RESPONSE OF TAMARIND (*TAMARINDUS INDICA*) TO PRESOWING SEED TREATMENT WITH GROWTH STIMULANTS

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VANANGAMUDI, K. & VANANGAMUDI, M. 2003. Response of tamarind (*Tamarindus indica*) to presowing seed treatment with growth stimulants. An investigation was carried out to study the effect of presowing seed treatment with seven growth stimulants on germination and seedling growth of tamarind (*Tamarindus indica*). The growth stimulants evaluated were IBA 100 ppm, IAA 100 ppm, $ZnSO_4$ 2%, succinic acid 1%, KCl 1%, KH_2PO_4 3% and cow's urine 50/50 v/v. The unsoaked seeds served as the control. Two growth stimulants (IAA and succinic acid) proved superior to the others in enhancing the germination and seedling vigour. Soaking in IBA 100 ppm improved the shoot and root lengths and dry weight better than the other treatments. The leaf area was maximised by cow's urine. The chlorophyll and soluble protein contents were more for seeds soaked in KCl 3%.

Key words : *Tamarindus indica* - growth stimulants - germination - seedling - chlorophyll - soluble protein

VANANGAMUDI, K. & VANANGAMUDI, M. 2003. Tindak balas pokok asam jawa (*Tamarindus indica*) terhadap rawatan biji benih prasemaian dengan perangsang pertumbuhan. Kajian dijalankan untuk mengetahui kesan rawatan biji benih prasemaian dengan tujuh perangsang pertumbuhan terhadap percambahan dan pertumbuhan anak benih asam jawa (*Tamarindus indica*). Perangsang pertumbuhan yang dinilai ialah IBA 100 ppm, IAA 100 ppm, $ZnSO_4$ 2%, asid suksinik 1%, KCI 1%, KH_2PO_4 3% dan air kencing lembu 50/50 v/v. Biji benih yang tidak direndam bertindak sebagai pengawal. Dua perangsang pertumbuhan (IAA dan asid suksinik) didapati lebih unggul berbanding yang lain dalam menambahkan percambahan biji benih dan kecergasan anak benih. Rendaman di dalam IBA 100 ppm menunjukkan keputusan lebih baik dalam memanjangkan akar dan pucuk dan menambahkan berat kering berbanding rawatan lain. Luas daun dimaksimumkan oleh air kencing lembu. Biji benih yang direndam dalam KCI 3% menghasilkan lebih banyak klorofil dan kandungan protein boleh larut.

Introduction

The forest zones of India occupy about 22% of the geographical area and a recent aerial survey indicated that only about 12% is functional forest area. The rest can be assumed as non-productive, degraded forest land. The remote sensing data show fast depletion of forest cover. This is of great concern to the environmentalists and scientists. Hence afforestation on a large scale must be taken up.

A major limiting factor in the afforestation of wastelands is drought stress after transplanting. Success can be increased with proper utilization of growth stimulants and growth regulators by promoting root growth. Growth regulators and growth stimulants have been extensively used in forestry to enhance the development of seedlings under nursery conditions (Nayital *et al.* 1993, Kumaran *et al.* 1996) because of their role in promoting root growth and internal differentiation including initiation of cambial activity and xylem differentiation (Wareing *et al.* 1964). Therefore, a study was conducted to examine the response of tamarind (*Tamarindus indica*) seedlings to presowing seed treatment with growth stimulants.

Materials and methods

Seeds of tamarind were scarified in concentrated H_2SO_4 for 15 min and then soaked for 12 h in growth stimulants, viz. indole butyric acid (IBA) 100 ppm, indole acetic acid (IAA) 100 ppm, zinc sulphate ($ZnSO_4$) 2%, succinic acid 1%, potassium chloride (KCl) 1%, potassium dihydrogen phosphate (KH_2PO_4) 3% and cow's urine 50/50 v/v. Unsoaked seeds served as control. Soaked seeds were shade dried for an hour and sown in 10 × 15 cm size polybags filled with nursery soil mixture, which consisted of red soil, sand and farmyard manure (FYM) (2:1:1). The experiment was set up in a completely randomized design with four replications. Each replication comprised 50 polybags.

The seedlings were counted on the 30th day after sowing and expressed in percentage (ISTA 1993). At 30, 90 and 150 days after sowing (DAS), five seedlings in each replication were selected at random and observed for shoot and root lengths, total dry weight, total leaf area (LICOR model LI 3000 leaf area meter), total chlorophyll content (Yoshida *et al.* 1971) and soluble protein (Lowry *et al.* 1951). Vigour index was computed as the integral of the seedling length × germination percentage (Abdul-Baki & Anderson 1973). The data were subjected to statistical analysis following Panse and Sukhatme (1967).

