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Scarification of Limba Seeds With Hot Water, Bleach, and Acid

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*Soaking seeds of limba (*Terminalia superba *Engler & Diels) in hot or boiling water resulted in seed death. Soaking seeds in concentrated sulfuric acid 95 to 98% (V/V) or sodium hypochlorite 5.25% (V/V) for 15 min and then rinsing them for 15 min with tap water resulted in the highest germination. This technique is appropriate for large-scale plantations or for research purposes. Investigations of low-technology techniques to improve germination in nurseries for social forestry should be undertaken.* Tree Planters' Notes 43(4):150-152; 1992.

Limba *(Terminalia superba* Engler & Diels) is a member of the family Combretaceae indigenous to Zaire and one of that country's most commercially important tree species, being used for veneer and timber (anonymous 1988). Its natural distribution according to Aubreville (1959) is given in figure 1. It thrives best in secondary semi-deciduous tropical forests on wet valley soils. In optimum edaphoclimatic conditions, it tends to form monospecific stands. Early work on reproductive biology and population genetics of this species was done by Vigneron (1984). The botanical description is given by Aubreville (1959) and by Vivien and Faure (1985). The fruit is a two-winged samara with a hard pericarp.

From 1953 to 1958, about 1,520,000 m^3 of logs were exported by Congo, Zaïre, and Cabinda. In 1958, 7,500 ha of limba were already planted, particularly in agroforestry systems in the Mayombe region of Zaïre, and initial provenance trials were established in 1968. Some of these agroforestry systems included the intercropping of limba with banana, coffee, cacao, or taro. Since 1985, afforestation programs with this species have been funded by the Fonds de Reconstitution du Capital Forestier.

Seeds of the tropical genus *Terminalia* are recognized as short-lived and recalcitrant. Both chemical and physical seedcoat dormancy has been recognized as well (Schaeffer 1990, Willan 1985). Although considerable information exists about most exotic tree species in the Tropics, information for handling, storage, and germination pretreatment for seeds of many indigenous species is scarce (Shehaghilo 1990). Therefore, basic information such as the time required for seeds to germinate, and pretreatments to ensure rapid and uniform germination in nursery are very important. To achieve good germination, seed dormancy must be broken. Dormancy may result from chemical, mechanical, physical or physiological factors. Chemical dormancy apparently occurs in *T. ivorensis* (Willan 1985). By using alternating temperature (34 °C/ 24 °C), 93%, germination was obtained in 41 days compared to 27% germination at a constant temperature of 30 °C, both under continuous light (see Willan 1985). For *T. superba,* germination problems occur in nurseries, but no information is available about the requirements for breaking seed dormancy.

This study was conducted to test the effect of hot water, bleach, and acid scarification as presowing treatments with potential to accelerate germination of *T. superba* seeds.

Materials and Methods

Seeds of *Terminalia* were collected from 4 stands with 5 parent trees each in June 1990 at Luki Biosphere Reserve (lat. 5° 37' S, long, 13° 06' E, alt. 350 m) in Zaïre. They were then air dried and sealed in polyethylene containers and stored at 4 °C until used in this experiment in November 1990. Nine presowing treatments were applied to 900 seeds of the bulked seed collections (table 1). The 900 seeds were divided into 9 subsamples of 100 seeds. Each subsample of 100 seeds was further divided into 4 replications of 25 seeds.

The pretreated seeds were sown on Kimpak K-22 media in clear germination boxes. Germination took place in Conviron G30 germinators in conditions as previously described (Khasa 1993). Germination counts were made weekly for a 5-week period. Seeds were considered to be successfully germinated when their radicles had reached the same length as the seed. At the end of the germination experiment, a cutting test was used to determine

