Indian J. Hort. 68(1), March 2011: 103-107

Influence of pre-harvest foliar application of growth regulators and micronutrients on mango cv. Himsagar

Nilesh Bhowmick* and B.C. Banik**
Dept. of Pomology and Post Harvest Technology, Faculty of Horticulture,
Uttar Banga Krishi Viswavidyalaya , PO Pundibari, Cooch Behar 736 165, West Bengal

ABSTRACT

The present experiment was carried out at Horticultural Research Station, Mohanpur, Nadia, in randomized block design to assess the effect of growth regulators (NAA and GA_3) and micronutrients ($ZnSO_4$ and borax) on fruit retention and fruit physico-chemical properties in mango cv. Himsagar. Maximum fruit retention percentage (7.25%) as well as maximum number of fruits at harvest (790.17/tree) was recorded with NAA at 40 ppm and maximum yield (217.24 kg/tree) was obtained with GA_3 at 40 ppm and lowest fruit retention percentage and yield was recorded with control. Maximum length (9.28 cm), breadth (7.31 cm) and weight (283.38 g) were recorded with GA_3 at 40 ppm, whereas highest TSS, total sugars and non-reducing sugar content were recorded with $ZnSO_4$ at 1.5 per cent.

Key words: Mango, fruit drop, growth regulators, micro-nutrients.

INTRODUCTION

Mango (*Mangifera indica* L.) is one of the most luscious fruit of world, which occupies a prime position in the international fruit processing industry of the world. It is one of the most choicest and popular fruit among the people and designated as the 'King of fruits'. In spite of profuse number of panicles and high initial fruit set, the ultimate retention, and yield are low mainly due to heavy fruit drop. The extent of fruit drop can be reduced significantly by use of plant growth regulators, mulching and irrigation during ontogeny to maturation of fruits (Sawke *et al*., 15).

MATERIALS AND METHODS

The present experiment was conducted at Horticultural Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, West Bengal, for two years on a commercial mango cultivar Himsagar. The selected trees were uniform in size and of 27 years age. The chemicals, *i.e*., NAA (T_1 = 20 ppm, T_2 = 40 ppm, T_3 = 60 ppm), GA_3 (T_4 = 20 ppm, T_5 = 40 ppm, T_6 = 80 ppm) and zinc sulphate (T_7 = 0.5%, T_8 = 1%, T_9 = 1.5%) and borax (T_{10} = 0.25%, T_{11} = 0.5%, T_{12} = 0.75%) along with water spray/control (T_{13}) were applied as foliar spray at marble stage of fruit growth. Recommended package of practices including application of 1000 g N, 500 g P_2O_5, 1000 g K_2O per plant, plant protection measures, and weed control were followed. The fertilizers were applied in the equal split doses. Half of the total quantity was applied in the month of June and the rest half in the month of October. Physico-chemical properties were studied after proper ripening of fruits. Total sugars, reducing sugar and acidity were estimated by the method described in AOAC (1). Total soluble solids, non-reducing sugar and ascorbic acid were estimated by the method mentioned by Ranganna (14), whereas statistical analysis were done through the method described by Panse and Sukhatme (11).

*Corresponding author's E-mail: nileshbhowmick@gmail.com
**Dept. of Fruits and Orchard Management, Bidhan Chandra Krishi Viswavidyalaya, PO: Krishi Viswavidyalaya, Nadia 741 252, West Bengal.

RESULTS AND DISCUSION

Pooled data from Table 1 shows that fruit retention percentage was maximum (7.25%) with NAA at 40 ppm followed by (7.00 %) GA_3 at 40 ppm. Lowest fruit retention was observed with control. Maximum number of fruits were harvested with NAA at 40 ppm (790.17/tree), followed by GA_3 at 40 ppm (776.67/tree) and $ZnSO_4$ at 1 per cent (774.33/tree). Lowest numbers of fruits were harvested with control (605.67/tree). Highest yield was obtained with GA_3 at 40 ppm (21.73 t/ha), followed by NAA at 40 ppm (20.67 t/ha) and lowest yield was recorded with control (14.20 t/ha).

