RESEARCH ARTICLE
Legume Research - An International Journal

Effect of Presowing Treatments on Seed and Seedling Quality Attributes of an Endemic Agroforestry Tree *Acacia nilotica subsp. cupressiformis* (J.L. Stewart) Ali and Faruqi

M.B. Noor mohamed, A.K. Shukla, R.S. Mehta, A. Keerthika, D.K. Gupta[1]

10.18805/LR-4601

ABSTRACT

Background: *Acacia nilotica var. cupressiformis* is an evergreen multipurpose leguminous tree species which is suitable to agroforestry purposes and mainly distributed in Western parts of Rajasthan in India particularly Pali and its adjoining areas. The species has many advantages, however the natural germination in wild is very limited due to its hard seed coat dormancy.

Methods: The experiment was conducted to study the effect of presowing treatment on seed coat of *A. nilotica var. cupressiformis* seeds with ten treatments in Completely Randomized Block Design at ICAR-Central Arid Zone Research Institute, Regional Research Station, Pali Marwar. The treatments were replicated thrice.

Result: Among the treatments, maximum germination and higher values was obtained in sand paper scarification with water soaking for 12hrs (T2) followed by mechanical scarification with sand paper (T1), acid scarification (50% for 20 min) (T7) and acid scarification (98% for 10 min) (T5). Further, the present study aims to initiate the research areas for conservation and utilization of *A. nilotica var. cupressiformis* in Western parts of Rajasthan and other parts of India.

Key words: *A. nilotica var. cupressiformis*, Germination, Presowing treatments, Seed.

INTRODUCTION

Acacia nilotica is one of the best multipurpose leguminous trees which belongs to the subfamily Mimosoideae of the family Fabaceae. It is indigenous to the Indian Sub-continent and also distributed in many countries. In India, it is distributed naturally in Maharashtra, Gujarat, Andhra Pradesh, Rajasthan, Haryana and Karnataka (Abhishek *et al.*, 2015). Though *A. nilotica subsp. cupressiformis* has also been reported from Punjab and Gujarat, in Rajasthan, it is endemic to the semi-arid region. Four of the nine recognized subspecies (*A. nilotica indica* (Benth.) Brenan, *A. nilotica subalata* (Vatke) Brenan, *A. nilotica cupressiformis* (J. Stewart) Ali and Faruqi and *A. nilotica adstringens* (Schumach. and Thonn.) Roberty) occur in India (Dwivedi 1993). Among them, *A. nilotica indica* is the most prevalent subspecies occurring throughout the country. Two subspecies (*A. nilotica indica* and *A. nilotica cupressiformis*) co-occur in Rajasthan in India.

A. nilotica var. cupressiformis is a tall evergreen tree with acute angle branching pattern which result into compact conical shape crown. This species is mainly distributed in western Rajasthan in India particularly in Pali and its adjoining areas. There is no shade effect on adjoining crops and it doesn't allow the birds or animals to build the nest in this tree due to its compact and narrow crown pattern. Ultimately it leads to less damage to the agricultural crops by birds and animals. This tree fulfills all the criteria of agroforestry such as leguminous tree, fast vertical growth, narrow crown, few branches, straight and clean bole, deep taproot system, and high proportion of main stem, loose canopy permitting transmittance of light and less interference with crop and adding nutrients to the soil. This characteristics of the tree leads to prefer to grow on agricultural lands. Besides to that the tree is used for live fencing, its pods are eaten by goats, its timber is used for making doors, cots, *etc*. and its branches and twigs are used for fuel purposes. Acacia is also found in the silvipastoral system of wastelands. Tree is lopped during the winter season for fodder to feed goats and sheep. The leaves are used as fodder and relished by the goats. The trees are producing considerable amount of gums during summer season. The average green fodder per plant is approximated to be 15-20 kg. Each plant gives about 5 to 10 kg pods, it is fed to the animals. One tree provides 20 to 40 kg fuel wood and 20

ICAR-Central Arid Zone Research Institute (CAZRI), Regional Research Station, Pali-Marwar-306 401, Rajasthan, India.
[1]ICAR-Indian Agricultural Research Institute (IARI), Hazaribagh-825 301, Jharkhand, India.

Corresponding Author: M.B. Noor mohamed, ICAR-Central Arid Zone Research Institute, Regional Research Station, Pali-Marwar-306 401, Rajasthan, India.
Email: mohamedforester@gmail.com

How to cite this article: Noor mohamed, M.B., Shukla, A.K., Mehta, R.S., Keerthika, A and Gupta, D.K. (2021). Effect of Presowing Treatments on Seed and Seedling Quality Attributes of an Endemic Agroforestry Tree *Acacia nilotica subsp. cupressiformis* (J.L. Stewart) Ali and Faruqi. Legume Research. DOI: 10.18805/LR-4601.

Submitted: 03-03-2021 **Accepted:** 25-05-2021 **Online:** 27-05-2021

to 40 kg fencing material for protection of field (Malhotra *et al.,* 1985).

