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Hema
Department of Horticulture, Chauras Campus, H.N.B. Garhwal University, Srinagar Garhwal, Uttarakhand, India

Sonali Mahajan
Department of Horticulture, Chauras Campus, H.N.B. Garhwal University, Srinagar Garhwal, Uttarakhand, India

Anjana Nautiyal
Shri Guru Ram Rai University, Dehradun, Uttarakhand, India

Ravinder Kaur
Dev Bhoomi Uttarakhand University, Dehradun, Uttarakhand, India

Corresponding Author:
Sonali Mahajan
Department of Horticulture, Chauras Campus, H.N.B. Garhwal University, Srinagar Garhwal, Uttarakhand, India

Effect of different concentration of nutrient and PGRs on quality of mango (*Mangifera indica* L.) cv. Amrapalli under valley conditions of Garhwal hill

Hema, Sonali Mahajan, Anjana Nautiyal and Ravinder Kaur

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Abstract
The experiment was carried out to study the "Effect of Different Concentration of Nutrient and PGRs on Quality of Mango cv. Amrapalli under Valley Conditions of Garhwal Hill" at the Horticultural Research Centre and Department of Horticulture, Chauras campus, H.N.B. Garhwal University, Srinagar Garhwal (Uttarakhand), India. The experiment was laid out in Randomized Block Design with 14 treatments and 3 replications. The results of the analysis of variance revealed that the mean sum of squares due to treatment were significant at 5% level for almost all parameters except pulp stone ratio which was found non-significant. The results revealed that maximum peel weight (15.25 gm), pulp weight (161.20 gm), pulp and peel ratio (10.75), stone weight (23.67 gm), pulp and stone ratio (4.48) were significantly recorded under the treatment NAA @ 50 ppm, whereas, in quality parameters, viz., total soluble solid (19.73ºBrix), ascorbic acid (41.43 mg/100 gm pulp), vitamin A (1037.67 IU/100 gm), total sugar (13.61), non reducing sugar (8.98%), reducing sugar (4.40%) were also found significantly in treatment KNO_3 @ 0.4%. Hence, NAA @ 50 ppm and KNO_3 @ 0.4% could be recommended to enhance the production of good quality of Mango cv. Amrapalli, under valley conditions of Garhwal hill.

Keywords: Mango, nutrient and PGRs

Introduction
Mango (*Mangifera indica* L.) is 'National Fruit' of India and has been cultivated in Indian sub-continent since over 4000 years. It originated in Indo- Burma region of South East Asia having 69 recognized species originating as forest trees with fibrous and resinous fruits (Kesterman and Bompard, 1993) [10]. India is recognized as one of the world's mega diversity countries bestowed with four hot spots namely Eastern Himalayas, the Western Ghats along with Sri Lanka, Andaman Islands and Western Himalayas. Presently, India harbors more than 1000 mango cultivars and represents a diverse mango gene pool (Dey and Singh, 2004) [4].
The mango is cultivated throughout India. The major growing states are Andhra Pradesh, Uttar Pradesh, Karnataka, Gujarat, Bihar, Tamil Nadu and Maharashtra (Anonymous, 2012) [2]. The mango tree is large, spreading and evergreen with a dense rounded or globular crown by habitat which bears small, polygamous, monoecious, male and bisexual flowers on the same panicle. The fruit of mango is drupe with hard covering of the seed or stone known as the endocarp. Among, the promising mango hybrids, Amrapalli is most suitable variety for internal market and export.
Plant nutrients are the chemical elements that are essential to the nourishment of plant health. Potassium nitrate is an ideal source of N and K for optimal plant nutrition. It is available in a variety of composition and formulation, to suit specific crop requirements and growth environments. The crucial importance of potassium in quality formation stems from its role in promoting synthesis of photosynthates and their transport to fruits and storage organs and to enhance their conversion into starch, protein, vitamins etc. (Usherwood, 1985) [16].

Plant growth regulator refers to organic compounds other than nutrients which promote, inhibit or modify to any plant physiological process at very low concentrations. Among plant growth regulators Gibberellins plays a major role in controlling elongation of plant cell i.e. leaf and shoot growth. Gibberellins are known to influence both cell division and cell enlargement (Adams *et al.*, 1975) [1] whereas, auxin promotes the growth along the longitudinal axis of the plant. Among auxins naphthalene acetic acid (NAA), was found effective on flower promoting activity in mango (Beyer, 1976). Naphthalene acetic acid and 2,4-Dichlorophenoxy acetic acid uses for controlling fruit drop in mango. Among various plant growth regulators, Gibberellic acid in proper concentration and at appropriate time have been found to enhance the fruit yield and improve the physico-chemical characteristics of fruit through modification of various physiological and bio-chemical process of plant (Pandey and Sinha, 2013) [12].

