Plant Archives Vol. 20, Supplement 2, 2020 pp. 4271-4274 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

EFFECT OF BIO REGULATORS ON HASTENING THE GROWTH AND DEVELOPMENT OF MANGO ROOTSTOCK

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Abstract

The present investigation was carried out in the Department of Horticulture, Faculty of Agriculture, Annamalai University. A field trial was conducted in a Completely Randomized Design with 10 treatments in three replications. The treatment consisted of two growth regulators *viz*., Gibberellic acid @ 100 ppm, 200 ppm and 300 ppm; Naphthalene acetic acid 500 ppm, 1000 ppm, and 1500 ppm and a growth retardant Alar @ 500 ppm, 1000 ppm, and 2000 ppm, were sprayed at monthly intervals. The first spray was given at 30 days after planting in the poly bag. The results of the study revealed that foliar application of GA_3 @ 300 ppm increasing the seedling growth characters like plant height, inter nodal length, number of leaves, leaf area, length of the tap root and number of secondary roots and maximizing the fresh and dry weight of mango rootstock. From the results of the present study, it can be concluded that foliar application of GA_3 @ 300 ppm has beneficial effect on hastening the growth and development of mango rootstock to attain the graftable size in earlier.
Keywords*:* Mango(*Mangifera indica*),Growth regulators,GA_3, NAA, Growth retardant and Alar.

Introduction

Mango (*Mangifera india* L.), the king of tropical fruits occupies an important place among the fruit crops grown in India and it is considered as the national fruit of India. It can be propagated by seed as well as by vegetative or asexual means. Asexual propagation, is prepared to obtain uniform and standard quality crops. For asexual propagation, it is must rising of healthy, vigorous and uniform rootstocks, for which seeds are used to obtain seedlings on which the desired variety (scion) can be grafted. The rootstocks exerts, not only a, considerable influences on growth, precocity and cropping of the scion cultivar grafted on them but they also impart resistance to scion cultivars against adverse biotic and a biotic factors. Seedling rootstocks are most commonly and widely used rootstocks for mango in tropical region. Since most of the fruit crops the seedlings (rootstock) growth and development was very poor and took long period (several months) to become graftable size.

Plant growth regulators have important roles in plants development, growth and regulation. Major types of plant bio-regulators are auxins, gibberellins cytokinins, abscisic acid, and ethylene, which are grouped in to in two types in which the one as promoters and other as retardant. Among these gibberellins are known to promote stem growth dramatically by increasing cell division and enlargement. There are about 110 known gibberellins, customarily abbreviated to GA. Most of the GA, produced by the plant is inactive and most likely functioning as precursors to active ones (Feucht and Wtson, 1958). Exogenous application of growth regulators have a profound influence on growth of many plants. Gibberellic acid has been reported to increase cell division (Sachs *et al.,* 1959) and cell enlargement (Haber and Leopold, 1960; Haber *et al.,* 1969). The use of GA to advance the growth and development of plant species is very old and well documented Abouzied and Bakry, 1978. Growth retardants are commonly used for obtaining plants of compact habit, mainly in ornamental plant production. Alar considers one of the most systematic growth retardants, so it has various effects in plants (Basra, 1994). Keeping this in view the present investigation was carried out to reduce the time required to reach graftable size of mango rootstocks by using plant growth regulators like GA_3, NAA and Alar.

Materials and Methods

The present investigation was carried out in the Department of Horticulture, Faculty of Agriculture, Annamalai University. Healthy uniform size mango stones of neelum variety were procured from the pulping industry during the first week of July from Krishnagiri, Tamilnadu. The stones procured from the processing industry were washed thoroughly and dipped in water. The stones, which were floating in water, were discarded and only those that settled in the bottom were selected and spread over ground. After surface drying, the stones were treated with bavistin at one percent and stones were sown in raised beds mixed with well decomposed farm yard manure and the stones were sown in lines and the beds were mulched with paddy straw. When the seedlings attained the age of fifteen days old, uniform and healthy seedlings were transplanted in the polythene bags of 15x10 cm size containing 1:1:1 potting media. A field trial was conducted in a Completely Randomized Design with 10 treatments in three replications. The treatment consisted of two growth regulators *viz*., Gibberellic acid @ 100 ppm, 200 ppm and 300 ppm; Naphthalene acetic acid 500 ppm, 1000 ppm, and 1500 ppm and a growth retardant Alar @ 500 ppm, 1000 ppm, and 2000 ppm. were sprayed at monthly intervals. The first spray was given at 30 days after planting in the poly bag. The observations on growth characters like plant height, inter nodal length, stem girth, number of leaves, leaf area. The root characters like length of the tap root, root girth and number of secondary roots, the fresh and dry weight of mango rootstock were recorded at 150 days after planting in the poly bag. The experimental data were analyzed statistically as per the procedure described by Gomez and Gomez (1984). The AGRES programme was used for the statistical analysis of the data.

