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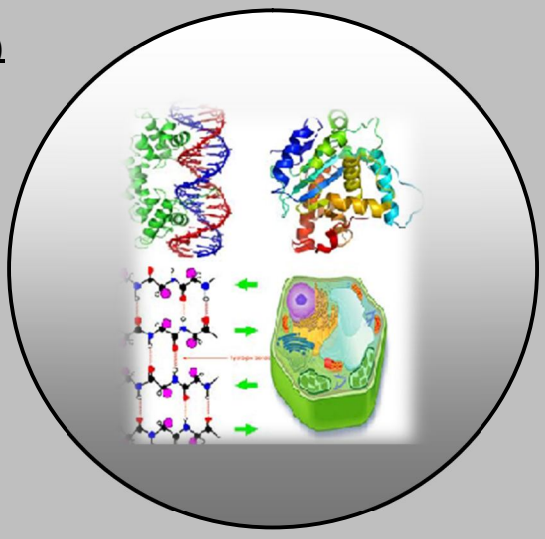

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Effect of Gibberellic Acid on Seed Germination and Seedling Growth Behaviour in Three Desert Tree Species

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ABSTRACT

We determined the effect of three concentrations of gibberellic acid on germination and seedling growth behavior of three species of desert region. Seed treatments consisted of G_1: Control (untreated seeds), G_2: 250 ppm, G_3: 500ppm and G_4: 750 ppm. Results showed that seeds treated with gibberellic acid achieved maximum germination and seedling dry weight especially in Acacia nilotica and Prosopis cineraria followed by Albizzia lebbeck. Minimum germination was recorded at untreated seeds. For all species, the effect of gibberellic acid is species dependent, rarely better than the control. This study has practical importance and could be recommended to farmers to achieve higher germination and uniform emergence under field conditions.
Keywords: Germination, Behavior, Dry weight and Emergence.

INTRODUCTION

Trees of the genera *Acacia nilotica*, *Albizzia lebbeck* and *Prosopis cineraria* are of central importance in the rural economy of many of the world's arid and semiarid areas. Species in these genera provide high quality animal fodder, timber, fuelwood, charcoal, gums and other products as well as contribute to soil stabilization and improvement through nitrogen fixation. In the past many regulatory substances have been tried to boost growth of various forest tree species with varying degrees of success. Of these growth regulatory substances gibberellic acid has been generally reported to stimulate growth of seedlings of many forest tree species (Seth and Mathauda, 1959, Nanda and Purohit 1964, Singh et al., 1984).

It may promote cell elongation, cell division and thus helps in the growth and development of many plant species. Gibberellic acid treatment can overcome dormancy in different seeds that have hard seed coat or dormant embryo. Seeds are the important means of artificial regeneration of these species but seed germination and speed of germination is not only erratic but also low takes more time to complete which results in prolong germination, irregular seedling growth and poor quality of the seedlings. Therefore, pretreatment of seeds for enhancing germination becomes imperative.

Thus, the present study was undertaken to find out effect of gibberellic acid on the seed germination in *Acacia nilotica* , *Albizzia lebbeck* and *Prosopis cineraria* and to test the hypothesis that seedling emerged from pretreated seeds perform differentially as compared to seedlings emerged from normal seed germination i.e without any pretreatment.

MATERIAL AND METHODS

Soil used in the experiment was sandy loam. The different concentrations, 250ppm, 500ppm and 750ppm of gibberellic acid were prepared and the seeds were soaked in solution of gibberellic acid for 24 hours in each of the concentrations. The germination study was initially conducted in petriplates in plant growth chamber with controlled environmental conditions. Each pretreatment had a control (i.e without any treatment) with the same number of seeds and replicates. Thereafter the two leaf stage pretreated germinated seedlings were sown in earthen glazed pots in a green house in the department of bioscience and biotechnology. For germination test, 300 seeds were exposed to each treatment and divided into four replications. The seeds were sterilized with 0.01% mercuric chloride solution for 5 minutes and then rinsed twice with distilled water before placing for germination test. The seeds were placed on moist filter paper in petriplates and kept in a plant growth chamber. Radical emergence was taken as the criterion of seed germination (Jann and Aman 1977). Germination counts were made daily after germination started till became constant. The data was subjected to analysis of variance following the Snedecor and Cochran (1967). The growth behavior of seedlings raised from such treated seeds was studied for six months. Germinated seedlings of the two species subjected to gibberellic acid pretreatment were sown directly in experimental earthern glazed pots at the rate of 10 seeds per pot.

