Effect of various pre-treatments on the seedling growth performance of Tamarindus indica L

Article *in* Plant Biosystems · January 2001

DOI: 10.1080/11263500112331350780

2 authors:

Macdonald Idu
University of Benin
117 PUBLICATIONS **698** CITATIONS
SEE PROFILE

Conrad Asotie Omonhinmin
Covenant University, Ota, Ogun State, Nigeria.
41 PUBLICATIONS **111** CITATIONS
SEE PROFILE

Germination Ecology of Two Savanna Tree Species, *Tamarindus indica* and *Prosopis africana*

Idu MacDonald*, A. C. Omonhinmin, I. A. Ogboghodo,

ABSTRACT

Various methods of seed scarification including concentrated sulphuric acid, alcohol; methanol, ethanol, iso-propanol, butanol and hot water (100°C), were applied on seeds of *Tamarindus indica* L. and *Prosopis africana* Guill and Peri., to improve germination and assess seed vigor. The highest germination and germination energy (Germ. En.) for *T. indica* occurred following pre-treatment in methanol for 10 minutes (70% germination; 42, Germ. En.), while better response was obtained for *P. africana* following pretreatment in ethanol for 10 minutes (58% germination; 38, Germ. En.), and Conc. H_2SO_4, for 5 minutes (60% germination; 38, Germ. En.).

INTRODUCTION

Seeds of Tamarind (*Tamarindus indica* L.) and Locust bean (*Prosopis africana* Guill and Peri.) like most leguminous plants possess hard seed coats, which hampers water imbibition, gaseous exchange and/or harbors inhibitors to suppress seed germination. Such barriers are commonly eliminated through a number of scarification and stratification methods, which include the use of sulphuric acid, alcohol and steeping in hot water as described by Gill and Bamidele, (1981); Eze and Orole, (1987); Marunda, (1990); Gill *et al.*, (1990); Gill and Anoliefo, (1994); Idu, (1995); Diallo *et al.*, (1996); Idu, M. and Omonhinmin, A.C. (2000, 2001).

Although research has been conducted in the area of seed dormancy and its elimination, very little is known about the effect of the various pre-treatments on the germination energy (vigor) of such pre-treated seeds. The reason to investigate this aspect of germination becomes more relevant, when you acknowledge the need to identify specialized techniques that allow maximum recovery of seeds. Such techniques are increasingly needed for well known, indigenous, and versatile but under-exploited species like *T. indica* and *P. africana.*

The objectives of the study were to evaluate the seed germination and vigor of *T. indica* and *P. africana* using a number of well-known pre-treatment methods.

MATERIALS AND METHODS

Seeds of *T. indica* and *P. africana* were harvested between the months of September and November 2000, in Yola, Adamawa, Nigeria, (90°14'N; 12°20'E). Seeds were air dried and kept at ambient temperature in Kilners jar.

Idu MacDonald, A. C. Omonhinmin, Department of Botany, University of Benin, P.M.B. 1154, Benin City, Nigeria; I. A. Ogboghodo, Department of Soil Science, University of Benin, P.M.B. 1154, Benin City, Nigeria. Received 12 Feb 2001. *Corresponding author. E-mail: macdonald.idu@uniben.net.

One seed lot of approximately 2000 seeds was used for the various pre-treatments for each species. Seeds were surface sterilized with 0.1% Mercuric chloride for 1 min and rinsed in several changes of distilled water before being subjected to the various pre-treatments.

Seeds were subjected to the following pre-treatments: 95% sulphuric acid (H_2SO_4) for 5, 10, and 15 min: methanol, ethanol, Iso-propanol and butanol for 10 and 20 min: hot water (100°C) for 10, 15, 20 and 30 min. Acid and alcohol treated seeds were thoroughly washed in several changes of distilled water after treatment. Following pre-treatment, seeds were placed in Petri dishes lined with filter paper (Whatman No 1) and moistened daily with distilled water; which were placed in germination chamber at 28 ±2°C temperature.

For each exposure period under the different pre treatments, 120 seeds were subdivided into 60 seeds each for the light and dark regimes (three replications). A set of untreated seeds served as control.

TABLE 1: Germination percentages after 30 days and germination energy after 8 days in light and darkness for *Tamarindus indica*.