These chemicals showed more or less similar trends in terms of fruit retention in both years. Medium and higher concentration of NAA and medium concentration of GA_3, $ZnSO_4$, and borax showed higher fruit retention than other treatments. Maximum number of fruits were harvested with NAA at 40 ppm but yield was highest (21.73 t/ha) with GA_3 at 40 ppm fruit weight was more with this treatment. The increase in fruit retention by using different growth regulators and micronutrients suggests that the endogenous level of these chemicals or their analogues were deficient

Table 1 Response of growth regulators and micro-nutrients on fruit retention and yield in mango cv. Himsagar.

Treatment	% of fruit retained at harvest			No. of fruits tree at harvest			Yield/ha (tonne)		
	1st y	2nd y	Avg.	1st y	2nd y	Pooled	1st y	2nd y	Avg
NAA at 20 ppm (T_1)	4.75 (2.18)#	5.00 (2.24)	4.88 (2.21)	1117.67	315.00	716.34	27.27	8.02	17.65
NAA at 40 ppm (T_2)	7.29 (2.70)#	7.20 (2.68)	7.25 (2.69)	1292.00	288.33	790.17	33.66	7.68	20.67
NAA at 60 ppm(T_3)	6.19 (2.49)#	5.71 (2.39)	5.95 (2.44)	1217.00	303.67	760.34	31.31	7.96	19.64
GA_3 at 20 ppm (T_4)	4.33 (2.08)#	4.65 (2.16)	4.49 (2.12)#	1089.00	321.33	705.17	29.62	8.92	19.27
GA_3 at 40 ppm (T_5)	7.08 (2.66)#	6.92 (2.63)	7.00 (2.65)#	1262.33	291.00	776.67	35.03	8.42	21.73
GA_3 at 80 ppm (T_6)	5.87 (2.42)#	5.34 (2.31)	5.61 (2.37)	1131.33	328.67	730.00	28.34	8.42	18.38
$ZnSO_4$ at 0.5% (T_7)	5.49 (2.34)#	5.26 (2.29)	5.38 (2.32)	1201.33	297.67	749.50	32.11	7.99	20.05
$ZnSO_4$ at 1% (T_8)	6.62 (2.57)#	5.41 (2.33)#	6.02 (2.45)	1249.33	299.33	774.33	32.80	8.13	20.47
$ZnSO_4$ at 1.5% (T_9)	3.81 (1.95)#	3.79 (1.95)#	3.80 (1.95)	1071.00	347.33	709.17	25.57	8.75	17.16
Borax at 0.25% (T_{10})	5.26 (2.29)#	5.12 (2.26)#	5.19 (2.28)	1081.33	331.00	706.17	27.36	8.54	17.95
Borax at 0.5% (T_{11})	5.99 (2.45)#	5.32 (2.31)#	5.66 (2.38)	1183.67	311.33	747.50	32.05	8.84	20.45
Borax at 0.75% (T_{12})	4.15 (2.04)#	3.58 (1.89)	3.87 (1.97)	1062.67	364.00	713.34	25.64	9.07	17.36
Control (T_{13})	3.02 (1.74)#	2.98 (1.73)	3.00 (1.73)	988.33	223.00	605.67	22.98	5.41	14.20
CD at 5%	0.23	0.15	0.11	91.68	31.79	47.32	-	-	-

Figures in the parentheses indicates square root transformed values.

at these stages. The most important role of auxin in abscission appears to be the maintenance of ongoing physiological and biochemical functions. Auxin from the subtending organ moves steadily to the abscission zone and maintains the relatively quiescent physiology characteristic of inhibited abscission. Application of exogenous auxin usually serves to augment inhibition and further delay abscission. Auxin also acts as a mobilize of nutrients and promotes the translocation of nutrients to developing fruits. The ability of GA to prevent the abscission of young fruit appears to be a secondary effect on abscission process .The primary effect of GA appears to be the promotion of the development of the young fruit including, specifically, the synthesis of IAA- which retards the abscission (Addicott, 2). It is well known that micronutrients play important role in many plant metabolism processes. Zinc increases the synthesis of tryptophan a precursor of auxin. It plays key role in protein synthesis, maintain the integral component of enzyme structure and membrane integrity, essential for chlorophyll synthesis, RNA synthesis. Boron has various roles, *i.e.*, sugar transport, cell wall synthesis, lignifications of cell wall structure, carbohydrate, RNA, phenol metabolism, plasma membrane integrity, pollen germination and pollen tube growth (Das, 6).

