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RESEARCH ARTICLE

Effects of different pre-sowing treatments on seed germination of the *Cassia javanica* L. var. *indoctiensis*

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SUMMARY: The experimental study was undertaken primarily to develop larger scale seedlings trees of *Cassia javanica* to the landscape of Botanic Garden of Indian Republic Noida and the process involved to break its seed dormancy. Three different experiments were conducted to determine the effect of various treatments such as growth regulators, acid scarification, surface sterilization, mechanical scarification, hot water, sulphuric acid and water soaking, on seed germination. In all the experiments, daily observations were recorded for 60 days after sowing. It was observed in experiment 1, that mechanical scarification resulted in better germination of *C. javanica* as compared to unscarified seeds. Whereas in experiment 2, seeds dipped in distelled water for 5 minute showed the highest germination ratio (20%). While in experiment 3, 21 per cent germination was observed in con. sulphuric acid scarification for 45 minute. Among various treatments applied resulted better germination in comparison to untreated seeds. It was observed that seed treatment is essential for overcoming dormancy in *Cassia* seeds since germination is influenced by various factors.

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Cassia is beautiful flowering tree which is moderately stress tolerant and widely grown as an ornamental tree in tropical/ sub-tropical areas of Indo-Malaya region. In a study to evaluate a large number of ornamental plants, it was found to be tolerant to extreme vagaries of the summer (Bhat and Al-Menaie, 1999). Its flowers are pleasantly fragrant also. Cassia are known as pink shower is flowering deciduous ornamental tree. Cassia is well known mainly for the landscaping attributes, tolerance to drought conditions and low maintenance requirements (Ghouse *et al.*, 1980). These characteristics qualifies Cassia for introducing in Delhi region and attempts have been made to introduce these trees to botanic garden conditions. However introduction of any plant into a new region requires thorough study with respect to its germinability and growth requirements and adaptability to particular climatic conditions. Cassia seeds usually exhibit seed coat imposed dormancy which may be due to impermeability of testa to water and gases (Rolston, 1978). The most common cause of delay in seed germination is the imperviousness of the seed coat *i.e.* blocking of water entry into the seed (Cavanagh, 1980). For germination to start, the impermeable seed coat must be rendered permeable. Hence, dormancy breaking treatment of Cassia seeds is of big importance and needs specific treatments for breaking seed dormancy (Nalawadi *et al.,* 1977; Ramamoorthy *et al.*, 2005). Therefore, in the present investigation, three experiments were conducted at Botanic Garden Seed Bank Laboratory for *C. javanica* with an objective to determine treatments that promote maximum germination and produce superior quality seedlings. In addition to this, another objective of the study was to establish changes if any, occurring in the seed coat which increases seed coat permeability and ensures availability of moisture in the embryo to trigger the process of germination.

EXPERIMENTAL METHODOLOGY

Experiment 1 :

Effect of surface sterilization, mechanical scarification and hot water treatment on germination :

Mature dry seeds of *C.javanica* were extracted from pods collected from BGIR woodland and individual seeds were weighed. Seeds having a weight < 0.20 g were denoted as light seeds and >0.20 -0.40 g were denoted as heavy seeds. To control any unwanted fungal infection during germination, seeds were surface sterilized in 0.05 per cent Bavistin for ten minutes. The treatments included mechanical scarification with sand paper and hot water treatment of light and heavy seeds of Cassia. There were 8 treatments with 20 seeds/ treatment for each species. Each treatment included 5 replications with 4 seeds/ replication. Forty seeds each of light and heavy seeds were scarified and the remaining 40 seeds were kept unscarified. Twenty seeds each from the mechanical scarified and unscarified seeds were treated with hot water at 65^0C for five minutes and the remaining half of the seeds were soaked in distilled water. The treatments were denoted as follows:

T_1 Light mechanical scarified distilled water (LSD)
T_2 Light unscarified distilled water (LUD)
T_3 Light unscarified hot water (LUH)
T_4 Light mechanical scarified hot water (LSH)
T_5 Heavy unscarified hot water (HUH)
T_6 Heavy mechanical scarified hot water (HSH)
T_7 Heavy mechanical scarified distilled water (HSD)
T_8 Heavy unscarified distilled water (HUD)

The beakers with the treated seeds were labeled as per the treatments done and kept at room temperature for 24 h. Then the seeds were transferred to 9 cm Petri dishes lined with moistened filter paper and were then wrapped in aluminum foil to prevent entry of any unwanted foreign residue to the treated seeds. The Petri dishes were kept in a germination chamber. The observations on the number of seeds germinated were recorded daily for a period of two months.