Results and discussion

Of the growth stimulants examined, three (IAA, succinic acid and KH_2PO_4) produced the best germination and vigour in *Tamarindus indica* (Table 1). Several chemicals and growth regulators, known to enhance germination, have been documented (Brahman 1995, Masilamani & Dharmalingam 1995). Increased germination and vigour brought about by soaking the seeds in 2% KH_2PO_4 have also been reported in *Azadirachta indica* (Kumaran *et al.* 1996).

Chemicals and growth regulators enhance germination mainly by exerting their antagonising effect on the inhibitors present in the dormant seed (Khan 1977). They may cause an increase in cytochrome activity or enhance the rate of metabolism during germination (Verma & Tandon 1988) and they also easily penetrate the seed at their optimum concentrations and are available at the site of action (Tinus 1982). Auxins are critical in the germination of *Thyrsostachys siamensis* and *Dendrocalmus strictus* because of their effect on cell elongation (Richa & Sharma 1994). The promoting effect of auxins on germination may be attributed to their indirect effect on membrane permeability, solubilization of carbohydrates through synthesis of different enzymes and production of some precursors needed for germination. The auxins may exert their primary effect on the cell wall and change subcellular protein concentration.

The longest combined lengths of shoot and root were recorded with cow's urine, followed by IBA and KH_2PO_4 (Table 1). This is in general agreement with the findings of Brahman (1995) in *Enterolobium cyclocarpum* and Sivagnanam (1995) in *Azadirachta indica*. Wareing and Phillips (1970) reported that auxins influence stem elongation significantly. According to Davis (1973), there are two stages in the action of auxin. The first stage is an immediate cell elongation through the breaking of acid liable bonds within the polysaccharide matrix of the cell wall; the second stage is protein synthesis. Increased root length and shoot length due to potassium may be ascribed to the production of osmoticum; osmoticum in root cell sap enables the plant to absorb more water and nutrients from the soil. The auxins present in cow's urine may induce shoot and root growth. The beneficial effect of cowdung solution was also reported by Palani *et al.* (1995) in *Acacia nilotica.*

Table 1 Influence of growth stimulants on germination, vigour index, shoot and root lengths in *Tamarindus indica*

Growth stimulant	Germination (%)	Vigour index	Shoot length (cm)			Root length (cm)		
			30 DAS	90 DAS	150 DAS	30 DAS	90 DAS	150 DAS
IBA	64.5 (53.4)	2883	19.9	24.0	25.6	31.4	34.8	41.9
IAA	85.5 (68.0)	3604	17.2	19.8	22.6	31.4	30.2	41.9
$ZnSO_4$	44.8 (42.0)	1889	12.8	18.3	24.1	25.1	31.6	36.6
Succinic acid	84.0 (66.5)	4150	18.1	21.3	23.1	29.6	34.3	34.1
KCl	72.0 (58.2)	3096	18.8	20.7	26.6	24.8	30.5	35.3
KH_2PO_4	84.5 (67.0)	3368	17.0	22.7	27.2	24.0	37.9	40.0
Cow's urine	70.5 (57.1)	3225	17.2	24.0	26.3	22.9	32.9	42.4
Control	75.0 (60.2)	3145	16.7	19.4	27.9	29.0	33.3	36.4
SEd	2.64	193		0.84			1.62	
CD (p=0.05)	5.44	400		1.67			3.24	

(Figures in parentheses indicate arc sine values).

SEd = standard error deviation
CD = critical difference
DAS = days after sowing

Cow's urine 50/50 v/v and IBA 100 ppm increased the leaf area (Table 2). Several researchers have demonstrated the positive effect of growth regulators and chemicals on leaf area (Sivagnanam 1995). Extension of leaf surface area is brought about by phytochrome, the production of which is stimulated by an additional supply of growth regulators. The auxins present in cow's urine might have induced the increment in leaf area. In the present investigation, the increased plant growth attributes caused by the various growth stimulants also confirm the above assertions.

