122.67	58.18(7.69)
T_{11}	202.33	57.33	230.00	128.67	52.01(7.27)
T_{12}	203.00	44.00	227.67	129.67	50.19(7.15)
T_{13}	213.00	56.67	213.67	124.00	48.87(7.06)
T_{14}	180.00	49.33	213.67	129.67	49.12(6.99)
T_{15}	207.00	54.00	201.00	131.67	50.04(7.13)
C.D. (0.05)	27.19	NS	NS	3.82	NS
SE(m)	9.37	8.90	9.83	1.32	4.87(0.34)
SE(d)	13.25	-	-	1.86	-
C.V. (%)	8.36	-	-	1.77	-

*NS- Non-significant

*The values in the parenthesis are square root transformed values

T_0 (RDF + Control -water spray)
T_1 (RDF + NAA 50 ppm)
T_2 (RDF + NAA 75 ppm)
T_3 (RDF + NAA 100 ppm)
T_4 (RDF + GA_3 50 ppm)
T_5 (RDF + GA_3 75 ppm)
T_6 (RDF + GA_3 100 ppm)
T_7 (RDF + NAA 50 ppm + GA_3 50 ppm)
T_8 (RDF + NAA 50 ppm + GA_3 75 ppm)
T_9 (RDF + NAA 50 ppm + GA_3 100 ppm)
T_{10} (RDF + NAA 75 ppm + GA_3 50 ppm)
T_{11} (RDF + NAA 75 ppm + GA_3 75 ppm)
T_{12} (RDF + NAA 75 ppm + GA_3 100 ppm)
T_{13} (RDF + NAA 100 ppm + GA_3 50 ppm)
T_{14} (RDF + NAA 100 ppm + GA_3 75 ppm)
T_{15} (RDF + NAA 100 ppm + GA_3 100 ppm)

Table 3a. Effect of different level and combinations of GA_3 and NAA on fruit yield and yielding attributes of papaya cv. Vinayak

Treatment	Fruit length (cm)	Fruit weight (kg)	Fruit diameter (cm)	Number of fruits per plant
T_0	23.84	1.34	10.25	19.67
T_1	24.04	1.41	11.40	21.00
T_2	24.33	1.45	12.53	22.33
T_3	24.86	1.48	11.55	23.33
T_4	28.55	1.74	14.42	29.33

T_5	25.85	1.50	12.59	25.33
T_6	26.06	1.55	13.63	25.67
T_7	31.28	2.03	15.81	31.33
T_8	26.44	1.64	14.44	26.67
T_9	27.33	1.56	14.11	24.67
T_{10}	30.49	1.92	15.33	29.67
T_{11}	26.84	1.55	14.01	23.67
T_{12}	27.18	1.59	13.26	23.33
T_{13}	28.36	1.74	14.80	28.00
T_{14}	27.67	1.60	13.47	24.67
T_{15}	27.69	1.64	14.60	26.33
C.D. (0.05)	1.91	0.14	1.66	2.66
SE(m)	0.66	0.05	0.57	0.92
SE(d)	0.93	0.07	0.81	1.30
C.V. (%)	4.24	5.13	7.33	6.28

T_0 (RDF + Control -water spray)
T_1 (RDF + NAA 50 ppm)
T_2 (RDF + NAA 75 ppm)
T_3 (RDF + NAA 100 ppm)
T_4 (RDF + GA_3 50 ppm)
T_5 (RDF + GA_3 75 ppm)
T_6 (RDF + GA_3 100 ppm)
T_7 (RDF + NAA 50 ppm + GA_3 50 ppm)
T_8 (RDF + NAA 50 ppm + GA_3 75 ppm)
T_9 (RDF + NAA 50 ppm + GA_3 100 ppm)
T_{10} (RDF + NAA 75 ppm + GA_3 50 ppm)
T_{11} (RDF + NAA 75 ppm + GA_3 75 ppm)
T_{12} (RDF + NAA 75 ppm + GA_3 100 ppm)
T_{13} (RDF + NAA 100 ppm + GA_3 50 ppm)
T_{14} (RDF + NAA 100 ppm + GA_3 75 ppm)
T_{15} (RDF + NAA 100 ppm + GA_3 100 ppm)

Table 3b. Effect of different level and combinations of GA_3 and NAA on fruit yield and yielding attributes of papaya cv. Vinayak

