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RESEARCH PAPER

Effect of foliar sprays of growth regulators and micronutrients on incidence of mango malformation

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Abstract : Malformation disease is not merely a serious threat but a menace to the mango industry in several mango growing areas of the world. It does not result in any malformation of mango fruits as may become notated from its name, but produces abnormal vegetative shoots and inflorescence which do not bear fruits. Floral malformation is a major problem in mango cultivation in India causing heavy loss in yield. Therefore, an incite was made to minimize the menace by the foliar application of different growth regulators and micronutrients at the flower but initiation/flower bud stage. It was found that spraying 200ppm NAA increased the leaf index, length of flower panicles, fruit set, reduction of malformation and even the bio-chemical status like carbohydrate, nitrogen and enhanced RNA and DNA level. Whereas length of terminal shoots, percentage of hermaphrodite flower and level of mangiferin was enhanced by 50ppm GA_3. Foliar application of 50ppm $AgNO_3$ reduced the duration of flowering and intensity of floral malformation, yet increased the RNA and DNA and magnese content. Even the micronutrient like 0.3% $ZnSO_4$ effect on increase of leaf index and sex ratio was noticed.

Key Words : Microtomy, Malformation, Biochemical status, Micronutrients, Amrapali

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INTRODUCTION

Mango (*Mangifera indica* L.) occupies a pre-eminent role in development of economic status of the country and better linkage in the international trade. Among several limitations in mango cultivation, the most serious and challenging national problem in mango malformation which pose a great threat to the mango industry. Floral malformation is characterized by the deformation of panicles, suppression of apical dominance shortened primary and secondary axis, thickened rachides of the panicles. The counteracting effect of antimalformin chemicals *i.e.* silver nitrate in control of malformation (Ram, 1992) and spray of chelated Zn and Fe. For control sporadic results have been reported with the use of growth regulators *viz.*, GA_3 cycocel, ethrel, cytokinins and the malady (Das *et al.*, 1988; Bist and Ram, 1988 and Shawky *et al.*, 1978) So, the present investigation was initiated to find out the most effective chemical on expression of bio chemical activities in malformed and healthy shoots/ panicles and to make comparative study of magnitude of causes and manipulation of severity of floral malformation.

MATERIALS AND METHODS

Experiment was carried out during the year 2010-11 and field studies were conducted at nursery of Horticulture Department, Khandwa (M.P.) and Biochemical studies were undertaken in the research laboratory Deptt. of Horticulture, College of Agriculture, Khandwa (M.P.).

Ten years old tree of Amarpali of uniform in size and vigour infested with malflormation were selected from the orchard. Thirty trees one for each treatment were marked in the first week of march 2010 with recommended agronomical trials. The present investigation was conducted in Randomized

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Block Design, each having three replications with one tree as a unit. Spray of chemicals was done first at growth flush stage (15th July) and secondly at flower bud initiation stage (10th October). The biochemical analysis condsisted of chorophhyl content following the method described by Witham *et al.* (1971). Carbohydrate and C/N ratio by the method of Mahadevan and Sridhar (1986). Protein by the method given by Lawry *et al.* (1951) and micronutrient analysis by using absorption spectophotometer (Samara *et al.*, 1978). Estimation of RNA and DNA by the extraction method of Nieman and Poulson (1963) and estimated using diphenylamine (Burton, 1956) and Orcinol Reagents (Peach and Tracey, 1955), respectively and micro technique was done with Canada Balsam of DPX mount.