Singh *et al.* (17) reported NAA at 30 and 40 ppm proved to be the best treatments for the control of fruit drop in mango cv. Dashehari. Singh and Ram (18) observed maximum increase over control in fruit retention (300%) with NAA at 40 ppm in cv. Dashehari. They also reported GA_3 at 20 and 40 ppm showed 160 percent fruit retention. Highest fruit retention (230-300%) over control was found with 50-25 ppm NAA in cv. Chausa (Prakash and Ram, 12). Daulta *et al.* (7) observed higher fruit retention (36.40%) in

cv. Dashehari with 0.8 per cent $ZnSO_4$. Fresh weight of fruits per tree, number of fruits per tree were improved by the foliar application of zinc sulphate in mango hybrids Sindhu and Mallika (Shivanandam *et al.*, 16). Prasad *et al.* (13) reported that 100 ppm GA_3 resulted in highest fruit yield of mango. Maximum fruit retention at marble stage (43.94%), harvest stage (9.32%) and highest number of fruits per plant were recorded with GA_3 (40 ppm) in Amrapali (Bhowmick and Banik, 5).

Pooled data of Table 2 shows that maximum fruit length was recorded with GA_3 at 40 ppm (9.28 cm), which was statistically at par with borax at 0.5 per cent (9.14 cm) and GA_3 at 20 ppm (9.11 cm) and was lowest in control (8.53 cm). Pooled data reveals that maximum fruit weight was obtained with GA_3 at 40 ppm (283.38 g) that was statistically at par with borax at 0.5 per cent (277.38 g) and control gave the lowest (237.63 g) fruit weight. Pulp percentage was highest (75.65%) with NAA at 60 ppm, which was statistically at par with GA_3 at 20 ppm (75.59%). Lowest pulp percentage (70.40) was observed with control. Peel percentage was highest (14.83) with control, whereas, it was lowest (11.71) with NAA at 60 ppm. Stone percentage was highest (15.37) and lowest (11.87) with borax at 0.75 per cent and GA_3 at 20 ppm, respectively.

Singh *et al.* (17) reported that NAA at 20 ppm increased 42.8 per cent length and 41.7 percent breadth in mango cv. Fajri. Kumar and Singh (9) observed similar findings with 50 ppm GA_3 on cv. Amrapali. Dutta (8) reported that foliar application of boric acid at 3000 ppm was found to be optimum for mango cv. Himsagar in terms of fruit retention, fruit length, fruit breadth, fruit weight, pulp weight, total soluble solids, acidity, total sugars and ascorbic acid.

TSS content was recorded maximum (19.68°Brix) with $ZnSO_4$ at 1.5 per cent followed by borax at 0.75 per cent (19.43°Brix) and NAA at 20 ppm (19.43°Brix) and it was found lowest (17.53°Brix) with control. Maximum total sugars (16.43%) content was recorded with $ZnSO_4$ at 1.5 per cent, which was statistically at par (15.76%) with NAA at 20 ppm and was lowest with control (13.46%). Maximum reducing sugar content (5.03%) was recorded with borax at 0.25 per cent that was followed by NAA at 60 ppm (4.59%) and was lowest (3.81%) with $ZnSO_4$ at 1 per cent. Non-reducing sugar content was highest (11.96%) with $ZnSO_4$ at 1.5 per cent followed by borax at 0.5 per cent (11.53%). It was lowest (8.74%) with NAA at 60 ppm, which was closely followed by control (8.75%). Highest acidity (0.257%) was recorded with GA_3 at 40 ppm and it was recorded lowest (0.188%) with NAA at 20 ppm. Ascorbic acid content was highest (42.42 mg/100 g of fruit pulp) with NAA at 40 ppm, whereas,it was lowest (34.53 mg /100 g of fruit pulp) with NAA at 60 ppm. TSS: acid ratio was maximum (103.38) with NAA at20 ppm which was followed by borax at 0.25 per cent (94.78) and was lowest (70.04) with control (Table 3).

The present investigation was supported with Banik *et al.* (4) who found higher TSS and total sugars content with the spray of boron at 0.4 percent plus urea at 1 per cent in mango cv. Fazli. Singh *et al.* (17) reported that quality of fruit in cv. Dashehari was improved by GA_3 at 75 and 50 ppm. Pre harvest

Table 2. Response of growth regulators and micro-nutrients on fruit physical properties (pooted data).