	Light		Dark	
Treatments	**Germ. %†**	**Germ. En.‡**	**Germ. %†**	**Germ. En.‡**
Acid				
Conc. H_2SO_4 5 min	48 ± 1.28	26	38 ± 0.46	20
Conc. H_2SO_4 10 min	62 ± 0.36	34	52 ± 0.22	30
Conc. H_2SO_4 15 min	42 ± 0.33	22	44 ± 1.12	24
Alcohol				
Methanol 10 min	70 ± 0.46	42	68 ± 2.41	36
Methanol 20 min	64 ± 1.36	36	64 ± 0.04	34
Iso-propanol 10 min	39 ± 2.23	24	40 ± 0.86	24
Iso-propanol 20 min	40 ± 2.16	20	42 ± 3.84	20
Ethanol 10 min	68 ± 1.03	40	64 ± 1.42	38
Ethanol 20 min	64 ± 3.21	38	62 ± 0.37	34
Butanol 10 min	30 ± 1.62	20	62 ± 2.82	18
Butanol 20 min	28 ± 2.18	14	32 ± 3.16	18
Hot Water (100°C)				
Hot water 10 min	14 ± 0.30	8	16 ± 2.11	8
Hot water 15 min	30 ± 2.23	12	22 ± 1.23	10
Hot water 20 min	22 ± 1.34	10	26 ± 1.56	12
Hot water 30 min	38 ± 1.83	12	22 ± 2.16	8
Control	18 ± 0.87	8	14 ± 1.12	10

†Germ. %: Germination Percentage.

‡Germ. En: Germination Energy.

Seed germination criterion was 2 mm radicle emergence of normal seedlings (Ellis *et al.*, 1985). Percentages were recorded daily for 30 days. Germination energy was calculated on the 8th day, represents the percentage of total number of seeds that had germinated when germination reached its peak (Bhardwaj, *et al.*, 2001).

RESULTS

The germination percentages achieved after 30 days and germination energies after 8-day energy period, under light and dark conditions are shown for both species in Tables 1 and 2.

The highest germination percentage for *T. indica* was obtained from the methanol 10 min pre-treatments (70%, light; 68%, dark). *P. africana* recorded higher germination following pre treatment in conc. H_2SO_4 5 min (60%, light; 52%, dark) and ethanol for 10 min (58%, light; 46%, dark). Poor germination

TABLE 2: Germination percentages after 30 days and germination energy after 8 days in light and darkness for *Prosopis africana*.

	Light		Dark	
Treatments	**Germ. %†**	**Germ. En.‡**	**Germ. %†**	**Germ. En.‡**
Acid				
Conc. H_2SO_4 5 min	60 ± 2.31	38	52 ± 0.62	34
Conc. H_2SO_4 10 min	54 ± 2.44	28	50 ± 0.18	30
Conc. H_2SO_4 15 min	42 ± 0.36	18	40 ± 3.30	16
Alcohol				
Methanol 10 min	58 ± 2.80	34	42 ± 3.82	28
Methanol 20 min	42 ± 0.72	26	40 ± 2.18	20
Iso-propanol 10 min	26 ± 2.04	16	28 ± 2.21	12
Iso-propanol 20 min	32 ± 2.04	18	32 ± 1.42	24
Ethanol 10 min	58 ± 0.42	38	46 ± 1.30	34
Ethanol 20 min	44 ± 1.52	28	38 ± 2.14	25
Butanol 10 min	21 ± 0.84	6	22 ± 0.08	6
Butanol 20 min	29 ± 3.41	8	28 ± 2.34	8
Hot Water (100°C)				
Hot water 10 min	30 ± 0.30	20	28 ± 1.58	16
Hot water 15 min	44 ± 1.64	28	32 ± 0.31	24
Hot water 20 min	36 ± 2.32	22	32 ± 0.52	24
Hot water 30 min	20 ± 2.74	18	22 ± 0.02	16
Control	14 ± 1.54	10	12 ± 0.11	8

†Germ. %: Germination Percentage.

‡Germ. En: Germination Energy.

results were obtained from the conc. H_2SO_4 15 min, butanol and iso-propanol as well as the hot water treatments.