Results and Discussion

The results of this study presented in table. 1 indicated that observations at 150 days after planting, growth regulators increased the rootstock growth characters like seedling height, internodal length, leaf production, leaf area and total leaf area. The maximum values (60.46 cm, 2.65 cm, 31.67, 67.25 cm^2 and 2129.81 cm^2 respectively) for these traits were registered in GA_3 300 ppm (T_4) at 150 days after planting in poly bag. Which was followed by GA_3 at 200 ppm (T_3) which recorded the values of 60.42 cm, 2.38 cm, 29.23, 62.31 cm^2 and 1821.32 cm^2 respectively. The least values of seedling height, internodal length and leaf area (29.76 cm, 0.98 cm and 32.54 cm^2 respectively) were recorded in the treatment which received the foliar application of the growth retardant Alar 2000 ppm (T_{10}) and with regard to number of leaves and total leaf area the least values of 14.72, and 679.47 cm respectively were registered in the control.

It was apparent that foliar application of mango rootstocks with GA_3 increased the seedling growth characters over the control and other treatments, which may be attributed to the growth promoting effect of GA_3 in stimulating and accelerating cell division, increasing cell elongation and enlargement or both as suggested by Hartmann *et al*. (1990). Significant increase in the internodal length noticed due to GA_3 treatment may be due to cell elongation of the individual cells as reported earlier by Nanda *et al*. (1967).

Further, Phinney (1983) opined that exogenously applied gibberellin does not release axillary buds from the apical dominance, but can cause rapid elongation in released buds leading to increase in plant height. Earlier reports by Nitsch and Nitsch (1963) have also suggested that the increase in plant height may be due to higher bio-activities of endogenous hormones in the plant system. In addition, increase in vegetative characters might be due to the increased cell division in apical meristem and cell elongation brought about by GA_3 as suggested by Sponsel (1985).

Foliar application of GA_3 react almost exclusively in the stem elongation properties. that have direct effect on stem elongation by inducing cell wall lossening, by increasing the solute concentration by increasing cell wall extensibility, stimulating the wall synthesis, reducing the rigidity of cell wall by increasing cell division leading to more growth (Yallesh Kumar *et al.,* 2008). This is in agreement with the findings of Shaban (2010) and Muralidhara *et al.* (2014) in mango.

Foliar application of GA_3 have been reported to increase the plant height and the production of more number of leaves and leaf area caused the increased plasticity of the cell wall followed by the hydrolysis of starch to sugars which lowers the water potential of cell resulting in the entry of water into the cell causing cell elongation. This might have attributed to increase the photosynthetic activity, accelerated translocation and efficiency of utilizing photosynthetic products resulting in cell elongation and rapid cell division in growing portion. (Sargent, 1965). Similar views were also expressed by Kadam *et al.*2010 in Kagzi lime, Surakshita *et al.,* 2014 in Jamun.

Significantly lowest plant height and internodal length obtained with alar 2000 ppm compared to other treatments including control might be due to the retardation effect of alar and also due to their inhibitory action, as they bring about the reduction of cell division in the meristematic tissue and retard elongation of cells of internodes as observed by Dennis and Esther (1969). Moreover, alar decreases, inhibits and or blocks gibberellin biosynthesis as suggested by Krause *et al*. (1989). The results are in close conformity with the findings of Jasbir Singh Wazir (2011) in alstromeria.

With regard to the stem girth and root girth(Table.1 & 2), it was observed in the present study that application of alar 2000 ppm (T_{10}) increased the stem girth (3.02 cm) and root girth (27.65mm), followed by (T_9) alar 1000 ppm which recorded the values of 2.87 cm and 26.79 mm respectively. While the least values (2.16 cm and 21.42 mm respectively) for this trait was recorded in the control (T_1). Retardation of plant height and transverse cell expansion and division in the sub apical tissues were stimulated by alar and might have resulted in the increase in stem girth observed by Barras-Ali (2002). Application of alar stimulate the cell production of the cambium, accompanied by a delay in cell differentiation and to increase the cell volume of the parenchymatous cortical cell resulting in increasing of stem girth was observed by Crittendon (1966) in bean plants. Similar results were obtained with foliar application of alar has been reported by El-Sheibany *et al.* (2007) in Chrysanthimum.

The results of the present investigation revealed that the differences in root length and number of secondary roots (Table.2) was significant due to application of growth regulators and it was observed that rootstocks sprayed with GA_3 300 ppm (T_4) exhibited the longest tap root (37.59 cm) and the maximum number of secondary roots(27.54) and the next best treatment was GA_3 at 200 ppm (T_3) which recorded the values of 35.26 cm and 25.93 respectively. The least length of tap root (24.72 cm) was registered in the treatment (T_{10}) alar 2000 ppm and the minimum number of secondary roots (18.73) was recorded in the control (T_1). This cloud be attributed to gibberellins, auxins and vitamins produced at the effect of these compounds on plant growth and development have been well documented (Torrey, 1976). The different degree of stimulation of roots parameters might be further related to different degree of production of these compounds by foliar application of GA_3 and also GA_3 having phenolic compounds stimulate the physical efficiency of storage organs to increase the root parameters. Modification in root geometry and morphology might be morphogenic effect mediated by gibberellins (Allen *et al.* 1980). Moreover, vigorous shoot growth due to the GA_3 treatment might have resulted into increased production of photosynthates and their translocation through phloem to the root zone might be responsible for increasing the radical length. The results are in confirmation with the finding of Patil *et al.* (2013) in Rangpur Lime and Vachhani *et al*. (2014) in Khirnee.