Treatment	**Peel weight (g)**	**Pulp weight (g)**	**Pulp: peel ratio**	**Number of seeds**
T_0	141.56	1,081.80	7.64	259.00
T_1	157.83	1,236.71	7.85	345.67
T_2	152.86	1,257.76	8.28	397.33
T_3	143.59	1,292.03	9.01	334.67
T_4	144.94	1,501.87	10.39	494.67
T_5	157.49	1,239.65	7.89	336.00
T_6	152.08	1,372.42	9.24	375.33
T_7	159.18	1,744.27	10.98	601.67
T_8	155.01	1,342.49	8.67	424.67
T_9	142.91	1,286.12	8.99	393.00
T_{10}	161.86	1,630.35	10.07	530.00
T_{11}	156.49	1,243.48	7.96	419.67
T_{12}	155.12	1,274.97	8.21	383.67
T_{13}	144.28	1,429.65	9.92	494.67
T_{14}	150.88	1,271.32	8.45	432.00
T_{15}	151.78	1,358.22	8.94	490.67

C.D. (0.05)	10.02	176.58	1.39	83.14
SE(m)	3.45	60.84	0.48	28.65
SE(d)	4.88	86.05	0.68	40.51
C.V. (%)	3.94	7.82	9.30	11.83

T_0 (RDF + Control -water spray)
T_1 (RDF + NAA 50 ppm)
T_2 (RDF + NAA 75 ppm)
T_3 (RDF + NAA 100 ppm)
T_4 (RDF + GA_3 50 ppm)
T_5 (RDF + GA_3 75 ppm)
T_6 (RDF + GA_3 100 ppm)
T_7 (RDF + NAA 50 ppm + GA_3 50 ppm)
T_8 (RDF + NAA 50 ppm + GA_3 75 ppm)
T_9 (RDF + NAA 50 ppm + GA_3 100 ppm)
T_{10} (RDF + NAA 75 ppm + GA_3 50 ppm)
T_{11} (RDF + NAA 75 ppm + GA_3 75 ppm)
T_{12} (RDF + NAA 75 ppm + GA_3 100 ppm)
T_{13} (RDF + NAA 100 ppm + GA_3 50 ppm)
T_{14} (RDF + NAA 100 ppm + GA_3 75 ppm)
T_{15} (RDF + NAA 100 ppm + GA_3 100 ppm)

Table 4. Quality attributes as influenced by different level and combinations of GA_3 and NAA in Papaya cv. Vinayak

Treatment	**TSS (^{0} Brix)**	**Total sugar (%)**	**Reducing sugar (%)**	**Non reducing sugar (%)**	**Acidity (%)**	**Ascorbic acid (mg/100 g)**
T_0	8.53	5.34	4.76	0.57	0.233	48.40
T_1	8.73	5.82	4.96	0.85	0.200	51.20
T_2	8.67	6.21	5.078	1.14	0.193	51.20
T_3	8.73	6.75	5.77	0.98	0.193	48.80
T_4	9.00	6.47	5.15	1.32	0.187	55.20
T_5	8.93	6.29	5.53	0.76	0.187	52.00
T_6	8.87	6.53	5.65	0.88	0.187	51.60
T_7	9.20	7.68	6.29	1.43	0.160	56.80
T_8	9.13	7.36	6.01	1.36	0.180	54.80
T_9	8.93	7.00	6.15	0.85	0.187	53.60
T_{10}	9.13	7.32	5.84	1.48	0.167	56.40
T_{11}	8.93	6.75	5.38	1.37	0.180	55.60
T_{12}	8.87	7.13	6.02	0.84	0.180	52.40
T_{13}	9.13	7.00	5.61	1.39	0.187	56.40
T_{14}	8.80	6.91	5.90	1.01	0.193	54.80
T_{15}	8.80	6.55	5.69	0.86	0.200	50.00
C.D. (0.05)	0.23	0.72	0.73	0.39	0.028	2.09
SE(m)	0.08	0.25	0.25	0.14	0.010	0.72
SE(d)	0.11	0.35	0.35	0.19	0.014	1.02
C.V. (%)	1.51	6.40	7.72	22.05	8.858	2.35