The experiment was laid out in a randomized block design with three replicates. Survival percentage of the seedlings produced was recorded. Observation for growth parameters including plant height, stem diameter, number of leaves and leaf area were recorded monthly. With the help of the above data the following growth parameters i.e. specific leaf area and sturdiness were determined.

RESULTS AND DISCUSSION

Gibberellins are group of plant hormones which occur naturally in plants, GA3 treatment can overcome dormancy in different seeds that have hard seed coat or dormant embryo. In all the species survival percentage, height and total biomass increased after pretreatment with GA_3 relative to control.The result of the influence of gibberellic acid on seed germination and seedling growth behavior has been presented in Table 1.

Table 1. Percent survival and morphological parameters of the species after growth hormone pretreatment of seeds.

Tree species	Levels	Germination (%)	Height (cm)	Stem diameter (mm)	Leaf production	Leaf area (cm^2)	Root length (cm)	Root spread (cm)
A.lebbeck	G_1	60	25	4.11	586	0.99±0.010	29±1.019	3.3±0.102
	G_2	74	27	4.20	693	0.101±0.001	33±1.019	3.4±0.311
	G_3	89	32	4.35	910	1.03±0.006	36±2.121	3.6±0.212
	G_4	90	28	4.12	406	0.98±0.02	30±0.588	3.1±0.059
A.nilotica	G_1	80	34	3.42	1400	0.20±0.059	33±1.176	3.0±0.102
	G_2	90	49	4.07	1516	0.21±0.006	44±1.556	3.3±0.102
	G_3	92	50	4.75	1670	0.22±0.006	50±0.588	3.5±0.256
	G_4	89	52	4.98	2200	0.23±0.006	50±0.588	3.6±0.212
P.cineraria	G_1	84	27	3.60	985	0.19±0.01	44±1.556	3.1±0.059
	G_2	89	29	3.67	1000	0.20±0.059	46±1.556	3.3±0.102
	G_3	92	36	3.89	1120	0.21±0.006	49±1.019	3.4±0.311
	G_4	90	41	3.99	1573	0.22±0.006	52±1.176	3.5±0.256
SEM±		63.7	73.7	0.08				

SEM = Mean standard error

Table 2. Parameters based on dry mass of the species after growth hormone pretreatment of seeds.

Tree species	Levels	Root wt (g)	Shoot wt (g)	Total biomass (g)	Root: Shoot ratio	Leaf: Stem ratio	Specific leaf area ($cm^2\ g^{-1}$)	Height: Diameter ratio
A.lebbeck	G_1	13	16	29	0.813	0.778	0.141	6.083
	G_2	14	16	30	0.875	0.778	0.144	6.429
	G_3	16	19	35	0.842	0.900	0.114	7.356
	G_4	13	12	31	0.722	0.800	0.196	6.796
A.nilotica	G_1	15	16	31	0.938	0.778	0.027	9.942
	G_2	16	19	35	0.842	0.900	0.023	12.039
	G_3	20	23	43	0.869	0.769	0.022	10.526
	G_4	23	26	49	0.885	0.857	0.019	10.442
P.cineraria	G_1	15	15	28	1.154	0.857	0.031	7.500
	G_2	17	14	32	1.286	0.750	0.033	7.901
	G_3	20	17	37	1.176	0.818	0.042	9.254
	G_4	21	19	40	1.105	0.900	0.024	10.276

The seeds treated with gibberellic acid for 24 hrs resulted in maximum seed germination of 92% in 500ppm in *Acacia nilotica* and *Prosopis cineraria* species while minimum 60% were recorded in control. Gibberellic acid pretreatment increased all the growth parameters of the three species. The growth parameters of *Acacia nilotica* and *Prosopis cineraria* increased upto G_4 level while in case of *Albizzia lebbeck* growth parameters increased upto G_3 level. Highest height growth and leaf production was observed in *Acacia nilotica* (52 cm, 2200 respectively) at G_4 level. Height growth and stem diameter was positively correlated to GA_3 levels in all the three species.

