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

Sonali Mahajan, DK Rana, Hema and Lekh Raj

Abstract
The present investigation entitled "Effect of Different Concentration of Nutrient and PGRs on Physico-chemical Quality and Yield of Mango cv. Amrapalli under Valley Conditions of Garhwal Hill" was carried out at the Horticultural Research Centre and Department of Horticulture, Chauras campus, H.N.B. Garhwal University, Srinagar Garhwal (Uttarakhand), India during the year 2017. The experiment was laid out in Randomized Block Design with 14 treatments and 3 replications. The results revealed that maximum fruit weight (212.81 gm), fruit length (10.66 cm), fruit diameter (7.26 cm), fruit volume (209.54 cc), specific gravity (1.04 gm/ml), pulp weight (161.20 gm), stone length (4.71 cm), stone diameter (2.15 cm), yield/plant (10.50 kg/tree) and number of fruits/kg (4.26) were significantly recorded under the treatment NAA @ 50 ppm, whereas, in quality parameters, *viz*., TSS (19.73ºBrix), titratable acidity (0.15%), TSS/acidity ratio (131.53) 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**,** GA_3, NAA, 2,4-D, KNO_3, specific gravity

Introduction
Mango (*Mangifera indica* L.) which belongs to family Anacardiaceae is one of the most popular fruit crop of India. The chromosome number of *M. indica* is n=20 and 2n=40. The English word "mango" originated from the Tamil word *mangai* or *manga* or Malayalam *manga* from the Dravidian root word for the same via Portuguese. Due to its high delicacy, flavor, nutritional value, attractive appearance, wide adaptability and popularity it has the status of "The King of Fruits". It is the main fruit of Asia and developed its own importance in all over the world.

The mango is undoubtedly the most important fruit crop of India. It covers largest area compared to any other fruit in the country and thrives in almost all regions except at altitudes above 3000 feet (Gangolly *et al.*, 1953) [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).

Plant nutrients are the chemical elements that are essential to the nourishment of plant health. Potassium nitrate is a unique source of potassium by its nutritional value and its contribution to the health and yields of plant. 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; Mengel and Kirkby, 1987) [11, 6]. The potassium nitrate is used commercially as an effective flower inducer in mango due to promoting the activity of nitrate reductase and stimulating the production of ethylene (Chadha and Pal, 1994) [3].

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) 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) [9].

Many investigators found that spraying Amrapalli mango trees with NAA at 50 ppm increased the yield and physico-chemical characters *viz*., fruit yield (48.6 kg/plant), fruit weight (224.58 gm), total soluble solids, (18.65°Brix) and TSS/acid ratio (149.05) than control (Vejendla *et al*., 2008 and Nkansah *et al.,* 2012) [12]. The use of PGR *viz*., NAA 100 ppm increases the physico-chemical characters *viz*., fruit weight (196.67 gm), 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) [7].

Materials and Methods

The present studies were carried out on seven years old Mango cv. Amrapalli plants established in Horticultural Research Centre, Chauras campus, H.N.B. Garhwal University, Srinagar Garhwal. Plants uniform in 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.* Fruit weight, Fruit length, Fruit breadth, Fruit volume, Specific gravity, Pulp weight, Stone length, Stone breadth, Total soluble solids, Titratable acidity, TSS/acid ratio, Yield/plant (kg/tree) and Number of fruits/kg.

Required quantity of 2, 4-D and GA_3 were dissolved in a small quantity of ethyl alcohol but few drops of NH_4OH was added in NAA to avoid precipitation. Then the final volume was made upto one litre with distilled water. The stock solution of nutrient and PGRs were diluted with water for preparing the required strength of the foliar spray. Nutrient solutions were sprayed on the scheduled date in the morning hours with the help of sprayer pump.

The specific gravity of five randomly selected fruits under each replication was carefully taken by dividing weight of fruits (W) from average volume (V).

$$\text{Specific gravity} = \frac{W}{V}$$

Where,
W = Average weight of fruit in gm.
V = Average volume of fruit in ml.

Titratable acidity was determined by titrating the aliquot of known quantity (25 gm) of sample against 0.1N NaOH solution to a pink end point using 1% phenolphthalein indicator (Ranganna, 1997; Sharma and Nautiyal, 2009). The recorded titratable acidity was expressed in terms of per cent malic acid.

$$\text{Titratable acidity (\%)} = \frac{\text{Titre x Normality of alkali x Vol. made up Equivalent weight of acidx100}}{\text{Vol. of aliquot taken for estimation x Weight or Vol. of sample taken x1000}}$$

TSS/acid ratio was calculated by dividing the value of TSS with titratable acidity.

$$\text{TSS/Acid Ratio} = \frac{\text{TSS}}{\text{Titratable acidity}}$$

Table 1: Treatments detail

Code	Treatments (PGRs and Nutrient)
T_0	Control
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 @ 25 ppm + NAA @ 25 ppm + 2, 4-D @ 5 ppm + KNO_3 @ 0.2%

Results and Discussion

The analysis of variance for 12 characters under the present studies are summarized and presented in table 2 & 3. The mean sum of square due to treatments revealed that significant differences was found at 5% level for almost all the characters under studied.