Treatment	Length (cm)	Breadth (cm)	Weight (g)	Pulp (%)	Peel (%)	Stone (%)
NAA at 20 ppm (T_1)	8.69	6.77	249.25	71.42	14.64	13.94
NAA at 40 ppm (T_2)	8.91	7.01	263.38	71.43	13.92	14.65
NAA at 60 ppm(T_3)	8.85	6.97	259.63	75.65	11.70	12.65
GA_3 at 20 ppm (T_4)	9.11	7.22	274.75	75.59	12.55	11.87
GA_3 at 40 ppm (T_5)	9.28	7.31	283.38	71.17	14.42	14.41
GA_3 at 80 ppm (T_6)	8.74	6.94	253.38	71.83	13.70	14.47
$ZnSO_4$ at 0.5% (T_7)	9.00	7.10	267.88	72.99	13.02	13.99
$ZnSO_4$ at 1% (T_8)	8.98	7.13	267.00	71.46	14.07	14.48
$ZnSO_4$ at 1.5% (T_9)	8.60	6.75	245.38	71.57	13.60	14.84
Borax at 0.25% (T_{10})	8.82	7.02	255.50	72.12	14.43	13.44
Borax at 0.5% (T_{11})	9.14	7.20	277.38	74.49	13.12	12.39
Borax at 0.75% (T_{12})	8.59	6.73	245.25	71.57	13.06	15.37
Control (T_{13})	8.53	6.63	237.63	70.40	14.83	14.78
CD at 5%	0.20	0.14	8.27	0.45	0.65	0.79

sprays of GA_3 (50 or 75 ppm) improved the fruit quality of cv. Amrapali in terms of TSS contents, sugar, ascorbic acid content (Kumar and Singh, 9). Prasad *et al.* (13) reported that NAA at 20 ppm resulted in the highest concentrations of TSS (22.5° Brix), reducing sugars, non-reducing sugars and ascorbic acid, and in the highest total sugar content and sugar:acid ratio (107.1). Dutta (8) reported that boric acid at 3000 ppm was found to be optimum in mango cv. Himsagar for different quality parameters.

Foliar application of all the growth regulators and micronutrients at marble stage of fruit development of mango cv. Himsagar prevented premature pre-harvest drop of fruits and as a consequence increased the number and quality of fruits over control. Maximum fruit retention percentage (7.25%) was recorded with NAA at 40 ppm (T_2), which was followed by GA_3 at 40 ppm (T_5). Maximum numbers of fruits per tree were harvested with NAA at 40 ppm (T_2) (790.17), whereas minimum numbers of fruits were harvested (605.67) with control (T_{13}). Maximum yield (21.73 t/ha) was recorded with GA_3 at 40 ppm (T_5).

REFERENCES

1. A.O.A.C. 1984. *Official Methods of Analysis*, (14th Edn.), Association of Official Agricultural Chemist, Washington, D.C., pp. 16.
2. Addicott, F.T. 1970. Plant hormones in the control of abscission. *Biological Rev.* **45**: 485-524.
3. Arteca, R.N. 1997. Chemistry, biological effects and mechanism of action of plant growth substances. **In**: *Plant Growth Substances Principles and Applications,* CBS Publisher and Distributors, New Delhi, pp. 47-104.

Table 3. Response of growth regulators and micro-nutrients on fruit bio-chemical properties (pooled data).

