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Studies on influence of growth regulators and nutrient foliar spray on seedling growth of tamarind (*Tamarindus indica* L.)

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ABSTRACT : A pot experiment was conducted to study the influence of growth regulators and nutrient foliar spray on seedling growth of tamarind. Growth regulators which were studied *viz.*, gibberellic acid (100, 200 and 300 ppm), NAA (100, 200 and 300 ppm), tricontinol (5 and 10 ppm), nutrients like urea (1 and 2 %), water soluble NPK (1 and 2 %), cow urine (5 and 10 %) and distilled water as control. The treatment with GA_3 300 ppm recorded the maximum seedling height (50.57 cm), seedling collar girth (2.18 cm), number of leaves (60.5), fresh and dry weight of shoots (29 g and 9.25 g, respectively), fresh and dry weight of roots (8.60 g and 4.60 g, respectively), number of days (137.73) taken to reach graftable size. Whereas, the minimum values was recorded for all the parameters in control.

KEY WORDS : Gibberellic acid, NAA, Urea, NPK, Vigour index, Tamarind

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Tamarind (*Tamarindus indica* L.) is a member of dicotyledonous family Fabaceae and belongs to the sub family Caesalpinoideae. It is a diploid species with chromosome number 2n= 24 (Purseglove, 1987). The name of tamarind is derived from an Arabic word "Tamarind- E- Hind" meaning "date of India" popularly known as "Indian date". Tamarind is a short trunked, multistemmed, large, evergreen or semi-evergreen tree growing up to 30 m with a trunk of about 8 m circumference and a crown diameter of up to 12m. Tamarind trees starts bearing the fruits at the age of 13 to 14 years and continue to produce fruits even after 60 years and some up to 200 years. Tamarind half the pod weight is contributed by pulp. Pulp contains both sugars (30-40%) and organic acids (8-18%), predominantly tartaric acid. The pulp is also a rich source of vitamins, minerals and calcium.

The pulp is widely used as a spice for souring curries, chutneys and certain beverages. Tamarind is native of the Dry Savanna of Tropical Africa and probably some parts of South India. It is cultivated throughout the tropics and subtropics of the world and has become naturalized at many places India is the main producer and consumer of tamarind in the world. It is estimated that India produces 3 million tons of fruits and exports the tamarind products worth of Rs. 50 cores per annum (Kotech and Kadam, 2002).

Tamarind is traditionally propagated from seed; tamarind produces relatively large seeds that average about 11-12.5 mm in diameter. They are flattish, shiny brown to blackish, with a hard impermeable seed coat. Germination of tamarind seed is epigeal**.** On an average, tamarind seeds begin to germinate about 13 days after sowing but may take a month to complete (Jøker, 2000). The present day nursery practices involve higher cost and risks with respect to raising of seedling rootstocks and their subsequent maintenance until they attain the graftable size. Healthy growth of rootstock is most important in attaining the higher rate of grafting success. In the nursery activities, Chemicals like GA_3 and NAA (Rajamanickam *et al.*, 2002) spray receive the considerable attention of the nursery men and growers for improving growth of seedlings in less time. Though tamarind is economically an important fruit crop of India, very little work has been done on raising of seedling rootstocks. Considering the above facts, the present study was undertaken.

RESEARCH METHODS

The present investigation was carried out at Regional Horticultural Research and Extension Centre, University of Horticultural Sciences, Gandhi Krishi Vignyan Kendra (West), Bangalore, during 2012-2013. The experimental field is located at an altitude of 930 meters above mean sea level 12° 58 North latitude and 77° 35 longitude.

The experimental design selected was Completely Randomized Design. Fifteen different treatments were imposed. Fifteen seeds were used for each treatment, which was replicated thrice. The seedlings were sprayed at 45 days intervel with T_1-distilled water as control, gibberellic acid (T_2-100, T_3-200 and T_4-300 ppm), NAA (T_5-100, T_6-200 and T_7-300 ppm), tricontinol (T_8-5 and T_9-10 ppm), nutrients like urea (T_{10}-1 and T_{11}-2 %), water soluble NPK (T_{12}-1 and T_{13}-2 %), cow urine (T_{14}-5 and T_{15}-10 %) and. Observations were recorded daily on germination parameters and monthly for vegetative parameters like plant height, number of leaves, stem girth, fresh weight, dry weight by keep the seedlings in hot air oven at the temperature of 60^0C till constant weight was attained and number of days taken to graftable size. The data collected from the five labelled seedlings in each treatment were averaged and completely randomised design (CRD) was employed to find out the significance among different treatments with the help of 'F' test (Sunderaraju *et al*., 1972).

RESEARCH FINDINGS AND DISCUSSION

Pre-sowing treatments influenced vegetative characters of seedling, resulting in their improved growth and development of seedling.

