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Effect of Stratification and Gibberellic Acid on Seed Germination and Seedling Growth of *Cryptomeria japonica* (Linn. f.) D. Don.

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Abstract

The present study was carried out revealed that with the increase in stratification duration there was an significant increase in germination percent and seedling growth parameters upto 45 days, thereafter it decreased. Gibberellic acid concentration also affected the germination and seedling growth characteristics. The maximum germination of 82.0% was recorded when the seeds were treated with 300 ppm of GA_3 while maximum seedling growth parameters were recorded at 200 ppm of GA_3 solution. Therefore, 45 days stratification of seeds treated with 200 ppm GA_3 is recommended for obtaining maximum germination and seedling growth attributes in *Cryptomeria japonica.*

Key words : Stratification, Gibberellic acid, Germination, *Cryptomeria japonica,* Seedling growth.

The perspective planning in the forestry sector has laid down that by the end year 2000 AD, one third of the land in India should be under forest cover, but unfortunately the same has not been achieved so far. Our demands for timber, fuel wood and fodder are on an increase and we are unable to meet the demands of the growing population. Some of the reasons for not achieving the desired results are increased biotic interference, lack of proper management and silvicultural practices for a number of economically important species. *Cryptomeria* is a genus of conifer in the cypress family Cupressaceae formerly belonging to the family Taxodiaceae. It includes only one species, *Cryptomeria japonica.* The tree is endemic to Japan, where it is known a sugi. It is a large ever green tree with attractive foliage and introduced into India in 1844. In its native habitat it attains a height of about 45.7 m and a girth of 6—7.6 m. It is widely cultivated in Japan for timber and afforestation purposes. *Cryptomeria japonica* grows in western Himalayas, Shimla, Darjeeling, Assam, Nilgiris and generally in hill stations. It does not thrive so well in western Himalayas and Shimla as it does in regions farther east. In Darjeeling hills, where it has become naturalized, it grows luxuriantly between 213—219 m on moist soil (1). The tree is extensively used in forestry plantation in Japan and China and widely cultivated as an ornamental tree in other temperate areas including Jammu and Kashmir. The wood is scented, reddish pink in color, light weight but strong, water proof and resistant to decay. It is used in all types of construction and interior paneling.The tree is firmly wind tolerant and can be used in shelter belt planting.

Propagation of tree species through seeds is the most economical and practical but the problem in conifer seeds is that they have an inherent problem of slow and poor germination both in field and laboratory conditions (2,3). Conifer seeds are generally characterized by morphophysiological dormancy (4) and requires a treatment of cold stratification to produce sufficient level of enzymes, hormones, soluble metabolites and other compounds needed by the embryo for germination. Besides the application of plant bioregulators, such as gibberellin play a vital role in the regulation of germination and for the release of germination and for the release of dormancy. No such information is available concerning the effect of stratification and gibberellic acid on germination of *Cryptomeria japonica.* Therefore the present study was undertaken to find the suitable stratification period and gibberellic acid concentration for optimum germination and seedling growth in *Cryptomeria japonica.*

Methods

The seeds of *Cryptomeria japonica* were col-

Table 1. Effect of stratification on seed germination in *C. Japonica.*

Stratification duration (days)	Germination (%)
Control	62.50
15	69.00
30	74.50
45	83.50
60	78.00
CD at 0.05	2.24

lected in November 2006. The experiment was conducted at nursery of Faculty of Forestry nursery, Shalimar at an elevation of 1, 584 m a.s.l. Four batches of seeds were placed under sand at 2—3 C for stratification. Stratification was done for 15, 30, 45 and 60 days; 400 seeds in four replications i.e. 100 seeds per replication were taken from each treatment for germination test. Stratified seeds were finally treated with gibberellic acid at three different concentrations viz. 100, 200 and 300 ppm for 24 hours before being placed in seed germinator at 20 C. Germination count was done daily up to 28 days. Germination percent was calculated as the number of seeds germinated and the number of seeds sown and expressed in percent.

The stratified seeds were also sown in polybags in the nursery with three replications per treatment (150 poly bags per treatment per replication).The seedling growth parameters were recorded after the completion of one growing season. Biomass of the seedlings was calculated on fresh weight bases. The experiment was laid out both in laboratory and in nursery in completely randomized design.