Besides, the species is of considerable importance in agro-forestry and wasteland management for its ability to grow fast and fix atmospheric nitrogen in hot semi-arid region of Rajasthan. Even though it has many advantages, there is no much information available about its botany, distribution, propagation and regeneration. Natural regeneration of this species is quite difficult and rarely seen in field it may be due to its seed coat dormancy that act as mechanical barrier limiting water and oxygen permeability. The tree is having many importance and suitable to agroforestry, however it is rarely seen growing in wild and fastly reducing in quantity in Western Rajasthan. And also, good crop stand can be obtained by improving the performance of seed germination through presowing treatment even in the adverse soil and atmospheric condition (Krishna Devi *et al.,* 2019). Many seed presowing treatments were conducted mainly in Acacia including scarification, as well as soaking in tap water, boiling or hot water, acids, organic solvents and alcohols (Bonner *et al*., 1974; Clemens *et al*., 1977; Delwaulle, 1979; Cavanagh, 1980; ISTA, 1981; Ren and Tao, 2004; Patane and Gresta, 2006; Okunomo and Bosah, 2007; Kassa *et al*., 2010). But there is no information on the presowing treatment and seed germination of *A. nilotica var. cupressiformis*. Therefore, we have intervened to save this important multipurpose tree from extinction, the studies on seed germination as a preliminary step in its conservation and utilization of this species in the hot semi-arid region of western Rajasthan.

MATERIALS AND METHODS

The study was conducted with ten treatments and three replications in Completely randomized block design (CRD) in hot semi-arid environment of India, at Research farm of ICAR-Central Arid Zone Research Institute, Regional Research Station (Pali-Marwar, Rajasthan). The seeds were collected from healthy *A. nilotica var. cupressiformis* tree at Central Arid Zone Research Institute, Regional Research Station, Pali Marwar (Rajasthan) during the summer month (May-June), 2019. The collected seeds were manually graded and good quality seeds were used for the presowing treatments. Twenty-five seeds were sown in pot with sand, soil and FYM mixture in the ratio of 1:2:1 and it replicated thrice. Pots were kept in shade throughout the experiment and watering was done manually once in a day. The germination was observed for 30 days with emergence of cotyledon leaves above the surface was counted as germinated. Germination parameters were recorded and calculated. Vigour index was also calculated as germination (%) X total length of seedling (shoot length and root length) (Abdul Baki and Anderson, 1973) Table 1.

RESULTS AND DISCUSSION

The germination parameters of *Acacia nilotica var. cupressiformis* seeds shown significant differences among the different presowing treatments (Table 2). The maximum germination percentage was recorded in mechanical scarification with sand paper + water soaking treatment (T_2) (100%) followed by mechanical scarification with sand paper (T_1) (85%), acid scarification (50% for 20 min) (66.66%) and acid scarification (98% for 10 min) (56.66%) (Table 2 and Fig 1). Nikoleave (1977) suggested that the seed coat dormancy may be overcome by peeling off or disrupting the seed coat. The process of hydrolysis could commence to release simple sugars that could be readily utilized in protein synthesis where the seed coat is softened. And also, the release of auxins and ethlyne could increase the nucleic acid metabolism and protein synthesis (Irwin, 1982 and Jackson, 1994). The minimum germination percentage obtained in control (T_{10}) (10%) followed by normal water soaking (T_9) and hot water boiling (80°C for 10 min) (T_3) (Table 2 and Fig 1). The speed of germination and mean daily germination also followed the same trend which recorded maximum in mechanical scarification with sand paper + water soaking treatment (T_2) (7.733 and 1.333) followed by mechanical scarification with sand paper (T_1) (6.233 and 1.133), acid scarification (50% for 20 min) (3.888 and 0.888) and acid scarification (98% for 10 min) (3.855 and 0.755) while minimum in control (T_{10}) (0.266 and 0.133) followed by normal water soaking (T_9) and hot water boiling (80°C for 10 min). Other treatments also shown the poor germination percentage, speed of germination and mean daily germination values. The highest germination value expressed by mechanical scarification with sand paper + water soaking (T_2) (24.44) followed by mechanical scarification with sand paper (T_1) while the lowest were in control (T_{10}) (0.244) followed by normal water soaking (T_9).

The hot water treatment significantly reduced the germination ability of seeds which may destroy the embryo due to overheat. Aliero (2004) inferred that *Parkia biglobosa* seeds germination decreased when seeds were soaked more than 4 seconds in boiling water and concluded that embryo gets destroyed. Other researchers also concluded that sudden dip of dry seeds in boiling water may lead to the rapture of the coat wall allowing water to permeate the seed tissues causing physiological changes and subsequent

Table 1: Treatment detail of presowing treatment on *A. nilotica var. cupressiformis* seeds.