IBA 100 ppm gave generally the highest shoot and root dry weights, followed by IAA 100 ppm (Table 2). Similar increases due to auxin application were recorded in *Pinus caribea* (Bhatnagar & Singh 1981), *Dendrocalamus strictus* and *Tectona grandis* (Mishra & Mishra 1984), and *Madhuca latifolia* (Singh *et al.* 1984). The relative increase in dry matter may probably be due to the direct correlation with the growth and development of the root system as well as the uptake and accumulation of mineral nutrients (Talwar & Bhatnagar 1978). Gurumurthi *et al.* (1974) noted the allosteric nature of IAA oxidase and the oxidising products of IAA oxidase that cause a physiological response leading to the accumulation of more photosynthates and nutrients.

Table 2 Influence of growth stimulants on leaf area, shoot dry weight and root dry weight in *Tamarindus indica*

Growth stimulant	Leaf area (cm^2 $plant^{-1}$)			Shoot dry weight (g $plant^{-1}$)			Root dry weight (g $plant^{-1}$)		
	30 DAS	90 DAS	150 DAS	30 DAS	90 DAS	150 DAS	30 DAS	90 DAS	150 DAS
IBA	102.2	127.9	170.0	0.30	0.41	1.04	0.29	0.45	1.91
IAA	47.1	58.0	73.7	3.30	0.33	0.94	0.47	0.71	1.47
$ZnSO_4$	43.5	51.3	64.9	0.19	0.32	1.16	0.28	0.41	1.46
Succinic acid	51.9	62.6	79.9	0.36	0.46	0.81	0.57	0.66	1.17
KCl	79.2	98.1	112.8	0.30	0.34	1.02	0.28	0.65	1.38
KH_2PO_4	36.1	43.0	53.4	0.22	0.42	0.67	0.28	0.56	1.15
Cow's urine	103.0	121.0	176.9	0.24	0.35	0.94	0.39	0.56	1.57
Control	39.2	59.9	80.0	0.21	0.34	0.68	0.29	0.56	1.06
SEd		2.97			0.028			0.025	
CD (p=0.05)		5.93			0.056			0.051	

SEd = standard error deviation
CD = critical difference
DAS = days after sowing

At 150 DAS, seeds soaked in 2% ZnSO4, and at 90 DAS, seeds soaked in 3% KCl, produced seedlings with higher chlorophyll contents than those of other treatments and the control (Table 3). The IBA treatment also gave a high chlorophyll content at 150 DAS. Increased chlorophyll content due to growth promotors like IBA can be attributed to the faster rate of synthesis of chlorophyll pigment than the degradation effect of chlorophyllase (Lee *et al.* 1986). Potassium and other salt solutions also have a similar effect on promoters, possibly due to the increased supply of K and increased photoreduction and photophosphorylation

in the plants (Pflüger & Mengel 1972). Peoples and Koch (1979) reported that potassium promoted CO_2 fixation by direct activation of RUBP carboxylase thereby favouring synthesis of chlorophyll.

The soluble protein content was highest in the KCl treatment followed by the IAA 100 ppm treatment (Table 3). Increased soluble protein contents due to potassium were observed by Sale and Campbell (1986) in many agricultural crops. The enhancement of reserved starch and chlorophyll contents could also be responsible for increased soluble protein content.

The study clearly brings out the advantages of soaking tamarind seed in solutions of growth stimulants, viz. IAA ppm, succinic acid 1% and IBA 100 ppm. Soaking of seed in cow's urine 50/50 v/v increased the leaf area. KCl 3% improved the total chlorophyll and soluble protein contents. Therefore, soaking in growth stimulants of tamarind seed prior to sowing is recommended to increase the field survival of the seedlings.

Table 3 Influence of growth stimulants on total chlorophyll and soluble protein contents in *Tamarindus indica*

Growth stimulant	Total chlorophyll (mg g^{-1})			Soluble protein (mg g^{-1})		
	30 DAS	90 DAS	150 DAS	30 DAS	90 DAS	150 DAS
IBA	0.87	1.22	2.30	0.76	1.36	2.15
IAA	0.72	1.31	2.07	1.21	2.34	3.07
$ZnSO_4$	0.86	1.30	2.53	0.43	0.99	1.82
Succinic acid	0.93	1.39	1.96	0.98	1.53	2.46
KCl	0.91	1.83	1.96	1.63	2.54	3.43
KH_2PO_4	0.74	1.05	2.19	0.65	1.20	1.95
Cow's urine	0.62	1.54	2.34	0.85	1.84	2.67
Control	0.85	1.47	2.05	0.69	1.32	2.10
SEd		0.061			0.082	
CD (p=0.05)		0.123			0.163	

SEd = standard error deviation
CD = critical difference
DAS = days after sowing

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