The use of PGR *viz*., NAA 100 ppm increases the physico-chemical characters *viz*., pulp weight (122.67 gm), pulp stone ratio (3.91), ascorbic acid content (43.16 mg/100 gm) and total sugar (8.10%) of Amrapalli mango over control (Naleo *et al.*, 2018) [11]. However, 2,4-D at 10 ppm concentration increases the physico-chemical characters *viz*., total soluble solids (18.13°Brix), titratable acidity (0.197%), fruit weight (184.16 gm) and total sugar (14.20%) of Amrapalli mango over control (Vejendla *et al*., 2008) [17]. Hence the foliar application of different concentration of nutrient and PGRs have been played very important role in improving the productivity and quality of fruits.

Materials and Methods

The present investigation was carried out in the Horticultural Research Centre, Chauras campus, H.N.B. Garhwal University, Srinagar Garhwal. Seven years old Mango cv. Amrapalli plants having uniform growth, vigour, productivity, free from pest and disease and growing apparently under healthy condition, were selected for the investigation. The trial was laid out on bearing Mango cv. Amrapalli trees in a Randomized Block Design. There were fourteen treatments and each treatment was replicated three times at pea stage and marble Stage. Thereafter observations were recorded *viz*. Pulp weight, Peel weight, Stone weight, Pulp and peel ratio, Pulp and stone ratio, Total soluble solids, Vitamin C, Vitamin A, Total Sugar, Reducing Sugar, and Non-reducing Sugar.

Sugars were estimated by the method given in (A.O.A.C., 1994) [3]. Twenty five ml of filtered juice was neutralized with the help of 1N sodium hydroxide (NaOH) and 2 ml of lead acetate was mixed. Few drops of potassium oxalate were added to it after 10 minutes diluted. 5 gm of citric acid was added to the filtrate, kept overnight and boiled for 5 min to invert the non-reducing sugars and neutralized using phenolphthalein indicator with 20 percent NaOH until pink color was obtained. The samples were titrated against 10 ml of Fehling's solution using methylene blue as an indicator to a brick red precipitated for determining total reducing sugars.

$$\text{Total sugar (\%)} = \frac{\text{Factor for fehling solution} \times \text{Dilution} \times 100}{\text{Titre} \times \text{Weight of sample taken}}$$

Reducing sugars was estimated by the method given in (A.O.A.C., 1994) [3]. Twenty five ml filtered juice was neutralized with 1N sodium hydroxide (NaOH) and 2 ml of lead acetate was mixed. Few drops of potassium oxalate were added to it after 10 minutes and diluted to make a known volume. The samples were titrated against 10 ml of Fehling's solution using methylene blue as an indicator to a brick red precipitated for determining the reducing sugars.

$$\text{Reducing sugar (\%)} = \frac{\text{Sugar (mg) of invert} \times \text{Dilution}}{\text{Titre value of sample} \times \text{weight per volume} \times 1000} \times 100$$

The amount of non-reducing sugar was calculated by subtracting the amount of reducing sugar from the total sugars and multiplied by standard factor 0.95 and result were expressed as percent.

Non reducing sugar = (Total sugar – Reducing sugar) × 0.95

The data generated from the present investigation was analyzed according to Randomized Block Designing. The statistical analysis of the data was carried out as per method described by (Cochran and Cox, 1963) [19]. The treatment effects were tested at 5 percent level of significance.

Table 1: Treatments detail

Code	Treatments (PGRs and Nutrient)	Concentration
T_0	Control	Water spray
T_1	GA_3	25 ppm
T_2	GA_3	50 ppm
T_3	GA_3	75 ppm
T_4	NAA	25 ppm
T_5	NAA	50 ppm
T_6	NAA	75 ppm
T_7	2,4-D	5 ppm
T_8	2,4-D	10 ppm
T_9	2,4-D	15 ppm
T_{10}	KNO_3	0.2%
T_{11}	KNO_3	0.4%
T_{12}	KNO_3	0.6%
T_{13}	GA_3 + NAA + 2,4-D + KNO_3	25 ppm +25 ppm+ 5 ppm +0.2%

Results and Discussion

The superior physical fruit quality with respect to peel weight (15.25 gm), pulp weight (161.20 gm), pulp and peel ratio (10.75), stone weight (23.67 gm), pulp and stone ratio (4.48) were observed in NAA @ 50 ppm. (Bhati and Yadav, 2003) [5] observed maximum pulp and stone ratio (10.89) of *Z. mauritiana* cv. Gola was recorded with 40 ppm NAA. In another investigation (Singh *et al*, 2005) [15] reported maximum pulp and stone ratio (3.91) of mango cv. Dashehari in 100 ppm NAA. The possible reason for variation in pulp and stone ratio may be due to cell enlargement and possible greater accumulation of sugars and water in expanded cells (Singh *et al.*, 2005) [15].

