

Presowing Treatments on Germination and Seedling Growth of *Terminalia arjuna* in Terai Zone of West Bengal

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ABSTRACT An experiment consisting of two cutting intensity and nine different chemical treatments consisting of water and conc. H_2SO_4 were analyzed to study their effect on germination and growth of seedlings of *Terminalia arjuna* at Pundibari, West Bengal during May to October 2006. Significantly better germination was obtained when the seeds were heavily pinched or seed coat nearly removed and dipped in conc. H_2SO_4 for one minute, respectively. Significantly better initial seedling growth was also recorded with these treatments. Moreover interaction of these two treatments gave the highest germinability of 73.33 %.

Key words: *Terminalia arjuna*, pre sowing treatment, germination, seedling growth, cutting intensity

Arjun (*Terminalia arjuna*), a native to India, is a deciduous tree, naturally occurring throughout Central and South India extending towards North side. It has been considered as the best tree species complexes to breed Indian tasar silkworm (*Antheraea mylitta* D.). Besides they have also been extensively exploited in many other industries like timber, tannin, leather and medicine as reported by Singh *et al.* [1]. Arjun is also used as a road side plantation in many states of India. The seeds of Arjun have wings around its seed coat which impedes proper and good complete germination. To facilitate germination, the seed must be placed in favourable environmental conditions like adequate moisture supply, appropriate gaseous balance and optimum light. It has been reported that mechanical and chemical scarification through sulphuric acid, potassium nitrate and thiourea has been successfully attempted in many species [2] but no such attempts have been made for *T. arjuna* in terai region of West Bengal. Thus the present study was undertaken to standardize the cutting intensity, water and acid pre sowing treatments for proper and optimum germination and better seedling growth of *T. arjuna*.

MATERIALS AND METHODS

The experiment was carried out in nursery of Department of Forestry, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar. The experimental site is located at 26° 19'86" N latitude and 89°23'53" E longitude at an elevation of 43 meters above mean sea level with subtropical climate which lies in the terai region of West Bengal receiving average annual rainfall of 250-300 cm from South-West monsoon of which 80 per cent is received from June to August. The soil of the nursery was sandy to sandy loam with acidic reaction, low organic carbon, medium available nitrogen and phosphorus and high available potash.

About 20 trees of *T. arjuna* were marked out side of the university campus for seed collection. Hundred seeds were sown to note the germination daily in the nursery beds till the completion of the germination or up to twenty-one days whichever was earlier to obtain total number of germination for calculating the per cent germination based on method prescribed by ISTA [3]. The seeds producing five mm or longer radicals were counted as germinated. Initial

seedling growth parameters like shoot and root length, shoot and root diameter, shoot and root dry weight and root: shoot ratio were also recorded. The experiment was laid out in factorial randomized block design replicated thrice with a total of 18 pre sowing treatment combinations in which the cutting intensity i.e. slightly pinched with only wings removed (C_1 , plate) and heavily pinched or seed coat nearly removed (C_2 , plate) were combined with nine pre sowing treatments. The pre sowing treatments are cold water dip for 12 hours (T_1), hot water soak and subsequent cooling for 12 hours (T_2), cold water dip for 24 hours (T_3), hot water soak and subsequent cooling for 24 hours (T_4), boiling water soak for 2 minutes and subsequent cooling for 24 hours (T_5), boiling water soak for 4 minutes and subsequent cooling for 24 hours (T_6), conc. H_2SO_4 dip for 1 minutes followed by washing and soaking in cold water for 12 hours (T_7), conc. H_2SO_4 dip for 2 minutes followed by washing and soaking in cold water for 12 hours (T_8) and control or no pre sowing treatment (T_9). The cold water taken was in room temperature while hot water taken was in temperature of just human tolerance limit. The significance of results of the data was subjected to analysis of variance following Gomez and Gomez [4].