T_0 (RDF + Control -water spray)
T_1 (RDF + NAA 50 ppm)
T_2 (RDF + NAA 75 ppm)
T_3 (RDF + NAA 100 ppm)
T_4 (RDF + GA_3 50 ppm)
T_5 (RDF + GA_3 75 ppm)
T_6 (RDF + GA_3 100 ppm)
T_7 (RDF + NAA 50 ppm + GA_3 50 ppm)
T_8 (RDF + NAA 50 ppm + GA_3 75 ppm)
T_9 (RDF + NAA 50 ppm + GA_3 100 ppm)
T_{10} (RDF + NAA 75 ppm + GA_3 50 ppm)
T_{11} (RDF + NAA 75 ppm + GA_3 75 ppm)
T_{12} (RDF + NAA 75 ppm + GA_3 100 ppm)
T_{13} (RDF + NAA 100 ppm + GA_3 50 ppm)
T_{14} (RDF + NAA 100 ppm + GA_3 75 ppm)
T_{15} (RDF + NAA 100 ppm + GA_3 100 ppm)

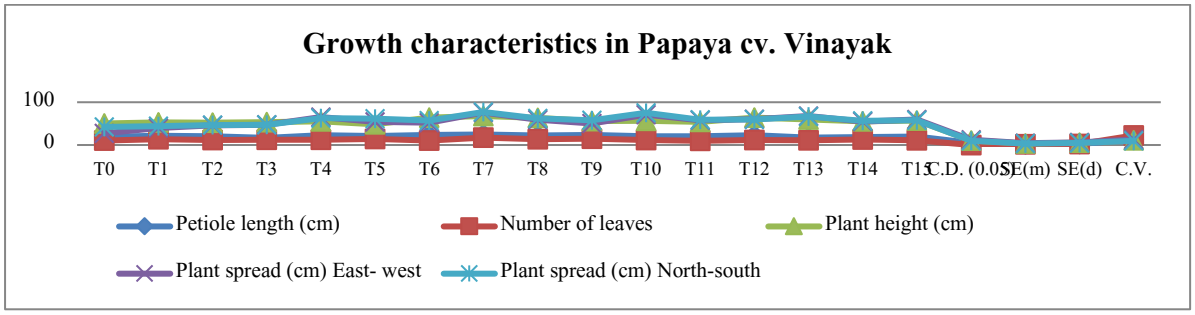

Figure 1. Growth characteristics in Papaya cv. Vinayak as influenced by different level and combinations of GA_3 and NAA.

T_0 (RDF + Control -water spray)
T_1 (RDF + NAA 50 ppm)
T_2 (RDF + NAA 75 ppm)
T_3 (RDF + NAA 100 ppm)
T_4 (RDF + GA_3 50 ppm)
T_5 (RDF + GA_3 75 ppm)
T_6 (RDF + GA_3 100 ppm)
T_7 (RDF + NAA 50 ppm + GA_3 50 ppm)
T_8 (RDF + NAA 50 ppm + GA_3 75 ppm)
T_9 (RDF + NAA 50 ppm + GA_3 100 ppm)
T_{10} (RDF + NAA 75 ppm + GA_3 50 ppm)
T_{11} (RDF + NAA 75 ppm + GA_3 75 ppm)
T_{12} (RDF + NAA 75 ppm + GA_3 100 ppm)
T_{13} (RDF + NAA 100 ppm + GA_3 50 ppm)
T_{14} (RDF + NAA 100 ppm + GA_3 75 ppm)
T_{15} (RDF + NAA 100 ppm + GA_3 100 ppm)

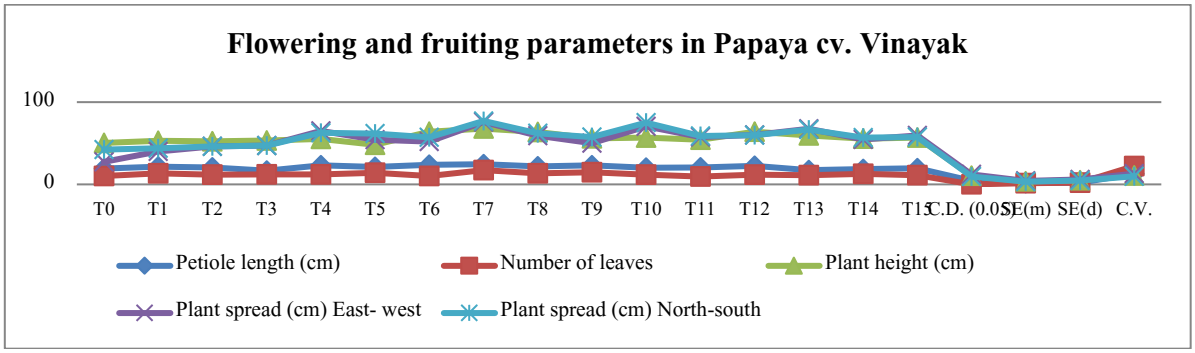

Figure 2. Flowering and fruiting parameters as influenced by different level and combinations of GA_3 and NAA in Papaya cv. Vinayak

