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Effect of growth regulators on floral malformation in mango (*Mangifera indica* L.) cv. Amrapali

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Abstract

Mango is a unique species in fruit trees with respect to growth, specific nature and diversity. Like other crops, it is prone to various biotic and abiotic stresses being major obstacle to mango production. Amongst biotic and abiotic problems of mango, Floral malformation has become a crux with yield losses ranging from 60% to 80. A field experiment was conducted to assess the effect of auxin and ethrel on floral malformation in mango. Studies were undertaken on 18 years old mango trees of Amrapali. The selected trees were sprayed "on year" with different concentration of auxin (NAA) *viz.* 150 ppm, 175 ppm & 200 ppm., etheral *viz.* 300 ppm, 400 ppm & 500 ppm and distilled water in the first week of October. The result revealed that PGR particularly NAA @ 200ppm had significantly effect on maximum (65.92) percentage of healthy inflorescences per shoot and (21.46) percentage of hermaphrodite flowers per inflorescence as compared to rest concentrations of PGRs. Similar this PGR spray showed highest 3.42 and 0.63 average number of fruits set and retention per panicles, respectively followed by ethrel @ 500 ppm. While the lowest hermaphrodite flowers, fruits set and retention per panicle was found in control (distilled water spray), but under this treatment maximum percentage (75.96) of male flowers per inflorescence was noted. From the above study, it can be concluded that exogenous spray of NAA @ 200 ppm applied before flower and fruit bud differentiation can reduce the malformed panicles to the extent of about seventeen percent. Perfect flowers (hermaphrodite) can also be increased both in normal as well as malformed panicles which helpful for higher fruits set and retention per panicle.

Key Words: Mango, Auxin, Ethrel, Panicles, Floral malformation and Inflorescence.

Introduction

Mango (*Mangifera indica* L.) belongs to the family Anacardiaceae, originated in South Asia. It covers an area of approximately 2.55 million hectares, which is about one third of the total area under fruit production in the country. Through India produces nearly 60 percent of the world mango, *i.e.* 18.676 million tonnes, is stands fourth in the export of fresh and processed fruits (Anonymous, 2014). Unfortunately, this crop suffers regularly a colossal loss due to floral malformation. The incidence of floral malformation in mango was first reported from Darbhanga in Bihar by Maries. Besides erratic bearing, floral malformation has posed a serious threat to the flourishing industry particularly in Central and Northern part of the Country (Kumar and Reddy, 2006). Due to this disorder, terminal growth of main rachis, secondary and tertiary branches of the panicles get suppressed and thickened forming a compact mass. Mainly male flowers are born in such panicles, which normally do not set fruits resulting into reduction in fruit yield (Shahbaz *et al.*, 2009). The problem aggravated due to non-availability of fully resistant commercial variety to this disorder. (Pandey and Pandey, 2000; Pandey *et.al.*, 2002 and Singh *et.al.*, 2014). In the present investigation, efforts have been made to bring out the information on the production of malformed panicles, hermaphrodite flowers, fruits set and fruits retention in response to spray of auxin and ethrel on flower and fruit bud differentiation.

Materials and Methods

The experiment was carried out at Imalia farm, Department of Horticulture, JNKVV, Jabalpur, during the year 2011-2012. The location of the experiment is situated on the Kymore Plateau agro-climatic region in the north western part of Madhya Pradesh at latitude of 23.10°N, longitude 79.58°W and altitude 300 meters above the mean sea level. The climate of this region is semi arid and sub tropical having warm and dry spring summer and cool winter are main characteristics feature. The mean annual maximum and minimum temperatures vary from 42-45°C in May and 5-9°C in January respectively. The average rainfall varies from 500-1200 mm. The main rainfall received during monsoon months *i.e.* from July to mid September. Mid July to end of August is heaviest rainy period with intermittent dry spell during the rainy period. The trial was conducted on 18 years old. Amrapali mango plants spaced apart from 5X5 m. 21 trees having "on year" were selected and each tree was divided in two sectors. Twenty normal shoots and twenty shoots having scars from each sector of the tree were employed. These shoots were ringed to