RESULTS AND DISCUSSION

Effect on germination

Cutting intensity: The intensity of cutting the seeds of Arjun significantly influenced its germination (Table 1). Seeds when heavily pinched or seed coat nearly removed (C_2) gave

better germination (48.76 %) than when slightly pinched with only wings removed (C_1) which gave 42.35 per cent germination only. Uniyal and Nautiyal [5] found that one of the major factors that impede germination is mechanical barrier due to the presence of hard seed coat which restricts the growing plumule to emerge out of the seed coat that imposes a high mechanical resistance on an often non dormant embryo or block water uptake or/and oxygen diffusion. Hilhorst [6] observed that removal of these restraints may enable germination to proceed. This explains better germination of Arjun when its seeds were subjected to treatment C_2 .

Chemical treatment

Germination of Arjun was significantly influenced by acid and water pre sowing treatments. The highest germination of 67.22 per cent was recorded when the seeds were treated with T_7 followed by T_8 which gave 60.00 per cent, T_6 (52.78 %), T_5 (46.11 %), T_4 (41.67 %), T_3 & T_2 (40.55 %), T_1 (31.67 %) and lowest with no pre sowing treatments (T_9) which gave only 24.45 per cent germination (Table 1). This clearly indicates that the acid treatment with sulphuric acid (T_7 & T_8) significantly resulted to overall better germination than when treated with boiling (T_6 & T_5) or hot (T_4 & T_2) or normal water (T_3 & T_1). However there is difference in significance of results when the seeds were subjected to different time of acid and water treatments and also in the intensity of temperature of the water used for treatment. Dipping the seeds for one minute in conc.

Table 1. Effect of cutting intensity and chemical treatment on germination of *Terminalia arjuna*

Cutting intensity	Chemical Treatment									Mean
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	
C_1	28.89 (30.01)*	38.89 (35.52)	40.00 (39.06)	40.00 (39.06)	44.44 (41.89)	44.44 (41.89)	61.11 (58.94)	55.56 (48.65)	27.78 (29.06)	42.35
C_2	34.44 (35.90)	42.22 (40.52)	41.11 (41.18)	43.34 (43.73)	47.78 (51.42)	61.11 (58.94)	73.33 (53.43)	64.44 (59.23)	31.11 (32.14)	48.76
Mean	31.67	40.55	40.55	41.67	46.11	52.78	67.22	60.00	24.45	

*Figures in parenthesis are ARC SIN values. C D p = 0.05; Chemical treatment (T) = 4.59 Cutting intensity (C) = 3.3-1 T x C = 5.99

sulphuric acid (T_7) gave significantly better germination than dipping the seeds in acid for two minute (T_8). This may be because of embryo damage by the acid when the seeds were dipped into it for more than one minute. Similar results were also reported by Mutha *et al.* [7]. Moreover dipping the seeds either for longer time in water or in water with higher temperatures gave significantly better germination than when seeds were dipped in water for shorter duration and low temperatures. Seeds when dipped in boiling water for four minutes (T_6) or hot water for 24 hours (T_4) or normal water for 24 hours (T_3) gave significantly better germination than when treated with boiling water for two minutes (T_5) or hot water for 12 hours (T_2) or normal water for 12 hours (T_1) respectively. Dipping the seeds in water facilitates germination by loosening the seed coat whereas higher temperature also has

similar effect in germination but in lesser time which explains the decreasing gradient in germination with boiling, hot and normal water. Such findings were also reported by Shukla *et al.* [8].