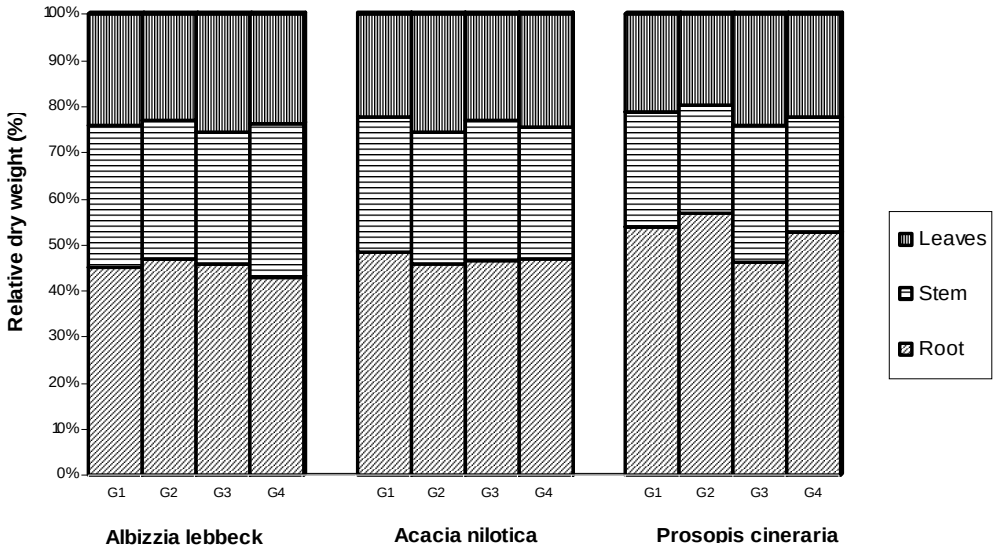

Figure 1. Proportional allocation of biomass of the species into different components at different levels of growth hormone pretreatment of seeds.

In case of *Prosopis cineraria* the correlation for height growth and stem diameter was significant and for *Acacia nilotica* only for stem diameter at $p<0.05$. Analysis of variance for height growth and stem diameter under different levels indicated significant difference between treatments, species and their interactions at 0.05.The highest root length value was observed in *Prosopis cineraria* seedlings (52cm) when high GA_3 pretreatment of seeds was done and lowest in *Albizzia lebbeck* (29cm) at the untreated level. Comparison between the three species showed that the highest total biomass value was observed in *Prosopis cineraria* (28g) at G_1 level (Table 2). The proportional allocation of biomass into different components under different gibberellic acid levels is depicted in Fig 1. In *A.lebbeck* proportional allocation of biomass to root component decreased relative to stem, which increased at highest level of pretreatment.

The leaf component in *A. nilotica* increased relatively at higher levels of GA_3 pretreatment and in *P. cineraria* there was increase in allocation of biomass to root component at expense of stem at low level of GA_3 pretreatment.

Total biomass was positively correlated to GA_3 levels in all the species. The correlation was significant for *Acacia nilotica* and *Prosopis cineraria* at $p<0.05$ but insignificant for *Albizzia lebbeck* (Table 3). Analysis of variance for total dry weight under different GA_3 levels indicated significant difference between treatments, species and their interactions at $p< 0.05$. However, Krishnamorthy (1975) had reported that yield of seedlings of dry matter was not affected by GA_3 despite an increase in height. The increase in growth yield of the three species studied under high GA_3 level may be due to increased cell elongation, cell division and stem elongation, resulting in an increased plant growth. The findings with pretreatment of seeds are similar to observations of other investigations (Singh et al., 1984) who have reported that GA_3 enhances the growth of seedlings of several forest tree species.

Table 3. Regression equations between growth hormone levels and growth parameters of the species.

Tree species	Germination (%)	Height (cm)	Stem diameter (mm)	Total biomass (g)
A.lebbeck	Y=62.5+0.04X r=0.99* t=9.92	Y=25.9+0.001X r=0.61 t=1.09	Y=9.2+0.001X r=0.21 t=0.30	Y=29.6+0.004X r=0.54 t=0.91
A.nilotica	Y=83.4+0.01X r=0.70 t=1.38	Y=38+0.02X r=0.86 t=2.38	Y=3.5+0.002X r=0.98* t=6.96	Y=30.2+0.02X r=0.99* t=9.92
P.cineraria	Y=85.6+0.008X r=0.79 t=1.82	Y=25.9+0.02X r=0.98* t=6.96	Y=3.6+0.006X r=0.98* t=6.96	Y=27.3+0.02X r=0.97* t=5.64

Significant at 5% level of probability

CONCLUSION

The present study was undertaken to assess the effect of different concentrations of gibberellic acid treatment on germination and seedling growth behavior value in *Albizzia lebbeck*, *Acacia nilotica* and *Prosopis cineraria*. The results of the study clearly indicated that the seed germination and growth rate hastened to maximum by the application of 750ppm GA_3 for 24hrs indicated thereby that as the concentration increased, growth behavior increases. The maximum growth attributes value was obtained at 750ppm in *Acacia nilotica*.

The study clearly indicates that the seeds of *Acacia nilotica* and *Prosopis cineraria* should be treated with 750ppm GA_3 solution for 24 hrs while in *Albizzia lebbeck* it should be treated with 500ppm for 24hrs.

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