prevent translocations of hormone to adjacent shoots. Experiment was consisted of fourteen treatment combinations due to two categories of shoots *i.e* normal and scar. Seven levels of sprays were tried in randomized complete block design (RCBD) with three replication. Seven plants were selected in each replication. The selected trees were sprayed "on year" with different concentration of auxin (NAA) *viz.* 150 ppm, 175 ppm & 200 ppm., ethrel *viz.* 300 ppm, 400 ppm & 500 ppm and distilled water in the first week of October. During spray distilled water used as control treatment. The stock solution of NAA and ethrel along with adhesive agent (Tween-80) was sprayed individually by hand sprayer. Amount of spray solution per plant was determined by spraying water in the plant. Data were recorded for statistical analysis on percentage of healthy inflorescences/shoot, percentage of hermaphrodite flowers/inflorescence, percentage of male flowers/inflorescence, average number of fruits set per panicle and average number of fruits retention per panicle.

Result and Discussions

The data presented in Table 1 & Fig. 1 revcals that spray of auxin and ethrel significantly increased the percentage of healthy inflorescences on scarred shoots. It was observed that the highest (83.73 & 48.11) percentage of healthy inflorescences/shoot was found in normal and scarred shoots, respectively when the plant was sprayed with NAA @ 200 ppm followed by etheral @ 500 ppm in the first week of October, whereas it was observed minimum 77.16 & 28.61 percentage of healthy panicles in both normal and scarred shoots under distilled water spray. These results were in agreement with Chowdhary and Rahim (2008) who reported that application of 200 ppm NAA during the first week of October was the most effective in reducing the incidence of floral malformation and increased the number of inflorescences on normal and scarred shoots.

Percentage of hermaphrodite flowers per inflorescence varied significantly among the different concentrations of NAA and ethrel. NAA @ 200 ppm spray recorded the highest percentage 29.78 & 13.14 of hermaphrodite flowers per inflorescence, while the control was recorded with the lowest percentage 10.51 and 3.19 in normal and malformed panicles, respectively shown in Table 1 & Fig. 2. These results were close to Chakrabarti and Kumar (2000). They reported that single application of 200 ppm NAA in the first October increased the percentage of perfect flowers, which lead to the increased number of hermaphrodite flowers. The exogenous application of 200 ppm NAA undertaken in the present studies resulted into seventeen percent reduction in floral malformation and two to three times the production of hermaphrodite flowers in both normal and malformed panicles to control. Similar iresults are also reported by Singh *et. al.* (2007) and Pandey and Pandey (1999).

A perusal of the data presented in Table 1 indicated that the percentage of male flowers per inflorescence was significantly decrease due to the application of different treatments, except control. The highest percentage (71.09 & 80.83) of male flowers per inflorescence was observed under control, while the lower percentage (58.11 & 70.19) was recorded with 200 ppm NAA spray followed by 500 ppm etheral in normal and malformed panicles, respectively (Fig. 3). Reduction in male flowers per inflorescence have been reported by Pandey and Sant (1995) and Ram and Singh (1998). Thus the results of the present studies are in agreement with the above reports. The external application of NAA might have increased the endogenous levels of auxin and helped in lowering down the suppression of apical dominance, normal growth of main rachis and secondary & tertiary branches of panicles, which resulted in reducing the percentage of male flowers in malformed and normal inflorescences. These results are in accordance with the findings of Singh and Singh (1998).

Analysis of data reveals that average number of fruits set in both normal and malformed panicles significantly increase with spray of either NAA or ethrel (Table 2). The highest (3.42) average number of fruit set per panicle was recorded in the first week of February under 200 ppm NAA followed by 500 ppm ethrel to foliar application. According to Waffa Haggag *et. al* (2011) a delicate balance between the levels of growth regulators and inhibitors exist in nature which decides the production of hermaphrodite flowers. It seems logical that the application of NAA might have helped for attaining the required levels of growth promoters for the production of hermaphrodite flowers which might have increases fruit set. These results also corroborated the findings of Ram and Yadav (1999) who stated that 200 ppm NAA reduced the incidence of malformation and increased the fruits set, whereas minimum (4.61 & 0.87) average number of fruit set per panicle was observed under distilled water spray in normal and malformed panicles, respectively (Fig.4).