Treatment	TSS (°Brix)	Total sugars (%)	Reducing sugar (%)	Non reducing sugar (%)	Acidity (%)	Ascorbic acid content (mg/100 g)	TSS : acid ratio
NAA at 20 ppm (T_1)	19.43	15.76	3.84	11.32	0.188	37.24	103.38
NAA at 40 ppm (T_2)	18.50	14.76	4.26	9.98	0.244	42.42	77.00
NAA at 60 ppm(T_3)	17.85	13.78	4.59	8.74	0.236	34.53	75.67
GA_3 at 20 ppm (T_4)	19.05	15.99	4.11	11.28	0.232	41.74	82.59
GA_3 at 40 ppm (T_5)	18.10	14.50	4.00	9.93	0.257	34.81	71.85
GA_3 at 80 ppm (T_6)	18.50	14.74	3.96	10.25	0.212	39.76	87.96
$ZnSO_4$ at 0.5% (T_7)	18.20	14.36	4.29	9.57	0.248	39.40	73.46
$ZnSO_4$ at 1% (T_8)	18.98	15.21	3.81	10.83	0.228	38.24	83.86
$ZnSO_4$ at 1.5% (T_9)	19.68	16.43	3.85	11.96	0.224	35.01	87.84
Borax at 0.25% (T_{10})	19.33	15.59	5.03	10.03	0.204	38.75	94.78
Borax at 0.5% (T_{11})	19.43	16.22	4.09	11.53	0.220	35.24	88.60
Borax at 0.75% (T_{12})	18.50	14.26	3.92	9.83	0.240	38.25	77.44
Control (T_{13})	17.53	13.46	4.25	8.75	0.252	35.72	70.04
CD at 5%	0.42	1.35	0.42	1.38	0.034	3.30	13.41

4. Banik, B.C., Sen, S.K. and Bose, T.K. 1997. Effect of zinc, iron and boron in combination with urea on mango cv. Fazli. *Env. Ecol.* **15**: 122-28.

5. Bhowmick, N. and Banik, B.C. 2006. Influence of NAA and GA_3 on fruit retention, yield and physico-chemical properties of mango cv. Amrapali under new alluvial zone of West Bengal. *Hort. J.* **19**: 158-60.

6. Das, D.K. 2000. **In**: *Micronutrients- Their Behaviour in Soils and Plants.* Kalyani Publishers, Ludhiana.

7. Daulta, B.S., Singh, H.K. and Chauhan, K.S. 1981. Effect of zinc and CCC sprays on flowering, fruiting and physico-chemical composition of fruit in mango (*Mangifera incdica* L.) cv. Dashehari. *Haryana J. Hort. Sci.* **10**: 161-65.

8. Dutta, P. 2004. Effect of foliar boron application on panicle growth, fruit retention and physico-chemical characters of mango cv. Himsagar. *Indian J. Hort*. **61**: 265-66.

9. Kumar, P. and Singh, S. 1993. Effect of GA_3 and ethrel on ripening and quality of mango cv. Amrapali. *Hort. J.* **6**: 19-23.

10. Mazumdar, B.C. and Majumder, K. 2003. Determination of chemical constituents. **In**: *Methods on Physico-chemical Analysis of Fruits*, Daya Publishing House, Delhi, pp. 93-139.

11. Panse, V.G. and Sukhatme, P.V. 1985. Design of Experiments. VIII Randomized Blocks and Latin Square. **In**: *Statistical Methodology for Agricultural Workers*, ICAR, New Delhi, pp. 145-56.

12. Prakash, S. and Ram, S. 1986. Effect of various concentrations of auxins and their time of application on fruit retention in mango cv. Chausa. *Prog. Hort.* **18**: 167-74.

13. Prasad, B., Brahmachari, V.S., Chowdhary, B.M., Prasad, K.K. and Ray, R. N. 2006. Effect of biological regulators on yield and physico-chemical composition of mango. *J. Res. Birsa Agri. Univ.* **18**: 279-81.

14. Ranganna, S. 1977. **In**: *Manual of Analysis of Fruits and Vegetable Products*. Tata and McGraw Hill Publishing Company Limited, New Delhi, India. pp. 94-101.

15. Sawke, D.P., Ramtake, J.R. and Salvi, M.J. 1990. Integrated approach for increasing mango production and productivity. *Seminar on Strategies Increasing Production,* K.K.V., Dapoli, 22-23rd March, 1990, pp. 11-35.

16. Shivanandam,V.N., Pradeep, S.L., Rajanna, K.M. and Sivappa. 2007. Effect of zinc sulphate on growth and yield of mango varieties and hybrids. *J. Soil Crops*, **17**: 225-29.

17. Singh, K.K., Singh, S. and Chadha, K.L. 1959. Effect of some plant regulators on fruit drop in mango. *Indian J. Hort.* **16**: 86-91.

18. Singh, R.S. and Ram, S. 1983. Studies on the use of plant growth regulators on the flowering and fruiting of mango cv. Dashehari. *Indian J. Hort.* **40**: 188-194.

Received: May, 10; Revised: August, 2010;
Accepted : December, 2010