Effect on seedling growth

Cutting intensity: As heavily pinched seeds (C_2) resulted into significantly better germination, consequently this has led to significantly better root length, root diameter, root dry weight, shoot length, shoot diameter and shoot dry weight of Arjun as is evidenced from table 2. Better germination has led to quicker seedling development and establishment at initial stage which facilitated proper and quicker growth of the seedlings. However a higher root: shoot ratio was obtained when the seeds were lightly

Table 2. Effect of cutting intensity and chemical treatment on initial seedling growth of *Terminalia arjuna*

Treatment	Root length (cm)	Root diameter (mm)	Root dry weight (g)	Shoot length (cm)	Shoot diameter (mm)	Shoot dry weight (g)	Root: Shoot ratio
Chemical treatment							
T_1	20.58	3.45	2.49	45.83	3.95	8.55	0.29
T_2	21.50	3.60	2.54	47.33	3.97	8.90	0.28
T_3	21.25	3.67	2.69	49.83	4.29	9.03	0.28
T_4	23.58	3.79	2.77	51.83	4.46	10.30	0.27
T_5	24.87	3.88	2.81	55.42	4.54	10.40	0.28
T_6	25.75	3.97	2.87	57.33	4.64	10.75	0.28
T_7	30.33	4.63	3.18	63.08	5.19	13.15	0.24
T_8	29.33	4.53	2.99	59.92	5.19	12.65	0.24
T_9	16.83	2.63	2.15	37.92	3.61	7.25	0.30
C D p = 0.05	2.21	0.43	0.22	2.98	0.34	0.58	0.027
Cutting intensity							
C_1	22.99	2.96	2.56	45.83	3.66	8.51	0.30
C_2	24.57	4.63	2.88	58.28	5.19	11.70	0.25
C D p = 0.05	2.79	0.49	0.41	2.86	0.55	0.84	0.062

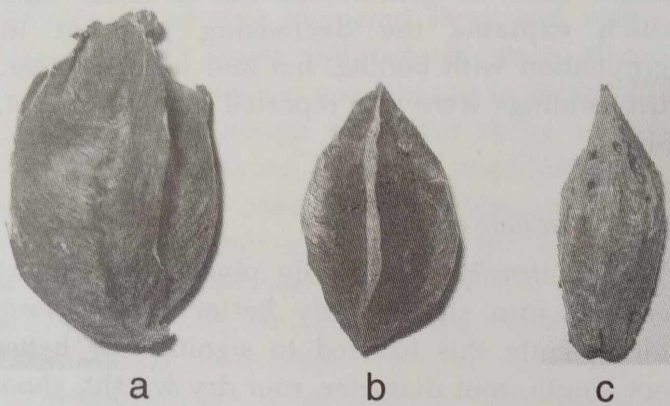


Fig. 1. (a) Normal *Terminalia arjuna* seed; (b) Slightly pinched seed with only wings removed and (c) Heavily pinched seed or seed coat nearly removed

pinched (C_1) as compared to C_2 though the difference was insignificant. Similar results were also reported by Shukla *et al.* [8].

Chemical treatment

All the seedling growth parameters were significantly higher when the seeds were treated with T_7 except root: shoot ratio than when treated with other acid and water pre sowing treatments (Table 2). The best growth parameters were recorded with T_7 followed by T_8 and lowest with T_9 i.e. with no pre sowing treatment whereas reverse was true for root shoot ratio. Such results can be explained by quicker seedling development and establishment due to better germination as was explained earlier. These findings are in conformity with those reported by Shukla *et al.* [8].

Interaction effects

The results also reveals that a combination of the best mechanical treatment i.e. heavy pinching of seeds and best chemical pre sowing treatment i.e. sulphuric acid one minute dip of seeds ($T_7 \times C_2$) gave significantly the best interaction effect (73.33%) and its difference was also significant with

all other treatment combinations of cutting intensity and chemical pre sowing treatments as far as the germination is concerned. Similar results have also been observed by Shukla *et al.* [8]. Thus it can be concluded that in Terai zone of West Bengal, proper and quicker germination of *Terminalia arjuna* can be ensured for better seedling development when the seeds are heavily pinched or seed coat nearly removed and then dipped for one minute in concentrated sulphuric acid, washed and subsequently dipped in cold water for 12 hours.

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