The highest (0.63) average number of fruits retention per panicle and per plant was found in NAA @ 200 ppm followed by Ethrel @ 500 ppm both these treatments are significantly ($P = 0.05$) superior to all other treatments (Table 2). The application of either NAA @ 200 ppm or Ethrel @ 500 ppm increased four to five times fruits retention in malformed panicles to control. The results obtained are in accordance with the earlier findings as quoted by Pandey and Pandey (2000) who have reported that higher fruit set and lower fruit drop which also depends upon sufficient production of endogenous levels of flowering substances resulting into increased fruit retention as compared to control. The minimum (0.60 & 0.07) average number of fruit retention was recorded under control in both normal as well as malformed panicles (Fig.5).

Table 1. Effect of growth regulators spray on initiation of healthy inflorescences, male flowers and hermaphrodite flowers.

Treatments	Percentage of healthy inflorescences / shoot			Percentage of male flowers/ inflorescence			Percentage of hermaphrodite flowers/ inflorescence		
	Normal Shoots	Scarred Shoots	Mean	Normal Panicles	Malformed Panicles	Mean	Normal Panicles	Malformed Panicles	Mean
NAA @ 150 ppm	78.11	30.11	54.11	67.11	76.13	71.26	18.13	7.13	12.63
NAA @ 175 ppm	80.24	38.82	59.53	62.17	74.71	68.44	21.43	9.10	15.26
NAA @ 200 ppm	83.73	48.11	65.92	58.11	70.19	64.15	29.78	13.14	21.46
Ethrel @ 300 ppm	79..14	37.14	58.14	65.27	73.24	69.25	23.11	8.77	15.94
Ethrel @ 400 ppm	80.51	40.77	60.64	63.14	72.01	67.57	25.76	10.51	18.13
Ethrel @ 500 ppm	82.19	45.37	63.78	61.11	70.72	65.91	27.51	11.82	19.66
Distilled Water (Control)	77.16	28.61	52.88	71.09	80.83	75.96	10.51	3.19	6.85
Mean	80.15	38.41	-	64.00	73.97	-	22.31	9.09	-
CD at 5%	Spray 1.61	Shoot 1.32	Interaction 2.37	Spray 1.37	Panicles 1.21	Interaction 1.92	Spray 1.43	Panicles 1.18	Interaction 2.43

Table 2. Effect of growth regulators spray on Fruit set and retention per panicle.

Treatments	Average Number of fruits set per panicle			Average Number of fruits retention per panicle		
	Normal Panicles	Malformed Panicles	Mean	Normal Panicles	Malformed Panicles	Mean
NAA @ 150 ppm	4.21	0.82	2.51	0.73	0.91	0,46
NAA @ 175 ppm	4.73	1.01	2.87	0.82	0.25	0.53
NAA @ 200 ppm	5.33	1.51	3.42	0.91	0.35	0.63
Ethrel @ 300 ppm	4.34	0.91	2.62	0.71	0.14	0.42
Ethrel @ 400 ppm	4.81	1.13	2.97	0.76	0.21	0.48
Ethrel @ 500 ppm	5.01	1.25	3.13	0.85	0.30	0.57
Distilled Water (Control)	3.89	0.73	2.31	0.60	0.07	0.33
Mean	4.61	0.87	-	0.76	0.21	-
CD at 5%	Spray 0.26	Panicle 0.31	Interaction 1.1	Spray 0.05	Panicle 0.04	Interaction 0.11