In the present investigation, it was observed that the root girth (Table 2) was found to be significantly influenced by the foliar application of alar. The least root girth was observed in the control. Increased root girth might be due to foliar application of alar, which affected the cell in the quiescent meristematic nuclear zone, causing reduction in cell size in nuclear abnormalities. There was some selectivity within the root apex, because elongation of the root cap and epidermal cells was not as inhibited as the vascular and cortical cells. Inhibition of cell elongation at high

concentrations of alar was very pronounced. Although alar has been classified as a growth retardant, its biochemical action is reported by Moore (1967) to be different from growth retardants. The anatomical effects of alar also appear to be different from reported effect of the growth retardants. Sachs *et al*. (1960) found that alar retarded growth by inhibition of cell division in the transverse plane rather than by inhibition of cell elongation resulted in the better increment of root girth. The results of several works like Julianna Harmath and Gabor Schmidt (2010) in bluebeard and Basford *et al*. (2010) in several ornamental plants like Dahlia, Fuchsi, Ageratum, Antirrhinum, Petunia, Salvia, Zinnia, Phlox, Nemesia and Lobelia genera.

The fresh weight and dry weight (Table.2) of rootstock was found significantly maximum (51.28 g and 19.72 g) respectively under T_4 (GA_3 300 ppm) in comparison to other treatments and as well as control and was followed by T_3 (GA_3 200 ppm) which recorded the values of 47.41 g and 18.23 g respectively. The minimum values of 22.95 g and 8.49 g respectively were recorded in the treatment T_1 (control). This seems to be the effect of mobilization of water and nutrients transported at higher rate which might have promoted more production of photosynthetic product and translocated them to various plant parts which might have resulted in better growth of the seedlings and hence, more fresh and dry weight (Khatana *et al.,* 2015). The results are in conformity with the findings of Dhankhar and Singh (1996) in Aonla, Anjanawe *et al.* (2013) in papaya and Muralidhara *et al.* (2014) in mango.

From the results of the present study, it can be concluded that foliar application of GA_3 @ 300 ppm has beneficial effect on hastening the growth and development of mango rootstock to attain the graftable size in earlier.

Table 1 : Effect of bio regulators on growth and development of mango rootstock at 150 days

Treatments	Height of seedling (cm)	Internodal length (cm)	Stem girth (cm)	Number of leaves per seedling	Leaf area (cm^2)	Total Leaf area (cm^2)
T_1 – control	44.13	1.68	2.16	14.72	46.14	679.47
T_2 - GA_3 100 ppm	51.84	1.97	2.35	24.43	53.58	1308.95
T_3 - GA_3 200 ppm	60.42	2.38	2.71	29.23	62.31	1821.32
T_4 - GA_3 300 ppm	60.46	2.65	2.74	31.67	67.25	2129.81
T_5 - NAA 500 ppm	49.86	1.92	2.33	23.58	52.51	1238.19
T_6- NAA1000 ppm	53.57	2.01	2.39	25.16	55.21	1339.08
T_7 -NAA 1500 ppm	59.15	2.32	2.53	28.25	61.06	1724.95
T_8 -ALAR 500 ppm	42.64	1.61	2.55	17.99	44.65	803.25
T_9 -ALAR 1000 ppm	36.27	1.32	2.87	20.75	39.32	815.89
T_{10} -ALAR 2000 ppm	29.76	0.98	3.02	21.31	32.54	693.75
S.Ed	**0.52**	**0.037**	**0.048**	**0.48**	**1.19**	**-**
CD (P=0.5)	**1.10**	**0.078**	**0.101**	**1.00**	**2.51**	**-**

Table 2 : Effect of bio regulators on growth and development of mango rootstock at 150 days.

Treatments	Length of tap root (cm)	Root girth (mm)	Number of secondary roots seedling^{-1}	Fresh weight (g)	Dry weight (g)
T_1 – control	29.61	21.42	18.73	22.95	8.49
T_2 - GA_3 100 ppm	32.15	22.77	23.73	39.86	14.97
T_3 - GA_3 200 ppm	35.26	25.43	25.93	47.41	18.23
T_4 - GA_3 300 ppm	37.59	25.87	27.54	51.28	19.72
T_5 - NAA 500 ppm	31.79	22.40	23.34	37.89	13.81
T_6- NAA1000 ppm	32.76	23.26	24.24	40.84	15.79
T_7 -NAA 1500 ppm	34.79	24.14	25.48	45.68	17.16
T_8 -ALAR 500 ppm	29.08	24.47	20.58	36.64	12.86
T_9 -ALAR 1000 ppm	26.63	26.79	22.01	32.16	11.47
T_{10} -ALAR 2000 ppm	24.72	27.65	22.33	28.04	10.02
S.Ed	**0.53**	**0.50**	0.89	**0.48**	**0.20**
CD (P=0.5)	**1.12**	**1.06**	1.87	**1.02**	**0.43**

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