Seedling height (cm):

The maximum height was recorded (Table 1) in treatment GA_3 300 ppm concentration (50.57 cm) this was at par with GA_3 200 ppm and minimum height in control (30.83). An increase in the plant height due to the growth regulators could be attributed to an increase in the meristematic activity of apical tissues. Growth regulators are involved in increasing photosynthetic activity, efficient translocation and utilization of photosynthates causing rapid cell elongation and cell division at growing region of the plant leading to stimulation of growth, besides increasing the uptake of nutrients (Dicks, 1980). The gibberlic acid increased the plant height in tamarind is mainly due to cell elongation increase in size and rapid cell division. Due to this the elongation of internodes will takes place, hence the seedling height will increase. Similar results were observed by Marler and Mickelbert (1992) in carambola.

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Seedling collar girth (cm) :

The results obtained (Table 1) in seedling collar girth, was maximum in GA_3 300 ppm (2.18 cm) and this was at par with GA_3 200 ppm (2.09 cm) and minimum was in control (1.25 cm). The gibberllic acid increased in the seedling collar girth in tamarind is mainly due to increased protein synthesis, cell elongation, increase in size, rapid cell division, hence, the seedling collar girth might have increased. Similar results were observed by Marler and Mickelbert (1992) in carambola and Gul *et al*. (2006) in *Araucaria heterophylla*.

Number of leaves per plant:

The maximum number of leaves (60.50) was noticed (Table 1) in treatment GA_3 300 ppm. The minimum number of leaves (31.03) was recorded in treatment water spray (control). The production of more number of leaves in gibberllic acid treatments may be due to the various growth induced by the GA_3, more number of branches which in turn facilitates better harvest of sunshine by the plants to produce more number of leaves. These results obtained on this aspect are in agreement with Marler and Mickelbert (1992) in carambola and Gul *et al*. (2006) in *Araucaria heterophylla*.

Fresh and dry weight of shoots (g):

The maximum (29 g and 9.25 g, respectively) fresh and dry weight shoots was recorded in the treatment GA_3 300 ppm, which was at par with GA_3 200 ppm (26.10 g and 8.40 g, respectively). Whereas, minimum fresh weight of seedling (14.63 g) was recorded in water spray (Table 2). The application GA_3 resulted in increase in more fresh and dry weight of shoots is mainly due to effect of GA_3 in translocated to the expanding internodes and beyond into apical region and young leaves. The increase in length is accompanied by increased dry weight and during expansion there is direct relation between dry weight and volume of water on the internode. The crude cell wall fraction of the dry weight also increases greatly and there is a direct relation between internode volume and amount of cell wall. Similar results were reported by Monselise and Halevy (1962) in citrus.

Root characters:

The maximum seedling root length was recorded (Table 2) in treatment GA_3 300 ppm concentration (40.50 cm) and which was at par with GA_3 200 ppm and minimum height was recorded in control (26.67). The increase in root length may be due to influence of GA_3 on different plant parts, which could be due to its effect in stimulating cell division, cell elongation, auxin metabolism, cell wall plasticity and permeability of cell membrane leading to enhanced growth in the root. The maximum fresh (8.60 g) and dry weight (4.60 g) of roots was noticed in the treatment GA_3 300 ppm whereas, minimum fresh (4.95g) and dry (2.10 g) weight of roots was noticed in water spray (control). The application of GA_3 accelerates the translocation and assimilation of auxins, reasons for better root growth and vegetative characters are due to the overall assimilation and redistribution of materials with in plants enhance the growth attributes Pandiyan *et al*.(2011).

Number of days taken for attaining graftable size:

The minimum number of days (137.73) taken to reach graftable size (2.04 cm) was recorded in GA_3 300 ppm which was at par with GA_3 200 ppm (146 days) whereas, maximum number of days (209 days) taken to reach graftable size (2.04 cm) was noticed (Table 2) in water spray. The minimum number

Table 1 : Effect of foliar application of growth regulators and macronutrients on seedling growth of tamarind