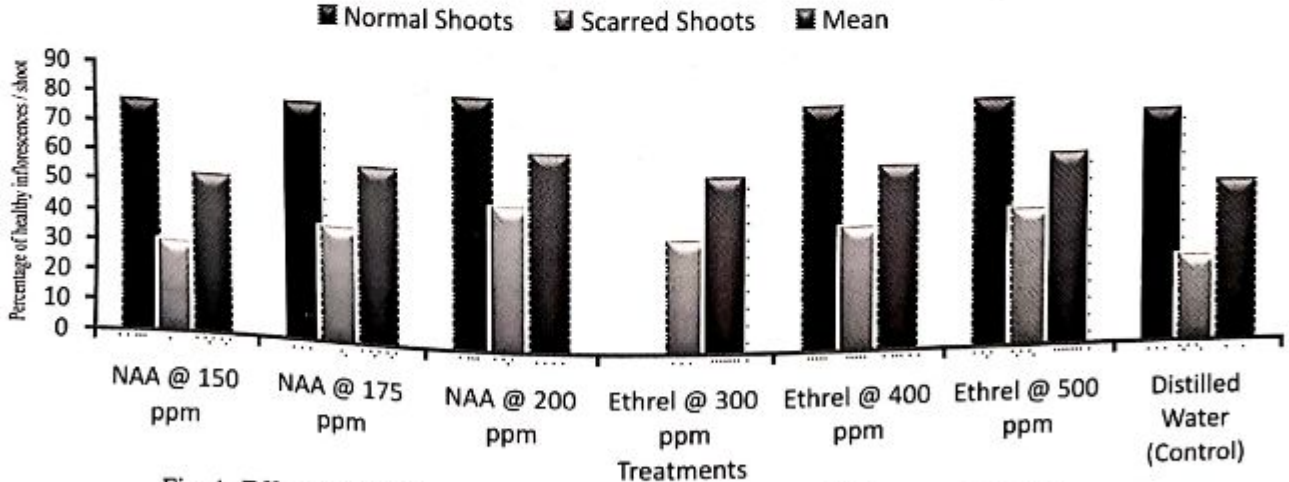


Fig. 1. Effect of growth regulators on initiation of healthy inflorescences/shoot.

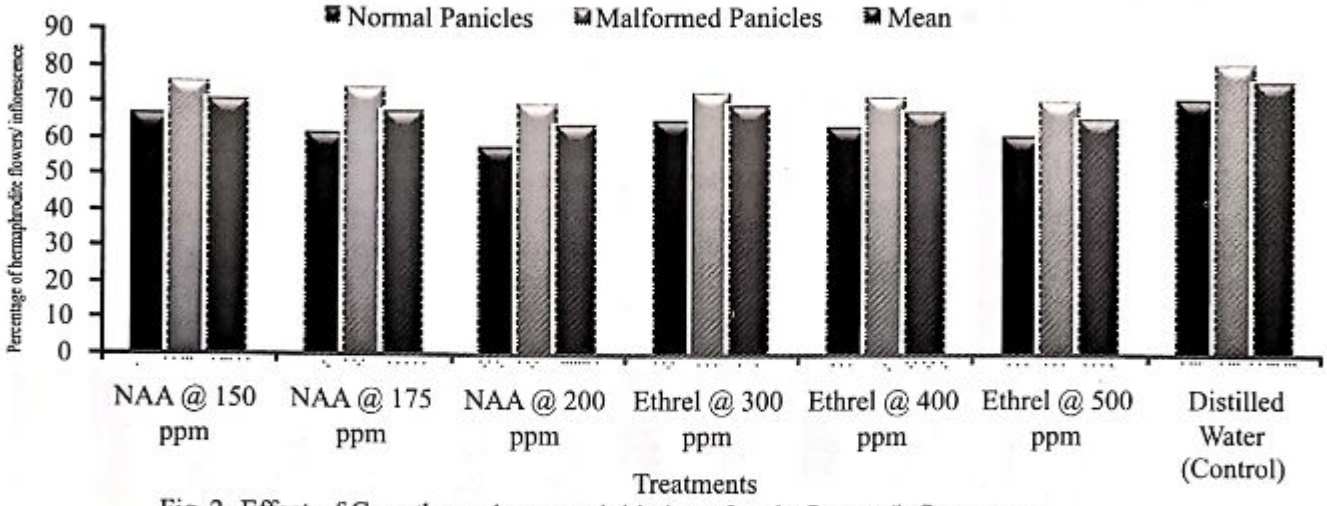


Fig. 2. Effect of Growth regulators on initiation of male flowers/inflorescence.