The maximum mean fruit weight (212.81 gm), fruit length (10.66 cm), fruit diameter (7.26 cm), fruit volume (209.54 cc), pulp weight (161.20 gm), stone length (4.71 cm) stone diameter (5.52 cm) was found in NAA @ 50 ppm. In support of results findings, Patil *et al.* (2005) [8] revealed that maximum fruit weight (330.41 gm) of mango recorded in 40 ppm NA. The possible reason behind increasing the fruit volume might be due to the rapid cell division and cell enlargement. The maximum mean specific gravity (1.04 gm/ml) in each were recorded with application of KNO_3 @ 0.2%, KNO_3 @ 0.4%, KNO_3 @ 0.6% and 2,4-D @ 15 ppm, respectively.

The highest mean total soluble solid (19.73ºBrix), TSS/acidity ratio (131.53) was observed in treatment KNO_3 @ 0.4%. Fruit juice acidity was significantly influenced by different concentration of nutrient and PGRs treatments. Decreases the mean fruit acidity (0.15%) was found in treatment KNO_3 @ 0.4% whereas, increases the mean fruit acidity (0.39%) was observed in control. The increase in TSS may be accounted to the hydrolysis of the polysaccharides, conversion of organic acids into soluble sugars and enhanced solubilisation of insoluble starch and pectin present in cell wall and middle lamella. The depletion in organic acids could be due to fast conversion of acids into sugars and their derivatives and their utilization in respiration (Gupta and Brahmachari, 2004) [5].

The highest mean fruit yield (10.50 kg/tree), number of fruits/ kg (4.26) was observed under NAA @ 50 ppm treatment. The possible reason due to increase in fruit yield in the plants treated with NAA might be due to resultant effect of growth suppression and better accumulation of nutritional reserves which was probably due to efficiency of plant growth substance in raising C:N ratio toward the optimum for bringing about fruit set (Sen *et al.*, 1965).

Table 2: Effect of different concentration of nutrient and PGRs on fruit length (cm), fruit weight (gm), fruit diameter (cm) fruit volume (cc), Specific gravity (gm/ml) and Pulp weight (gm) of mango cv. Amrapalli

Treatments	Fruit length (cm)	Fruit weight (gm)	Fruit diameter (cm)	Fruit volume (cc)	Specific gravity (gm/ml)	Pulp weight (gm)
T_0	7.31	143.98	3.82	141.89	1.00	92.66
T_1	9.96	195.01	5.77	192.28	1.01	141.71
T_2	10.15	200.73	6.38	196.25	1.02	147.86
T_3	8.52	170.06	4.46	166.22	1.02	117.36
T_4	10.34	200.79	6.81	196.66	1.02	148.48
T_5	10.66	212.81	7.26	209.54	1.02	161.20
T_6	9.61	189.03	5.34	183.77	1.03	135.99
T_7	8.73	174.22	4.74	169.56	1.03	121.39
T_8	8.94	177.85	4.85	171.85	1.03	125.36
T_9	8.39	164.41	4.36	158.74	1.04	112.21
T_{10}	7.84	148.46	3.89	142.93	1.04	96.65
T_{11}	8.06	152.40	3.97	146.73	1.04	101.24
T_{12}	8.34	159.35	4.15	153.69	1.04	107.46
T_{13}	9.35	186.16	5.08	180.94	1.03	133.28
SE(m)±	0.063	1.465	0.112	1.496	0.008	1.615
C.D. (5%)	0.184	4.281	0.328	4.373	0.022	4.721

Table 3: Effect of different concentration of nutrient and PGRs on Stone length (cm), Stone diameter (cm), TSS (°Brix), Titratable acidity (%), Yield/plant (kg/tree) and No. of fruits/kg of mango cv. Amrapalli

Treatments	Stone length (cm)	Stone diameter (cm)	TSS (°Brix)	Titratable acidity (%)	TSS/ acidity ratio	Yield/plant (kg/tree)	No. of fruits/kg
T_0	4.71	2.15	17.13	0.39	43.92	2.21	7.41
T_1	7.34	4.11	18.14	0.28	64.78	8.38	4.85
T_2	7.55	4.69	18.35	0.25	73.44	8.60	4.64
T_3	5.95	2.72	18.15	0.27	67.22	5.20	5.85
T_4	7.72	5.14	18.39	0.23	79.92	9.17	4.62
T_5	8.06	5.52	18.97	0.21	90.33	10.50	4.26
T_6	7.10	3.62	18.07	0.29	62.34	7.50	5.05
T_7	6.16	3.07	18.03	0.33	54.63	5.70	5.66
T_8	6.35	3.16	18.05	0.30	60.16	6.25	5.46
T_9	5.76	2.68	17.88	0.34	52.58	4.75	6.12
T_{10}	5.25	2.18	19.37	0.19	101.94	3.15	7.09
T_{11}	5.42	2.28	19.73	0.15	131.53	3.90	6.79
T_{12}	5.74	2.48	19.62	0.18	109.00	4.45	6.38
T_{13}	6.79	3.38	19.14	0.20	95.72	6.65	5.16
SE(m)±	0.060	0.095	0.273	0.012	4.447	0.38	0.04
C.D. (5%)	0.174	0.277	0.798	0.036	13.000	1.11	0.14

Conclusion

Thus, on the basis result obtained under present investigation, it may be concluded that treatment NAA @ 50 ppm found superior for physical and yield potential 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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