T_0 (RDF + Control -water spray)
T_1 (RDF + NAA 50 ppm)
T_2 (RDF + NAA 75 ppm)
T_3 (RDF + NAA 100 ppm)
T_4 (RDF + GA_3 50 ppm)
T_5 (RDF + GA_3 75 ppm)
T_6 (RDF + GA_3 100 ppm)
T_7 (RDF + NAA 50 ppm + GA_3 50 ppm)
T_8 (RDF + NAA 50 ppm + GA_3 75 ppm)
T_9 (RDF + NAA 50 ppm + GA_3 100 ppm)
T_{10} (RDF + NAA 75 ppm + GA_3 50 ppm)
T_{11} (RDF + NAA 75 ppm + GA_3 75 ppm)
T_{12} (RDF + NAA 75 ppm + GA_3 100 ppm)
T_{13} (RDF + NAA 100 ppm + GA_3 50 ppm)
T_{14} (RDF + NAA 100 ppm + GA_3 75 ppm)
T_{15} (RDF + NAA 100 ppm + GA_3 100 ppm)

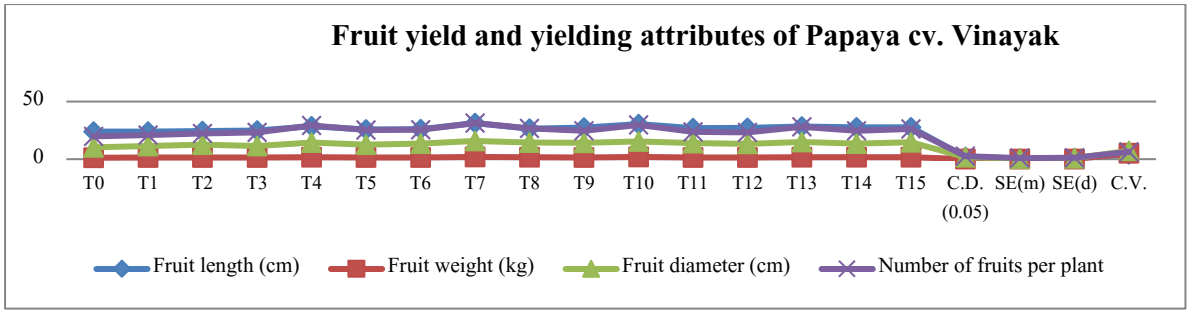

Figure 3a. Effect of different level and combinations of GA_3 and NAA on fruit yield and yielding attributes of papaya cv. Vinayak

T_0 (RDF + Control -water spray)
T_1 (RDF + NAA 50 ppm)
T_2 (RDF + NAA 75 ppm)
T_3 (RDF + NAA 100 ppm)
T_4 (RDF + GA_3 50 ppm)
T_5 (RDF + GA_3 75 ppm)
T_6 (RDF + GA_3 100 ppm)
T_7 (RDF + NAA 50 ppm + GA_3 50 ppm)
T_8 (RDF + NAA 50 ppm + GA_3 75 ppm)
T_9 (RDF + NAA 50 ppm + GA_3 100 ppm)
T_{10} (RDF + NAA 75 ppm + GA_3 50 ppm)
T_{11} (RDF + NAA 75 ppm + GA_3 75 ppm)
T_{12} (RDF + NAA 75 ppm + GA_3 100 ppm)
T_{13} (RDF + NAA 100 ppm + GA_3 50 ppm)
T_{14} (RDF + NAA 100 ppm + GA_3 75 ppm)
T_{15} (RDF + NAA 100 ppm + GA_3 100 ppm)