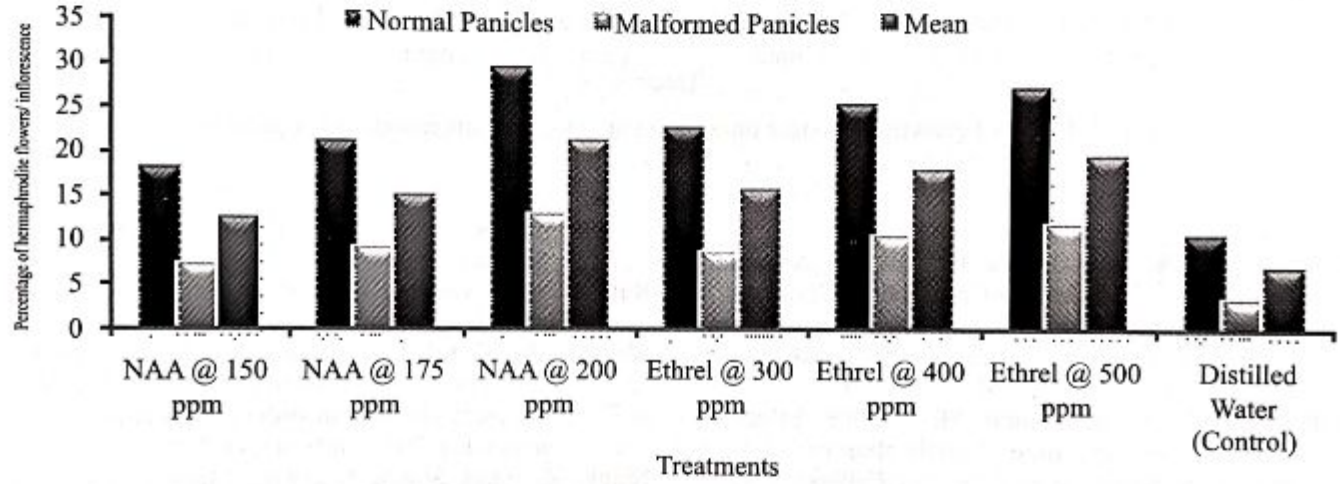
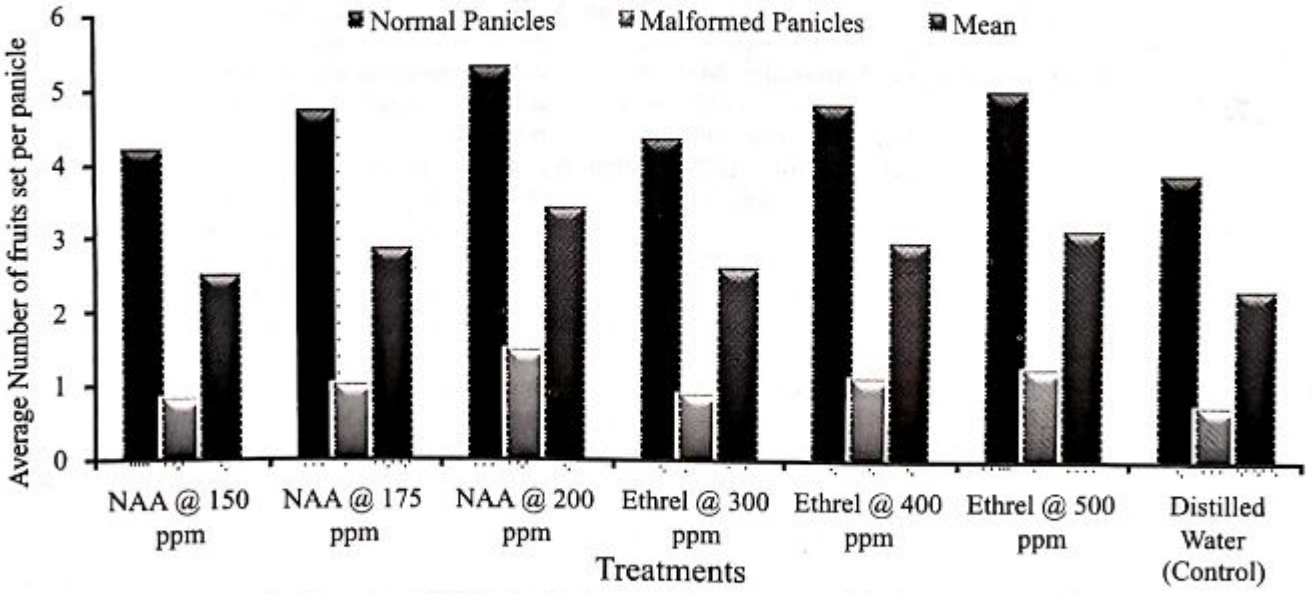