Treatments	Seedling height (cm)				Seedling collar girth (cm)				Number of leaves per plant			
	30DAS	60DAS	90 DAS	120DAS	30DAS	60DAS	90 DAS	120DAS	30DAS	60DAS	90 DAS	120DAS
T_1	18.10	22.63	27.73	30.83	0.63	0.83	0.94	1.25	13.60	20.70	25.70	31.03
T_2	24.93	31.70	37.63	43.70	0.92	1.20	1.49	1.85	23.53	32.50	41.00	49.50
T_3	27.47	35.86	41.76	48.20	0.93	1.31	1.73	2.09	25.13	36.00	44.00	53.00
T_4	30.40	37.51	45.75	50.57	0.95	1.43	1.78	2.18	28.13	40.50	49.50	60.50
T_5	19.10	24.60	29.74	33.33	0.83	1.01	1.33	1.75	18.93	25.60	31.60	39.60
T_6	21.41	28.33	33.41	37.45	0.87	1.01	1.38	1.84	19.47	27.50	32.20	40.20
T_7	23.80	29.60	33.78	38.60	0.90	1.03	1.40	1.85	20.40	28.00	35.00	43.20
T_8	20.47	24.47	29.54	34.37	0.84	1.00	1.42	1.76	20.00	25.00	31.03	38.17
T_9	21.83	26.96	30.93	34.90	0.92	0.99	1.36	1.69	14.60	23.70	30.07	40.00
T_{10}	20.56	27.40	33.47	39.17	0.89	1.01	1.41	1.62	22.53	32.17	39.00	44.20
T_{11}	25.60	31.56	36.57	42.60	0.89	1.00	1.37	1.69	25.47	31.00	37.20	48.30
T_{12}	23.80	29.63	34.64	39.80	0.90	1.05	1.38	1.68	20.73	30.67	35.41	45.03
T_{13}	26.90	32.43	35.50	38.00	0.91	1.08	1.39	1.77	22.23	32.20	38.30	49.10
T_{14}	19.40	24.13	29.27	33.40	0.84	0.98	1.33	1.54	20.10	28.33	33.00	37.40
T_{15}	21.73	26.13	30.33	35.45	0.84	1.01	1.36	1.57	22.33	30.20	34.50	41.50
F test	*	*	*	*	*	*	*	*	*	*	*	*
S.E.±	1.11	1.45	1.50	1.65	0.03	0.04	0.05	0.08	1.03	1.26	1.17	1.77
C.D. (P=0.05)	3.22	4.21	4.34	4.77	0.08	0.13	0.15	0.25	3.00	3.65	3.38	5.13
CV	8.38	8.74	7.66	7.40	6.16	7.86	6.78	8.85	8.51	7.40	5.66	6.99

* significant, DAS- Days after sowing

Table 2 : Effect of foliar application of growth regulators and macronutrients on biomass, root length and number of days taken to attain graftable size of tamarind

Treatments	Fresh weight		Dry weight of		Root length (cm)	Number of days taken to attain graftable size
	Shoot (g)	Root (g)	Shoot (g)	Root (g)		
T_1	14.63	4.95	4.67	2.10	26.67	209.00
T_2	24.10	7.27	8.00	3.00	33.00	170.40
T_3	26.10	7.73	8.40	3.47	36.17	146.00
T_4	29.00	8.60	9.25	4.60	40.50	137.73
T_5	16.95	6.47	5.40	2.77	27.00	183.00
T_6	20.10	7.00	6.75	2.91	29.83	171.60
T_7	21.10	7.20	6.98	3.10	33.00	173.00
T_8	18.20	6.07	5.96	2.49	29.00	180.30
T_9	18.90	6.73	6.00	2.63	31.00	187.26
T_{10}	22.98	7.10	7.50	2.10	29.50	191.80
T_{11}	23.15	7.15	7.89	2.53	33.00	183.70
T_{12}	22.34	6.33	7.20	2.97	34.00	176.80
T_{13}	23.00	7.20	7.60	2.97	34.17	186.00
T_{14}	17.30	6.53	5.90	2.53	26.87	200.20
T_{15}	19.50	6.80	6.62	2.77	29.50	196.40
F test	*	*	*	*	*	*
S.E.±	1.00	0.54	0.43	0.14	1.52	7.34
C.D. (P=0.05)	2.88	1.58	1.24	0.43	4.39	21.21
CV	8.18	13.8	10.73	9.01	8.36	6.92

* significant

of days taken to reach graftable size may be due to various growth parameters induced by the gibberllic acid. The promotion of growth either in terms of increase in plant height or the stem girth and leaf number may be attributed to increased plasticity of the cell wall followed by hydrolysis of starch to sugars which lowers the water potential of cell, resulting in the entry of water into the cell causing elongation. These osmotic driven responses under the influence of gibberellins might have attributed for increase in photosynthetic activity, accelerated translocation and efficiency of utilizing photosynthetic products, thus resulting in increased cell elongation and rapid cell division in the growing portion (Sargent, 1965) increased the girth of the seedling and attaining graftable size at an early days.

Conclusion:

From the present investigation, it was concluded that the maximum seedling height, stem girth, fresh weight and dry weight was noticed in the treatment GA_3 300 ppm at 120 days after spraying. Foliar spray with GA_3 300 ppm recorded the maximum number of leaves at all the 30, 60, 90 and 120 days after spray. Whereas, minimum values were noticed for all the characters in water spray (control).

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