RESULTS AND DISCUSSION

The foliar application of different chemicals were observed to increase the chlorophyll content of leaves. Maximum was recorded due to treatment of 0.3 per cent chelated $FeSO_4$ in both healthy and malformed shoots. As maximum was estimated at bud initiation stage and declines at later stages. The role of micronutrients in assimilation of chlorophyll has been considered to be associated with the nucleic acid metabolism of chloroplast and involvement inactivates several enzyme system (Price *et al.*,1972). The level of total carbohydrate in leaves was increased by foliar spray of 200ppm NAA followed by 100ppm $AgNO_3$. Which dwindles with flowering and fruiting in healthy tissues. It is suggested that amount of acid hydrolysable polysaccharides in malformed panicles are not being hydrolysed into simple sugars as in healthy panicles to meet out the energy requirements for their development. Significant difference (Table 1) in levels of total nitrogen and protein content were recorded in healthy and malformed shoots. Which decreases with growth in healthy ones. However, spraying of 200ppm NAA followed by 100 ppm $AgNO_3$ had increased the contents. The possible explanation of the present findings is that the peculiar morphological features and behavious of malformed growth inhibitors causing the disturbance in the various metabolic enzymic activity. However, the activity of $AgNO_3$ on increase of total nitrogen and protein content of leaves in malformed shoots has been demonstrated by Ram(1992). C/N ratio showed (Table 1) a significant reduction in healthy shoots with advancement of leaves age *i.e.* flower bud initiation to flowering and fruit maturity stage. The foliar application of 500 ppm ethephon had shown a significant influence on increase of C/N ratio followed by 100 ppm GA_3. Results might be due to less translocation and utilization of carbohydrates in development of flower parts and fruit set. The present findings are in accordance to the observation recorded by Singh and Dhillon (2008). A declining trend in (Table 1) levels of Zn, Fe and Mn were recorded in healthy shoots with maturity. However, the lower levels of these elements werer estimated in malformed shoots than healthy shoots. Application of 200 ppm NAA and 100 ppm GA_3 along with chelates of Fe, Cu and Zn also found effective in increasing the levels of these elements in leaves of both healthy and malformed shoots. As reported by Chakraborti and Ghosal (1989) that mango trees deficient in Zn showed more incidence of malformation. The metabolic role of copper has been established in several copper containing activity such as photosynthetic activity, chlorophyll synthesis, polyphenol oxidase and cytochrome oxidase activity (Price *et al.*, 1972). The increase in iron content of leaves may be due to involvement of iron in enzyme synthesis, chlorophyll synthesis and respiratory process (Price *et al.*, 1972). Result reveals that the malformed shoots contain lower level of iron than the healthy ones, which may be attributed due to imbalance between growth promters and growth inhibitors. Thus the present findings suggest the counteracting of micronutrient with other chemicals in regulation of hormonal imbalance for alteration of various physiological process. Mangiferin level show (Table 1) an increasing trend in healthy shoots from flower bud initiation to fruit maturity stage. However, the higher concentration of mangiferin was recorded in malformed shoots than healthy ones. Maximum mangiferin level was accumulated with the treatment of 100 ppm GA_3 followed by 200 ppm NAA. The influx of mangiferin into differentiating flower buds and developing panicles, caused by biotic and abiotic stress factors, tilted the hormonal balance in favour of vegetative growth, causing malformation. The present findings are in accordance to observations recorded by Chakrobarti and Sharma (2001). The level of RNA and DNA were higher (Table 1) in healthy shoots than malformed at flower bud initation stage which dwindles with growth. DNA content in malformed shoots has been enhanced by 200 ppm NAA followed by $AgNO_3$ and $FeSO_4$. As, RNA and DNA utilized for floral parts development in healthy shoots. Whereas, in malformed one forms compact mass of axillary buds/flowers on short internodes. The effective role of $AgNO_3$ on increase in level of nucleic acid might be due to selective effect of Ag+, which involves in ethylene oxidation process and also acted as antimalformin agent. Results are in accordance with Ram (1992). However, the response of iron alteration of RNA and DNA levels has clearly indicated its role in nucleic acid metabolism of chloroplast. Findings are in conformation with results of Singh and Dhillon (2008). Assessed from the microtomical view of flowering buds of healthy and malformed tissue that diseased tissues shows cell abnormality, with dense growth of epidermal hairs, full of fluid, hyperplasia and hypertrophy of the cells causing degeneration of ovary and resulting in no fruit set. As reported by Singh and Dhillon (2003) that hermaphrodite flowers on normal panicles possessed generally a single ovary and rarely, two whereas the flowers of malformed panicles had multiple

Table 1: Effect of foliar spray of chemical on chlorophyll content (mg/lit), carbohydrate (%), protein (% d.w.), C/N ratio, Zn,Cu and Fe (ppm), mn (ppm), Magniferin (%), RNA and DNA (ug/mg f.w.), content in leave of healthy and malformed shoots of mango cv Amrapali at different stages of growth