Fig. 3. Effect of growth regulators on initiation of hermaphrodite flowers/inflorescence



. 4. Effect of growth regulators on average number of fruits set per panicle.

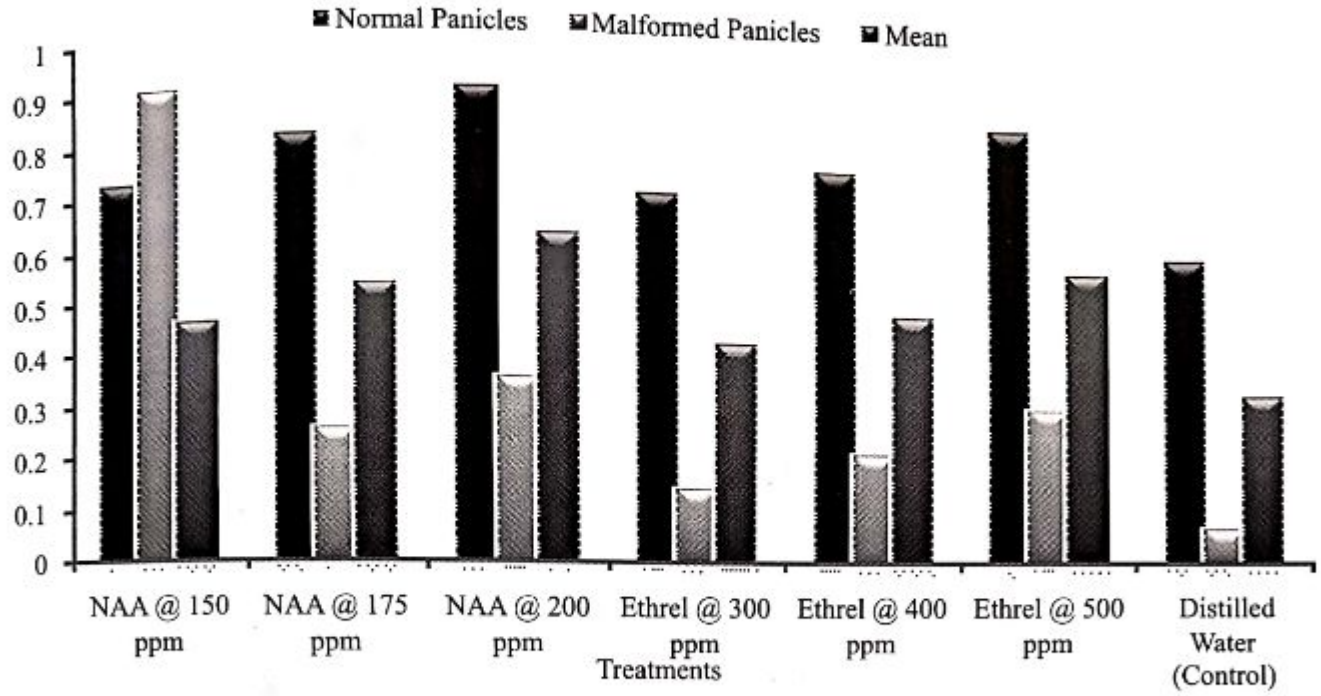


Fig. 5. Effect of growth regulators on average number of fruits retention per panicle.

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