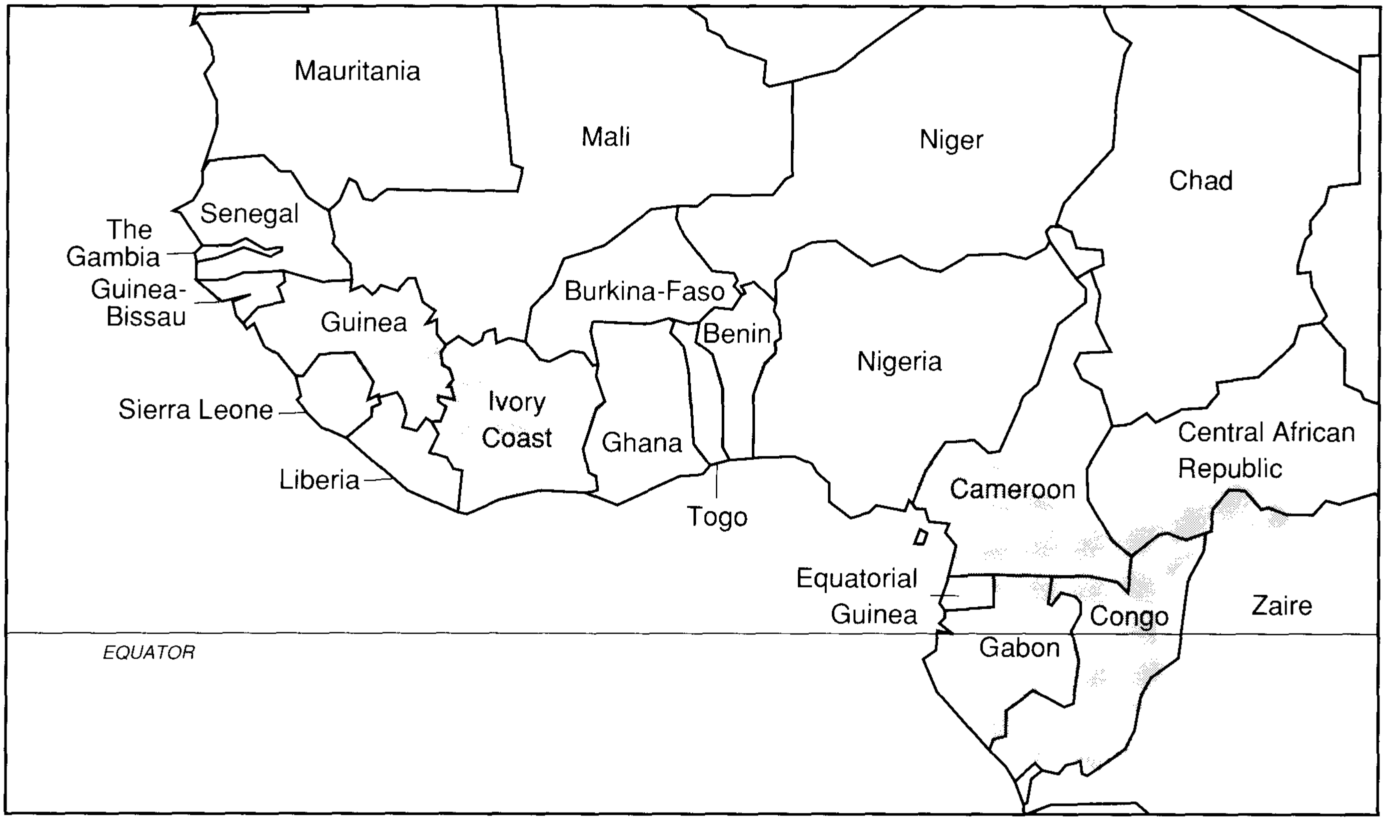

Figure 1—*Natural distribution of limba* (Terminalia superba) *(Aubreville 1959).*

Table 1—*Pretreatments used in this study*

Pretreatment	Description
0	Control (no pretreatment)
1	Pour 1 volume of seeds into 10 volumes of boiling water from which the heat source has been removed and soak until cool (12 to 24 h)
2	Immerse for 1 min in boiling water
3	As for 2, with immersion for 3 min
4	Immerse for 15 min in sodium hypochlorite 5.25% (V/V) and rinse under tap water for 15 min
5	Immerse in concentrated sulfuric acid 95 to 98% (V/V) at room temperature for a period of 15 min, then rinse under running tap water for 15 min
6	Same as 5, with immersion for 30 min
7	Same as 5, with immersion for 45 min
8	Same as 5, with immersion for 60 min

the apparent viability of ungerminated seeds (Willan 1985). Cumulative germination percentages (CG) were calculated.

Analyses of variance were performed using the General Linear Model Procedure of SAS® (SAS 1990) on transformed arcsin square root of percentages of CG, to fill the basic assumptions for use of Duncan's multiple range test for comparison of the means among treatments (Kirk 1982).

Results and Discussion

Hot water scarification has been reported as an economical method for breaking seed dormancy, especially for hard-coated seeds used in social forestry (Khasa 1993). In contrast, based on germination and cutting test data, all the *T. superba* seeds treated with hot or boiling water in this experiment were dead (table 2). This lethal effect demonstrates that this species is very sensitive to hot water, which passes through the slits in the pericarp during immersion. This was not the case with sulfuric acid, its high viscosity presumably limiting flow through the slits in the pericarp.

