EFFECTS OF GROWTH REGULATORS ON SEED GERMINATION AND SEEDLING GROWTH OF NEEM (*AZADIRACHTA INDICA*)

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KUMARAN, K., PALANI, M., JERLIN, R. & SURENDRAN, C. 1994. Effets of growth regulators on seed germination and seedling growth of neem (*Azadirachta indica*). The effects of GA (gibbrerellic acid), indole acetic acid (IAA), kinetin (KN) and chloro-choline-chloride (CCC) at 200 *ppm* and 400 *ppm* concentrations on seed germination and seedling growth of *Azadirachta indica* were determined. Seeds were soaked in the solutions for 24 and 48 *h* and water soaked seeds served as control. Results indicated that the germination was enhanced by KN, with the highest germination at KN-200 *ppm*. The seedling growth in terms of root length, shoot length and number of leaves was greatly enhanced by CCC, the effect being higher at 400 *ppm* concentration and 48 *h* soaking period.

Keywords: Neem seeds - growth regulators - soaking - germination - seedling growth

KUMARAN, K., PALANI, M., JERLIN, R. & SURENDRAN, C. 1994. Kesan pengatur tumbesaran pada percambahan bijibenih dan tumbesaran anak benih neem (*Azadirachta indica*). Kesan GA (*asid giberelik*) , asid asetik indola (IAA), kinetin (KN) dan kloro-kolin-klorida (CCC) dengan kepekatan 200 *ppm* dan 400 *ppm* pada percambahan biji benih dan tumbesaran anak benih *Azadirachta indica* telah ditentukan. Bijibenih *Azadirachta indica* telah direndam selama 24 dan 48 jam. Bijibenih yang direndam di dalam air dijadikan kawalan. Keputusan yang diperolehi menunjukkan bahawa kinetin (KN) mempertingkatkan percambahan. Percambahan yang tertinggi diperolehi dengan kinetin (KN) pada kepekatan 200 *ppm*. Pertumbuhan anak benih dari segi panjang akar, panjang pucuk serta bilangan daun amat dipertingkatkan dengan penggunaan CCC. Kesan yang lebih tinggi diperolehi dengan CCC pada kepekatan 400 *ppm* setelah direndam selama 48 jam.

Introduction

Native to the Indo-Pakistan sub-continent, neem (*Azadirachta indica* A. Juss) has aesthetic, insecticidal, medicinal, energy and timber values. The oil extracted from the kernel is used in soap manufacture and as an illuminant in villages. The important use of this species is due to the presence of azadirachtin, an active ingredient of margosan, a bio-pesticide marketed in the United States. Neem cake, the residue obtained after extraction of the oil, is an excellent organic fertilizer and soil conditioner. Neem bark contains 12-14% tannin which is comparable in quality with other sources of conventional tanning chemicals. Seed germination and seedling growth are known to be regulated by exogenous harmones (Khan 1977, Verma & Tandon 1988). Exogenous applications of growth regulators have marked

influence on both these phenomena. Much attention has been paid by various workers (Mehrotra *et al.* 1968, Singh & Murthy 1987, Virendra Singh 1990) to the application of growth substances and their effect on seed germination and seedling growth of various plants. However, similar research is absent in neem and hence the effects of four growth regulators on its seed germination and seedling growth were studied in an attempt to improve them.

Materials and methods

Neem seeds were collected from the 20-*y*-old germplasm maintained at the Forest College and Research Institute, Mettupalayam (11°19'N,76°56'E; 300 *m.* a.s.l.) The seeds were surface sterilized with 0.1% $HgCl_2$ for 3 *min* and thoroughly washed with distilled water. Subsequently the seeds were soaked completely in 200 and 400 *ppm* solutions of gibberellic acid (GA), indole acetic acid (IAA), kinetin (KN) and chloro-choline-chloride (CCC) for 24 and 48 *h* at room temperature. Seeds soaked in water served as control. The soaked seeds were sown on raised nursery beds in a randomised block design with four replications of 25 seeds per replication. Percentage germination was determined 21 days after sowing and root length (*cm*), shoot length (*cm*) and number of leaves were taken on one-month-old seedlings. The results were subjected to an analysis of variance and means tested (t-test) for significant differences (p = 0.01) after Panse and Sukhatme (1967).

Results and discussion

The data on seed germination and seedling growth in terms of root length, shoot length and number of leaves as influenced by different growth regulators at two concentrations and for two soaking periods are presented in Table 1. Results showed that all parameters were significantly different at the one per cent level for almost all the treatments.

Treating the seeds with KN-200 *ppm* was the only treatment that significantly increased the percentage germination in the 24 *h* soaking duration. GA at 400 *ppm* resulted in the least percentage germination when the soaking period was 24 *h*. The 48 *h* soaking treatment with 400 *ppm* had the least effect on germination, which was on par with the control. The low concentration of each of the growth regulators resulted in a significantly higher percentage germination than the high concentration except for treatment with IAA.

Root length was increased over the control by all the treatments of growth regulators for 24 *h*. Soaking for 48 *h* resulted in root growth similar to the control except for the IAA - 200 *ppm*, KN - 200 *ppm*, KN - 400 *ppm* and CCC - 400 *ppm* treatments which were greater. The longest shoot was induced by CCC treatment in both soaking periods, but the concentration response varied, *i.e.*, 200 *ppm* for 24 *h* and 400 *ppm* for 48 *h*. In both cases, these treatments also resulted in greater root length.