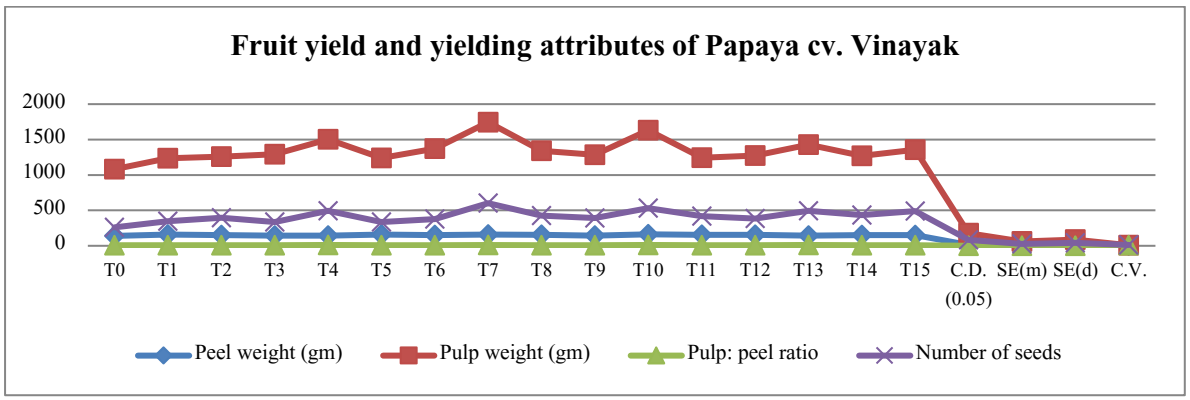

Figure 3b. Effect of different level and combinations of GA_3 and NAA on fruit yield and yielding attributes of papaya cv. Vinayak

T_0 (RDF + Control -water spray)
T_1 (RDF + NAA 50 ppm)
T_2 (RDF + NAA 75 ppm)
T_3 (RDF + NAA 100 ppm)
T_4 (RDF + GA_3 50 ppm)
T_5 (RDF + GA_3 75 ppm)
T_6 (RDF + GA_3 100 ppm)
T_7 (RDF + NAA 50 ppm + GA_3 50 ppm)
T_8 (RDF + NAA 50 ppm + GA_3 75 ppm)
T_9 (RDF + NAA 50 ppm + GA_3 100 ppm)
T_{10} (RDF + NAA 75 ppm + GA_3 50 ppm)
T_{11} (RDF + NAA 75 ppm + GA_3 75 ppm)
T_{12} (RDF + NAA 75 ppm + GA_3 100 ppm)
T_{13} (RDF + NAA 100 ppm + GA_3 50 ppm)
T_{14} (RDF + NAA 100 ppm + GA_3 75 ppm)
T_{15} (RDF + NAA 100 ppm + GA_3 100 ppm)

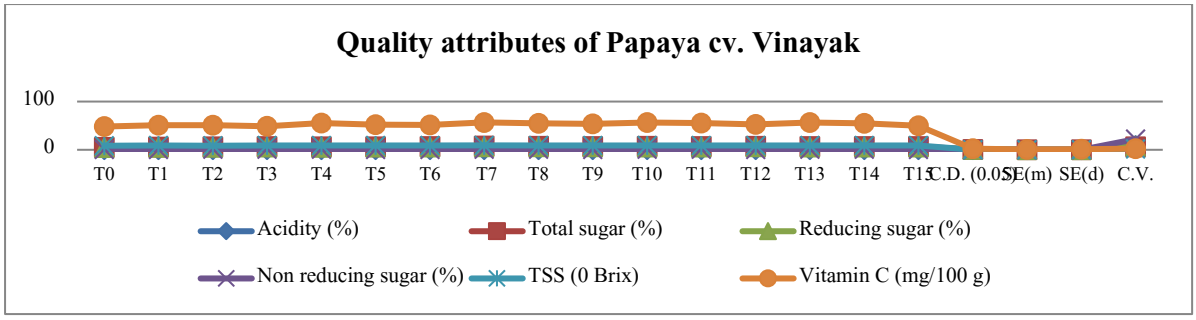

Figure 4. Quality attributes as influenced by different level and combinations of GA_3 and NAA in Papaya cv. Vinayak

T_0 (RDF + Control -water spray)
T_1 (RDF + NAA 50 ppm)
T_2 (RDF + NAA 75 ppm)
T_3 (RDF + NAA 100 ppm)
T_4 (RDF + GA_3 50 ppm)
T_5 (RDF + GA_3 75 ppm)
T_6 (RDF + GA_3 100 ppm)
T_7 (RDF + NAA 50 ppm + GA_3 50 ppm)
T_8 (RDF + NAA 50 ppm + GA_3 75 ppm)
T_9 (RDF + NAA 50 ppm + GA_3 100 ppm)
T_{10} (RDF + NAA 75 ppm + GA_3 50 ppm)
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T_{13} (RDF + NAA 100 ppm + GA_3 50 ppm)
T_{14} (RDF + NAA 100 ppm + GA_3 75 ppm)
T_{15} (RDF + NAA 100 ppm + GA_3 100 ppm)