The germination energy (Table 1 and 2) provides information on the distribution of the final germination percentages. It revealed the seeds that reached the emergent stage; however, the time taken was not shown. Pre treatments in conc. H_2SO_4 for 5, 10 min; methanol for 10, 20 min and ethanol for 10, 20 min pre-treated seeds showed high germination energies for both species, with most of the seed germination within the first 9 days. Other pre-treatments recorded low germination energies.

DISCUSSION

The results show that seeds of *T. indica* and *P. africana* possess hard testas, a common characteristic of most leguminous seeds.

Charring and burning of seeds due to prolonged exposure may have been responsible for the poor germination recorded for the H_2SO_4 (15 min) and hot water treatments. This expresses the sensitivity of the species to acid and hot water treatments. On the other hand, poor germination observed for the iso-propanol and butanol pre-treatments was probably due to the less severe nature of the treatments (Mott, 1979; Mayer and Poljakoff-Mayber 1989; Marunda, 1990). The sulphuric acid (except 15 min), methanol and ethanol pre-treatments showed the highest germination energy among the seeds. These treatments apart from eliminating dormancy through seed coat erosion, it also improve germination and hence vigor, probably by interaction with the redox, dehydrogenase reactions connected with germination. The results show that germination can be improved in the two species by treating the seeds with conc. sulphuric acid, methanol and ethanol. These results are consistent with those of Idu (1995). However, treating seeds of *T. indica* with methanol for 10 min and seeds of *P. africana* with sulphuric acid and ethanol for 5 min and 10 min respectively may be the most efficient pre-treatments for each species. These pre-treatments can ensure a fast and homogenous germination, a high nursery recovery and a uniform planting stock.

REFERENCES

Bhardwaj, S. D., S. Sharma, S. K. Gupta, and R. Bauyal. 2001. Storage Studies on Acorns of Ban oak (*Quercus leucotrichophora*). Seed Research 29: 28–33.

Diallo, I., P. Danthu, B. Sambou, D. Dione, A. Goudiaby, and K. Poulsen. 1996. Effect of different pre-treatments on the germination of *Faidherbia albida* (DEL.). International Tree Crops Journal 9: 31–36.

Ellis, R.H., T. D. Hong, and E.H. Roberts. 1985. Handbook of Seed Technology for Genebanks. Volume 1. Principles and Methodology. International Board for Plant Genetic Resources. Rome, 42–43 pp.

Eze, T. M. O. and B. C. Orole 1987. Germination of seeds *Prosopis africanum.* Journal of Forestry 17: 12–17.

Gill, L. S. and J. F. Bamidele 1981. Seed morphology, Germination and Cytology of three Savanna Trees in Nigeria. Nigerian Journal of Forestry 11: 16–23.

Gill, L. S., H. I. Onyibe, and A. E. Evivie 1990. Germination biology of *Mimosa pigra* (Leguminosae). Nigerian Journal of Weed Science 3: 11–18.

Gill, L. S. and G. O. Anoliefo 1994. Germination biology of *Caesalpinia pulcherrima* L. (Leguminosae). Annals of Forestry 2: 65–68.

Idu, M. 1995. Seed Development and Germination responses of two *Cassia* L. species. Organism, Interactions and the Environment 2: 65–68.

Idu, M. and A. C. Omonhinmin 2000. Effect of chemical pre-treatment on the Germination and Seedling Development of *Dichrostachys cinerea* (L.) Wight and Arn (Fabaceae). Journal of Tropical Forest Science 12(2): 406–409.

Idu, M. and A. C. Omonhinmin 2001. Effect of various pre-treatments on the seedling growth performance of *Tamarindus indica* L. Plant Biosystems 135(2): 165–168.

Marunda, C. T. 1990. Effect of seed pre-treatments on the development of *Acacia auriculiformis* and *A. holoserica* seedlings. *In:* Turnbull, J.W. (ed.).Tropical Trees Seed Research. ACIAR. Australia , 33–36 pp.

Mayer, A. M. and A. Poljakoff-Mayber 1989. The Germination of Seeds. Pergamon Press Ltd., London, 270p.

Mott, J. J. 1979. High temperature contact treatment of hard seed in *Slylosanthes.* Australian Journal of Agricultural Research 30: 847–854.