The maximum mean total soluble solid (19.73ºBrix), ascorbic acid (41.43 mg/100 gm pulp), vitamin A (1037.67 IU/100 gm), total sugar (13.61), non-reducing sugar (8.98%), reducing sugar (4.40%) was recorded with treatment KNO_3 @ 0.4%. The possible reason behind that KNO_3 is more prone to increasing reducing sugar, TSS and vitamin-A content and non- significant role in improving non reducing sugar in Alphonso mango (Pujari *et al.*, 2016) [13]. Results regarding total sugar were found to be in agreement with (Vijayalakshmi and Srinivasan 2000) [18] who revealed that maximum total sugar (14.57%) content of Alphonso mangoes in 1% KNO_3. (Burondkar *et al*, 2009) [6] also observed similar findings of maximum total sugar (16.85%) content of mango cv. Alphonso with 1% KNO_3. While (Debaje *et al.* 2010) [7] found the maximum total sugar (0.98%) content

of hasta bahar acid lime fruits in 1% KNO_3. It may be due to increases the attributed to enhanced carbohydrate metabolism. Foliar application of P and K increases sugar content as K increases the capacity of production and translocation of sugar in mango (Dsouza, 2007) [9]. Increase in sugar contents might be due to synergetic effect on nitrogen as well as others eliments in the sugar metabolism of strawberry fruits (Rana and Chandel, 2003) [14].

Table 2: Effect of different concentration of nutrient and PGRs on Peel weight (gm), Pulp weight (gm), Stone weight (gm), Pulp peel ratio, Pulp stone ratio and TSS (°Brix) of mango cv. Amrapalli

Treatments	Peel weight (gm)	Pulp weight (gm)	Stone weight (gm)	Pulp peel ratio	Pulp stone ratio	TSS (°Brix)
T_0	27.65	92.66	23.67	3.36	3.93	17.13
T_1	18.37	141.71	34.93	7.76	4.07	18.14
T_2	17.65	147.86	35.22	8.42	4.2	18.35
T_3	23.40	117.36	29.30	5.04	4.03	18.15
T_4	16.12	148.48	36.19	9.41	4.11	18.39
T_5	15.25	161.20	36.36	10.75	4.48	18.97
T_6	19.40	135.99	33.64	7.16	4.05	18.07
T_7	22.45	121.39	30.38	5.61	4.00	18.03
T_8	21.39	125.36	31.10	5.95	4.07	18.05
T_9	24.56	112.21	27.64	4.59	4.06	17.88
T_{10}	26.91	96.65	24.92	3.62	3.88	19.37
T_{11}	26.06	101.24	25.10	3.89	4.03	19.73
T_{12}	25.19	107.46	26.70	4.28	4.03	19.62
T_{13}	20.79	133.28	32.09	6.49	4.15	19.14
SE(m)±	1.461	1.615	1.151	0.552	0.144	0.273
C.D. (5%)	4.269	4.721	3.364	1.614	0.420	0.798

Table 3: Effect of different concentration of nutrient and PGRs on Vitamin A (IU/100 gm), Vitamin C (mg/100 gm), Total sugar (%), Non-reducing sugar (%), and reducing sugar (%) of mango cv. Amrapalli

Treatments	Vitamin A (IU/100 gm)	Vitamin C (mg/100 gm)	Total sugar (%)	Non- reducing sugar (%)	Reducing sugar (%)
T_0	832.00	31.53	10.79	7.12	3.49
T_1	908.00	35.93	12.62	8.33	4.08
T_2	920.33	36.50	12.70	8.38	4.10
T_3	912.33	36.33	12.63	8.34	4.08
T_4	939.33	36.63	12.76	8.42	4.12
T_5	957.67	37.20	12.83	8.47	4.14
T_6	898.33	35.20	12.59	8.31	4.07
T_7	880.67	34.27	11.76	7.76	3.80
T_8	886.00	34.67	11.86	7.83	3.83
T_9	874.67	32.77	11.20	7.39	3.62
T_{10}	995.00	39.20	13.23	8.73	4.27
T_{11}	1037.67	41.43	13.61	8.98	4.40
T_{12}	1014.33	40.57	13.42	8.86	4.34
T_{13}	983.00	38.80	12.85	8.48	4.15
SE(m)±	11.833	0.361	0.180	0.119	0.058
C.D. (5%)	34.588	1.056	0.527	0.348	0.170

Conclusion

On the basis result obtained under present investigation, it may be concluded that treatment NAA @ 50 ppm found superior for physical characters, while chemical quality of mango cv. Amrapalli was noted best in KNO_3 @ 0.4%. Hence, NAA @ 50 ppm and KNO_3 @ 0.4% could be recommended to enhance the production of good quality of Mango cv. Amrapalli, under valley conditions of Garhwal hill.

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