Treatments	Treatment details
T_1	Mechanical scarification with sand paper
T_2	Mechanical scarification with sand paper + Water soaking (12hrs.)
T_3	Boiling in hot water (80°C for 10 min)
T_4	Soaking with cold water
T_5	Acid scarification with 98% H_2So_4 for 10 min
T_6	Acid scarification with 98% H_2So_4 for 5 min
T_7	Acid scarification with 50% H_2So_4 for 20 min
T_8	Acid scarification with 50% H_2So_4 for 5 min
T_9	Normal water soaking for 12 hrs.
T_{10}	Control

germination of the embryo (Sabongari, 2001: Ramesha, 2016). And the acid treatment (98%+5 min and 50%+5min) also led to poor germination of seeds which may be due to the less disruption of the seed coat. The results of this study were supported by Mohamed Ahmed and Khalil (2014) which the seeds of *Acacia nilotica* subspecies *tomentosa* and subspecies *adstingens* took fewer days for breaking dormancy with the increase in emersion length in sulfuric acid. Kheloufi *et al*. (2017) also reported that sulphuric acid with 60 to 120 min soaking time is favourable for the seeds of *A. cyanophylla* and *Acacia farnesiana* which increases the germination rate index. Goda (1987) reported that seeds of *Acacia nilotica* when treated with H_2SO_4 for 90 minutes produced vigorous seedlings and higher per cent germination. Parameswari *et al.*, (2001) also reported that the seeds scarified with commercial sulphuric acid @ 200 ml kg for 15 minutes maximized

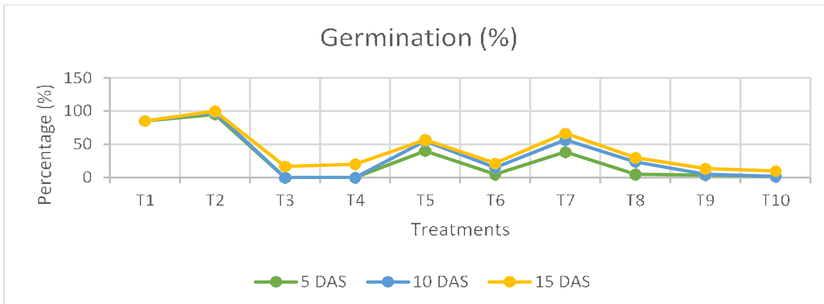

Fig 1: Effect of presowing treatments on seed germination percentage on different time interval in *A. nilotica var, cupressiformis.*

Table 2: Effect of presowing treatments on seed germination attributes in *A. nilotica var. cupressiformis.*

Treatments	Germination percentage (%)	Speed of germination/ Germination index	Mean daily germination	Germination value
T_1	85.00	6.233	1.133	17.66
T_2	100.0	7.733	1.333	24.44
T_3	16.66	0.222	0.222	0.633
T_4	20.00	0.266	0.266	0.977
T_5	56.66	3.855	0.755	7.695
T_6	21.66	0.922	0.288	1.000
T_7	66.66	3.888	0.888	10.41
T_8	30.00	1.200	0.400	2.200
T_9	13.33	0.411	0.177	0.416
T_{10}	10.00	0.266	0.133	0.244
Mean	42.00	2.50	0.56	6.568
S. Em±	2.84	0.29	0.04	0.19
CD (0.05)	8.37	0.85	0.11	0.56

Table 3: Effect of presowing treatments on growth parameter of *A. nilotica var. cupressiformis* seedlings.

Treatments	Shoot length (cm)	Root length (cm)	Root: Shoot Ratio	Vigour index
T_1	7.36	5.46	0.74	1090.8
T_2	7.83	6.03	0.77	1386.6
T_3	5.56	3.90	0.70	163.16
T_4	5.46	3.80	0.70	169.33
T_6	4.33	2.73	0.63	173.38
T_7	6.56	3.43	0.52	688.38
T_8	4.73	2.53	0.54	230.50
T_9	4.16	2.13	0.51	80.666
T_{10}	3.76	2.00	0.55	48.000
Mean	5.58	3.62	0.63	463.37
S. Em±	0.36	0.24	0.06	30.15
CD (0.05)	1.06	0.69	0.18	88.93

the seed germination by reducing both the abnormal seedling and hard seed.

Significant differences were observed in morphometric parameters of *Acacia nilotica var. cupressiformis* seedlings among the pre sowing treatments (Table 3). The maximum shoot and root length registered in mechanical scarification with sand paper + water soaking treatment (T_2) (7.83 cm and 6.03 cm) followed by mechanical scarification with sand paper (T_1) while minimum was in control (T_{10}) (3.76 and 2.00 cm) followed by normal water soaking (T_9). And also, the highest vigor index was recorded in T_2 (1386.6) followed by T_1, T_7 and T_5. The lowest vigor index was registered in control (T_{10}) (48.00) followed by T_9, T_3, T_4, T_6.

CONCLUSION

From the study, it is concluded that seed coat scarification is prerequisite to break seed coat dormancy and quick germination. Scarification with sand paper combined with water soaking for 12 hrs followed by scarification with sand paper was found effective in influencing the germination process and registered higher germinability when compared with control and other treatments. In acid treatments, acid scarification (50% for 20 min) and acid scarification (98% for 10 min) was given moderate germination. Further trails may be conducted on acid treatment with different time periods which may influence the higher rate of germination and growth in *Acacia nilotica var. cupressiformis.*

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