Experiment 2:

Effect of sulphuric acid treatment and water soaking on germination :

A randomized plots experimental design was adopted for the study. Six hundred seeds of the species were collected from botanic garden woodland. There were twelve treatments with five replications for each treatment and ten seeds were tested for each replication (one seed in each pot). The twelve pre-sowing seed treatment used in the experiment for *C. javanica* were as follows:

– The seeds were scarified with dilute H_2SO_4 for five minutes. After 5 min seeds were washed thoroughly in tap water to remove any trace of acid. Then the seeds were dipped into water at 21^0C and soaked for 24 (T_1), 48 (T_2) and 72 h (T_3).
– The seeds were scarified with H_2SO_4 for five minutes. After 5 min seeds were washed thoroughly in tap water to remove any trace of acid. Then the seeds were dropped into water at 50°C and soaked for 24 (T_4), 48 (T_5) and 72 h (T_6). - Seeds were dipped in distilled water for 5 min, then dipped into water at 21°C and soaked for 24 (T_7), 48 (T8) and 72 h (T_9).
– Seeds were dipped in distilled water for 5 min, then dipped into water at 50°C and soaked for 24 (T_{10}), 48 (T_{11}) and 72 h (T_{12}).

Experiment 3 :

***Effect of growth regulators and acid scarification on germination* :**

Gibberellic acid (GA) can act as a substitute for light and temperature and promote germination in several plants by overcoming seed dormancy. Immersion in concentrated sulphuric acid (H_2SO_4) has been successfully used as a means of scarifying impermeable seeds (Teem *et al.,* 1980). Hence, the objective of this experiment was to determine the effect of various concentrations of GA and H_2SO_4 scarification on germinability of cassia seeds. Two hundred and forty seeds each of *C. javanica* were subjected to different treatments which included acid scarification with concentrated H_2SO_4 for different time periods, hot water treatment, treatment with gibberellic acid and control (Table 1).

A completely randomized block design (CRBD) was adopted for the study. 30 seeds were tried in each treatment. Treated seeds were sown in 15-cm plastic containers in three replicates with 10 seeds for each replication. Daily observations were taken for the germination experiment for a period of two months from the date of sowing. Based on the data, germination percentages were assessed for various parameter/ germination technique.

EXPERIMENTAL FINDINGS AND DISCUSSION

The experimental findings of the present study have been presented in the following sub heads:

Experiment no. 1:

It is evident from the data in Table 1, among all treatments, seeds treated with light mechanically scarified hot water (LSH) significantly resulted in maximum germination (19%) and it was followed by treatment of mechanical scarified hot water treatment (HSW) in which germination percentage was 13 per cent. Seeds under treatment T_3, T_7 and T_{10} failed to germinate.

Experiment no. 2 :

Among the different treatments done for evaluating the

Table 1: Germination percentage of Cassia javanica seeds

Treatments	Treatments	Germination %
T_1	Light mechanical scarified distilled water (LSD)	9
T_2	Light unscarified distilled water (LUD)	8
T_3	Light unscarified hot water (LUH)	0
T_4	Heavy unscarified hot water (HUH)	4
T_5	Light mechanical scarified hot water (LSH)	19
T_6	Heavy unscarified distelled water (UDW)	8
T_7	Heavy mechanical scarified distilled water (HSD)	0
T_8	Heavy mechanical scarified hot water (HSW)	13
T_9	Control	4
	SEM =2.88	
	Standard error of mean = Significance at P? 0.01	

percentage of Cassia seeds. Treatment T_7 (seeds dipped in distilled water for 5 min and than dipped in water at 21^0C for 24 hrs) resulted in significantly maximum germination (20%) among all treatments. It was followed by T_6 and T_{10} where germination percentage of 15 and 14 was recorded, respectively . Seeds treated with T_4 and T_3 failed to germinate (Table 2) .