The pattern of treatment response with regard to number of leaves was similar to the response for shoot length. Soaking seeds in CCC was the most effective

Table 1. Germination percentage and seedling growth as affected by growth regulators

Treatment	24 *h*				48 *h*			
	Germination %	Root length (*cm*)	Shoot length (*cm*)	No. of leaves	Germination %	Root length (*cm*)	Shoot length (*cm*)	No. of leaves
Control	77.30^{bc} (61.59)	13.47^{i}	8.69^{hi}	5.07^{gh}	77.30^{de} (61.59)	15.55^{efghi}	14.81^{bcdefg}	13.2^{h}
GA-200 *ppm*	82.66^{b} (65.42)	16.15^{de}	10.68^{cdef}	5.20^{g}	86.67^{ab} (68.63)	16.61^{bcdef}	14.85^{bcdef}	18.2^{c}
GA-400 *ppm*	69.33^{cd} (56.38)	20.45^{bc}	10.41^{cdefg}	6.13^{de}	78.67^{cd} (62.51)	16.56^{bcdef}	15.39^{bcde}	16.18^{cdef}
IAA-200 *ppm*	82.66^{b} (65.42)	21.45^{b}	13.10^{b}	7.20^{bc}	86.67^{ab} (68.63)	17.74^{abc}	15.58^{bcd}	20.4^{b}
IAA-400 *ppm*	77.30^{bc} (61.59)	16.35^{d}	11.03^{cd}	7.40^{b}	81.33^{bc} (64.43)	16.15^{cdefg}	14.72^{bcdefghi}	17.6^{cd}
KN-200 *ppm*	96.00^{a} (80.68)	15.75^{defg}	11.26^{c}	6.40^{b}	89.33^{a} (71.01)	18.15^{ab}	16.27^{bc}	14.8^{g}
KN-400 *ppm*	77.30^{bc} (61.59)	15.52^{defgh}	10.70^{cde}	5.0^{ghi}	81.33^{bc} (64.61)	17.71^{abcd}	16.68^{ab}	17.4^{cde}
CCC-200 *ppm*	77.30^{bc} (61.59)	26.74^{a}	17.23^{a}	10.40^{a}	86.67^{ab} (68.63)	16.09^{cdefgh}	14.76^{bcdefghi}	16.8^{cdef}
CCC-400 *ppm*	82.66^{b} (65.42)	15.83^{def}	9.41^{gh}	6.07^{def}	77.30^{de} (61.59)	19.48^{a}	18.34^{a}	21.4^{a}
CD	7.85	1.72	1.09	0.67	5.41	1.98	1.99	0.83

Critical difference (CD) (p = 0.01);
Values in columns followed by the same lower case letter are not significantly different at the 1% level;
Figures in parentheses indicate transformed values.

treatment for increasing the number of leaves, but the concentration and time of soaking were inversely related.

Among the treatments, kinetin showed a positive influence on seed germination with the shorter soaking period being better than a longer duration. Seedling growth in terms of root length, shoot length and number of leaves was enhanced by CCC at the lower concentration for a shorter soaking duration and at the higher concentration for a longer soaking period.

Enhancement of germination has been reported in various species by various workers with respect to the influence of growth regulators such as IAA and KN in low concentration, GA at higher concentration and CCC at low concentration in *Cassia obtusifolia* (Singh & Murthy 1987); COU (coumanine), MH (malic hydrazide) and CCC in *Cassia sophera* (Thakur 1989); and IAA and IBA in *Picea smithiana* (Virendra Singh 1990). The effect of growth regulators on seedling growth was also reported by the same authors in the *Cassia* species.

Based on these results, it can be concluded that germination of *Azadirachta indica* was enhanced by kinetin at lower concentration and seedling growth was enhanced by CCC at both lower and higher concentrations. The effects of growth regulators on seedling survival and establishment after outplanting will be investigated in a further research.

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References

KHAN, A. A. 1977. *The Physiology and Biochemistry of Seed Dormancy and Germination.* Elsevier Scientific Publications Co. Amsterdam. 477 pp.

MEHROTRA, D.N., SAXENA, H.K., ROY, A. N. & SIVANATH. 1968. Effect of growth regulators on fruiting and yield of black gum. *Experimental Agriculture* 4 : 329 - 344.

PANSE, V. G. & SUKHATME, P.V. 1967. *Statistical Methods for Agricultural Workers.* 2nd edition. Indian Council of Agricultural Research (ICAR), New Delhi. 361 pp.

SINGH, C. & MURTHY, Y. S. 1987. Effect of some growth regulators on the seed germination and seedling growth of *Cassia obtusifolia. Acta Botanica Indica* 15 : 77 - 79.

THAKUR, C. 1989. Influence of different growth regulators on seed germination and seedling growth of *Cassia sophera. Acta Botanica Indica* 17: 187 - 191.

VERMA, A. N. & TANDON, P. 1988. Effect of growth regulators on germination and seedling growth of *Pinus kesiya* and *Schima khosiana. Indian Journal of Forestry* 11 : 32 - 36.

VIRENDRA SINGH. 1990. Influence of IAA and IBA on seed germination of spruce. *Indian Forester* 116 : 450 - 453.