All the seeds scarified with concentrated sulfuric acid, 95 to 98%> (V/V), or treated with sodium hypochlorite 5.25% (V/V) germinated well (table 2), but these methods could be used only for large-scale plantations or for research purposes because

Table 2—*Cumulative germination percentages of limba* (Terminalia superba) *during a 5-week period*

	Cumulative germination %				
Pretreatment	1 wk	2 wk	3 wk	4 wk	5 wk
0	0.0 b	30.3 b	53.3 b	56.5 c	—
1	0.0 b	0.0 c	0.0 c	0.0 d	0.0 c
2	0.0 b	0.0 c	0.0 c	0.0 d	0.0 c
3	0.0 b	0.0 c	0.0 c	0.0 d	0.0 c
4	30.4 a	59.3 a	63.9 ab	66.0 abc	70.0 b
5	40.5 a	59.9 a	69.4 ab	73.9 ab	79.9 ab
6	31.9 a	50.0 a	59.6 ab	64.0 ab	67.0 b
7	0.0 b	56.6 a	62.5 ab	78.3 ab	82.5 a
8	0.0 b	54.9 a	74.0 a	82.2 a	86.2 a

Means with the same letter within each column are not significantly different at α = 0.05 by Duncan's multiple range test.

of the high cost (Khasa 1991). Both sulfuric acid and sodium hypochlorite softened the seed pericarp, causing uniform inflow of water and unrestricted expansion of the embryo. Seeds soaked in sulfuric acid exhibited more fungal contamination than those from water treatments, whereas seeds soaked in sodium hypochlorite showed no fungal development. The acid treatment may have enhanced the leakage of metabolites from the seed, thus providing a nutritious medium for germination of fungal spores.

Sulfuric acid scarification may give erratic results; treatments 7 and 8 were among the worst at the first week but among the best during the following weeks. Similarly, treatment 6 gave unexpected results. Treatment 5 (immersion in concentrated sulfuric acid, 95 to 98% (V/V), at room temperature for a period of 15 min, followed by rinsing under running tap water for 15 min and then sowing immediately, was the most stable and therefore recommendable in nurseries for large-scale plantations or in laboratories for research purposes. According to the cutting test data, the percentage of seed that had the potential to germinate, but did not, was 18%. We noticed that some seeds had been damaged by insects. The potential germinability may be calculated from the total of cumulative germination and sound ungerminated seeds.

Mechanical scarification of the pericarp may enhance germination of limba as observed for other species (Schaeffer 1990). Future investigations of simpler methods suitable for use in small village nurseries for social forestry activities should be undertaken. Some of these methods are soaking in room temperature water for 24 or 48 hours, and mechanical scarification of the pericarp with subsequent overnight soaking in room temperature water.

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References

Anonymous 1988. Liste des essences forstiéres du Zaïre. Service Permanent d'Inventaire et d' Aménagement Forestier (I st ed.), Ministére de l'Environnement, Kinshasa.

Aubreville, A. 1959. Flore forestiére de la Cóte d'Ivoire. CTFT, Nogent sur Marne, Tome 1, pp. 1-362; Tome 2, pp. 1-340; Tome 3, pp. 1-334.

Khasa, P.D. 1993. Breaking seed coat dormancy in *Acacia auriculiformis* A. Cunn. ex Benth. Forestry Chronicle (In press).

Kirk, R.E. 1982. Experimental design: procedures for the behavioral sciences. 2nd ed. Broks/Cole publishing company.

SAS Institute Inc. 1990. SAS® Procedures guide, Version 6, 3rd. ed. Cary, NC: SAS Institute, Inc.

Schaeffer, C. 1990. Seed testing research on species indigenous to Kenya. In: Turnbell J.W., ed. Tropical tree seed research: proceedings of an international workshop held at the Forestry Training Centre, Gympie, Queensland, Australia; 1989 August 21-24. ACIAR Proc. No. 28:132-139.

Shehaghilo, LM. 1990. Germination problems of some multipurpose indigenous tree seeds in Tanzania: In: Turnbell, J.W., ed. Tropical tree seed research: proceedings of an international workshop held at the Forestry Training Centre, Gympie, Queensland, Australia; 1989 August 21-24. ACIAR Proc. No. 28:140-141.

Vigneron, P. 1984. Variabilité génétique des provenances ivoiriennes et congolaises de *Terminalia superba* Engler & Diels. Apports de polymorphisme enzymatique. These de doctorat. Université de Paris-sud.

Vivien, J.; Faure, J.J., 1985. Arbres des foréts denses d'Afrique Centrale. Paris: Ministére des relations extérieures, Coopération et Développement, Agence de Cooperation Culturelle et Technique.

Willan, R.L. 1985. A guide to forest seed handling with special reference to the tropics. For. Pap. 20/2. Rome: FAO.