Results and Discussion

The results of the effect of stratification and gibberellic acid on germination and seedling growth parameters are depicted in Tables 1 to 4. Table 1 and 2 show that germination percent and seedling growth parameters were significantly affected by strati fication duration. With the increase in stratification there was an increase in the germination percent and seedling growth characteristics up to 45 days, thereafter it decreased . The maximum germination of 83.50% was recorded in 45 days of stratification duration and minimum of 62.50% was recorded under control conditions (Table 1). Under nursery conditions maximum plant height 18.50 cm was recored when the seeds were stratified for 45 days and minimum of 11.20 cm was observed under control conditions. Collar diameter also showed the similar trend with maximum of 2.55 mm in 45 days of stratification duration which was statistically at par with 2.47 mm in seedlings, the seeds of which were stratified for 30 days. However, maximum shoot root ratio of 3.26 was observed in seedlings, the seeds of which were stratified for 30 days of duration which was statically at par with 3.20 under 45 days of stratification. The minimum shoot root ratio was recorded in control. Significant difference was observed in biomass per seedling and survival percent (Table 2). The maximum biomass per seedling of 4.70 g was recorded in 45 days of stratification and minimum of 3.09 g in control . The maximum survival of 79.0% was recorded in 45 days of stratification which was closely followed by 74.0% in 30 days of stratication. The minimum was again recorded in control.

The data on the effect of different concentrations of gibberellic acid on seed germination and seedling growth characteristics are presented in Table 2 and 4. The maximum germination of 82.00% was recorded in seeds treated with 200 ppm GA_3 for 24 hours which was statistically at par with 81.00% in

Table 2. Effect of stratification on seedling growth characters of *C. Japonica* in nursery.

Stratification (days)	Plant height (cm)	Collar diameter (mm)	Shoot-root ratio	Biomass/ seedling (g)	Survival percentage (%)
Control	11.20	2.10	2.07	3.09	60.0
15	12.80	2.18	2.18	3.18	65.0
30	15.30	2.47	3.26	3.40	74.0
45	18.50	2.55	3.20	3.70	77.0
60	16.00	2.42	3.74	3.90	68.0
CD at 0.05	0.90	0.09	0.28	0.52	1.82

Table 3. Effect of GA_3 on seed germination in *C. Japonica.*

GA_3 concentration (ppm)	Germination (%)
Control	62.50
100	70.00
200	81.00
300	82.00
CD at 0.05	1.60

seeds treated with 200 ppm GA_3 for 24 hours. The minimum germination of 62.50% was recorded in control (Table 2). Gibberellic acid concentration also affected the seedling growth parameters in nursery. The maximum plant height of 17.60 cm was recorded when the seeds were treated with 200 ppm GA_3 for 24 hours and minimum of 10.08 cm was recorded in control. The trend was almost similar for rest of the seedling growth attributes. The maximum collar diameter of 2.62 mm was recorded in 200 ppm GA_3 which was statistically at par with 2.55 mm in 300 ppm GA_3. Similarly, maximum shoot root ratio of 3.10 and biomass per seedling (4.50 g) was recorded in 100 ppm GA_3 respectively. However, maximum survival of 74% was recorded both in 200 and 300 ppm GA_3 solutions.

The results of the effect of stratification on *C. japonica* get support from the work of several other values. Radwan and Crouch (5) used stratification at 2 to 5 C for 4 months to break the embryo dormancy in *Cenothus sanguinus*. The stratified seeds of *Carpinus caroliana* for 18 months at 4.5 C resulted in 58.0% germination but the unstratified seed did not germinate (6). Singh (7) reported that 60 days stratified period resulted in an increase of 19.75% more germination than control . The improvement in seed germination may probably be associated to the increase in gibberellic acid level in the seed during stratification and subsequent transfer to germination chamber (8, 9) or as a result of an increase in cytokinin level (10). The results are also in conformity with Chandra and Chauhan (11) who reported gibberellic acid 500 ppm as best germination of spruce seed.

The increase in the seed germination and seedling growth characters with the increase in gibberellic acid concentration may probably be due to enhancement of hydrolase (especially amylase) synthesis. Alternatively it may first initiate the embryo growth as a result of which more gibberellic acid is synthesized by the growing embryo and then gibberellic acid induced hydro-base synthesis as suggested Chen and Varner (12).

Table 4. Effect of GA_3 on seedling growth characters of *C. Japonica* in nursery.

GA_3 concentration ppm	Plant height (cm)	Collar diameter (mm)	Shoot-root ratio	Biomass/ seedling (g)	Survival percentage
Control	10.80	2.10	2.12	3.10	59.0
100	14.90	2.16	2.32	3.20	63.0
200	17.60	2.62	3.10	4.50	74.0
300	16.20	2.55	2.68	4.10	74.0
CD at 0.05	1.02	0.12	0.30	0.38	0.80

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