Experiment no. 3 :

It is evident from Table 3 that application of concentrated H_2SO_4 resulted significantly high germination in which germination percentage was 21 per cent (T_3) and 16 per cent was recorded in T_1which was statistically higher than any other treatments. These treatments were followed by T_6 and T_5, respectively .Seeds treated with conc H_2SO_4 for 3^o min. and 60 min. and under control treatment, failed to germinate.

Mechanical scarification resulted in better germination in heavy seeds compared to unscarified seeds. This may be due to the fact that mechanical scarification might have helped in physically breacking the impermeable layer in the seed coat allowing water and oxygen to enter the seeds and permit the embryo to overcome the mechanical restriction of surrounding tissues. This agrees with the results of Lopes *et al.* (1998) and Rai (1999) for *C. grandis* and *Caesalpinea ferrea*. Todaria and Negim (1992) also found that mechanical scarification was effective in breaking the dormancy of *C . javanica* seeds.

Among the different treatments studied, T_7 showed the highest germination ratio. The result is supported by an earlier study of Matias *et al.* (1973) and Bahrdwaj and Chakravarty (1994) which showed that soaking in water for 2 -48 h has helped to improve the seed germination of Acacia, Albizia and Pinus trees. Also, Kobmoo and Hellum (1984) have proved that hot water treatment is the quickest, cheapest and simplest method for breaking seed dormancy. This also agrees with

Table 2 : Germination percentage of *Cassia javanica* seeds

Treatments	Treatments	Germination %
T_1	H_2SO_4 Scarificaiton and soaking in water at 24 deg cel for 24 hrs	7
T_2	H_2SO_4 Scarificaiton and soaking in water at 24 deg cel for 48 hrs	5
T_3	H_2SO_4 Scarificaiton and soaking in water at 24 deg cel for724 hrs	11
T_4	H_2SO_4 Scarificaiton and soaking in water at 50 deg cel for 24 hrs	0
T_5	H_2SO_4 Scarificaiton and soaking in water at 24 deg cel for 48 hrs	6
T_6	H_2SO_4 Scarificaiton and soaking in water at 24 deg cel for 72 hrs	15
T_7	Seeds dipped in distilled water for 5 min and then dipped in water at 21 deg cel for 24 hrs	20
T_8	Seeds dipped in distilled water for 5 min and then dipped in water at 21 deg cel for 48hrs	10
T_9	Seeds dipped in distilled water for 5 min and then dipped in water at 21 deg cel for 72 hrs	3
T_{10}	Seeds dipped in distilled water for 5 min and then dipped in water at 50 deg cel fo24 hrs	14
T_{11}	Seeds dipped in distilled water for 5 min and then dipped in water at 50 deg cel for 48 hr	7
T_{12}	Seeds dipped in distilled water for 5 min and then dipped in water at 50 deg cel for 72 hr	8
T_{13}	control	0
	SEM =4.78	
	Standard error of mean = Significance at P≤0.01	

Table 3: Germination percentage of *Cassia javanica* seeds

Treatments	Treatments	Germination %
T_1	Concentrated H_2SO_4 scarification for 15 min.	16
T_2	Concentrated H_2SO_4 scarification for 30 min.	0
T_3	Concentrated H_2SO_4 scarification for 45 min.	21
T_4	Concentrated H_2SO_4 scarification for 60 min.	0
T_5	Gibberellic acid (250 ppm) scarification for 24 hr.	8
T_6	Gibberellic acid (500 ppm) scarification for 24hr.	11
T_7	Control	0
	SEM =3.18	
	Standard error of mean = Significance at $P \leq 0.01\%$	

the findings of Maithani *et al.* (1991)

Among the treatments, the highest germination percentage (20%) was observed in T_3. Control plot yielded no germination, indicating the fact that *C.javanica* seeds require pre- sowing treatments for good germination.

Conclusion :

It was observed from the different germination experiments that almost all the pre- sowing dormancy breaking treatments resulted in better germination . Mechanical scarification and application of conc. H_2SO_4 and GA significantly resulted in better seed germination. For experiment 1, light mechanically scarified hot water treatment resulted in better germination. Regarding experiment 2, seed soaking in water (21^0 C) for 24 hr. showed the highest result and for experiment 3, H_2SO_4 scarification for 45 min. was the best which was followed by GA application. In addition to this above, three best treatments ensured better availability of moisture in the embryo therefore triggering the process of germination.

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