Treatments	500 ppm Ethephon	200 ppm NAA	50 ppm Kinetin	1000 ppm Cycocel	100 ppm GA	100 ppm $AgNO_3$	0.3% chelated $ZnSO_4$	0.3% chelated $CuSO_4$	0.3% chelated $FeSO_4$	Control	CD @ 5%
Flower bud (chl.)	1.20	1.35	1.24	1.21	1.26	1.28	1.36	1.40	1.45	1.15	0.06
Healthy (flr.)	1.05	1.09	1.07	1.05	0.98	1.09	1.14	1.14	1.17	1.02	0.06
Malformed (flr.)	0.52	0.54	0.56	0.62	0.52	0.57	0.72	0.70	0.79	0.46	0.06
Healthy (Fruit)	0.97	1.01	0.98	0.96	0.90	1.00	1.02	1.06	1.07	0.93	0.07
Flower bud (cbd)	18.64	20.73	17.59	16.62	18.77	20.12	16.63	17.46	15.83	13.39	1.26
Healthy (flr)	15.00	15.44	14.22	13.55	14.18	14.68	12.97	12.49	13.12	10.48	1.57
Malformed (flr)	15.98	15.94	14.38	15.32	14.81	15.41	13.68	13.87	15.28	12.42	0.82
Healthy (Fruit)	10.25	10.37	9.97	9.78	10.09	10.28	9.19	7.20	8.00	6.71	0.85
Flower bud (prtn)	1.78	2.23	1.73	1.72	1.75	2.00	1.81	1.65	1.84	1.63	0.12
Healthy (flr)	1.65	2.03	1.62	1.62	1.64	1.91	1.70	1.57	1.71	1.56	0.15
Malfomed (flr)	1.01	1.19	0.98	0.97	1.07	1.17	1.15	1.06	1.11	0.94	NS
Healthy (Fruit)	1.25	1.50	1.27	1.29	1.28	1.46	1.29	1.27	1.34	1.26	0.14
Flower bud(c/n)	10.80	9.83	10.22	9.67	10.53	10.17	9.12	9.98	8.66	8.35	0.74
Healthy (flr)	9.07	7.03	8.77	8.56	8.73	8.00	7.83	7.80	7.55	7.02	0.45
Malformed (flr)	15.48	13.28	18.87	15.09	14.29	13.11	12.14	13.08	14.05	13.07	0.87
Healthy (Fruit)	8.21	6.84	8.06	7.76	7.92	7.12	7.35	6.04	5.98	5.10	0.84
Flower bud (Zn)	19.05	20.70	18.86	19.21	20.00	20.01	26.13	17.34	18.00	16.25	1.08
Healthy (flr)	18.23	19.58	17.98	18.39	18.53	19.04	25.75	16.45	16.93	15.12	0.76
Malformed (flr)	13.15	13.29	12.03	11.85	12.66	12.98	14.43	11.33	11.37	10.27	0.87
Healthy (Fruit)	14.95	16.12	14.52	15.05	15.03	15.60	24.25	13.80	13.78	12.57	1.07
Flower bud (Cu)	12.07	12.92	12.37	12.37	12.45	12.67	12.10	14.30	12.00	11.78	0.69
Healthy (flr)	11.08	11.62	11.17	11.53	11.40	11.46	11.03	13.09	10.84	10.34	NS
Malformed (flr)	7.52	7.75	7.24	7.43	7.31	7.80	7.47	8.56	7.28	6.89	0.54
Healthy (fruit)	10.64	11.10	10.81	10.76	10.71	10.53	10.69	12.36	10.23	9.77	N.S.
Flower bud (Fe)	226.5	229.9	225.4	225.8	229.3	228.8	219.4	216.8	232.6	211.7	7.22
Healthy (flr)	211.1	214.8	210.3	210.5	214.1	213.6	199.6	198.6	217.4	196.4	5.23
Malformed (flr)	130.1	132.6	129.4	128.7	131.9	132.0	104.8	103.9	135.5	98.7	4.59
Healthy (fruit)	199.8	203.0	199.3	198.6	202.2	201.4	189.6	187.4	206.3	185.3	5.31
Flower bud (Mn)	84.27	101.23	82.13	81.67	87.60	99.27	80.20	79.69	79.23	75.87	3.16
Healthy (flr)	65.18	71.43	63.53	62.07	68.97	77.60	60.87	60.87	60.63	57.67	2.00
Malformed (flr)	39.67	40.03	36.63	36.63	39.77	42.43	36.10	34.90	34.53	32.83	1.35
Healthy (Fruit)	47.67	51.63	41.20	44.20	49.87	58.40	43.53	42.97	40.97	39.03	1.56
Flower bud (Mgfn)	3.79	4.34	4.14	3.64	4.48	3.88	4.27	4.12	4.00	2.98	0.14
Healthy (flr)	4.03	4.68	4.49	4.01	4.70	4.10	4.59	4.13	4.32	3.20	0.29
Malformed (flr)	5.43	5.54	5.20	4.51	5.62	5.48	5.45	4.93	5.44	3.98	N.S.
Healthy (Fruit)	7.21	8.32	7.88	7.15	8.40	7.33	8.25	7.77	7.55	5.19	0.32
Flower bud (RNA)	3.73	4.29	3.79	3.88	3.72	4.12	3.91	3.96	4.02	3.62	0.34
Healthy (flr)	3.11	3.51	3.09	3.28	3.03	3.37	3.28	3.30	3.29	2.93	0.31
Malformed (flr)	2.27	2.74	2.24	3.36	2.19	2.70	2.38	2.59	2.68	2.04	0.23
Healthy (Fruit)	2.31	2.71	2.35	2.33	2.31	2.64	2.37	2.53	2.50	1.97	0.36
Flower bud (DNA)	7.17	7.68	7.29	7.50	7.38	7.59	7.50	7.56	7.63	6.59	0.37
Healthy (flr)	5.82	6.61	6.09	6.22	6.11	6.55	6.23	6.31	6.59	5.18	0.50
Malformed (flr)	4.32	4.82	4.45	4.65	4.41	4.70	4.69	4.66	4.75	3.64	0.67
Healthy (Fruit)	4.63	5.27	4.91	5.04	4.64	5.12	4.82	4.97	5.18	4.00	0.67

ovaries, may be due abnormal floral morphology of hermaphrodite flowers eg. stigma, style and ovaries with degenrated embryo (s). So, microtomy reveals the imbalance of growth promoters and growth inhibitors.

Conclusion :

It is apparent from the microtomical study and findings of the present piece of investigation that the comparative picture on efficacy of most effective plant growth regulators *viz.,* 100 ppm $AgNO_3$ and 200 ppm NAA and in micronutrients $ZnSO_4$ has been achieved, which may be used as foliar spray for controlling the intensity of mango malformation reasonably.

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