Seedcoat Removal Increases Speed and Completeness of Germination of Water Oak

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Germination speed and completeness of water oak (Quercus nigra L.) seeds were enhanced by the use of three seedcoat treatments: removal of the seedcoat, drilling a hole in one side of the seedcoat, and cracking the seedcoat. All treatments enhanced germination speed and completeness compared to the control, with removal of the seedcoat being the most effective. Application of this technique would be most useful when seeds are in short supply or when a research study requires a complete, uniform group of seedlings. Tree Planters' Notes 43(2):52-53; 1992.

Rapid and complete germination of seeds is usually a desirable objective in the production of tree seedlings. Seedlings thus produced are cultured more efficiently and production cost are reduced as a result.

There are numerous methods used to achieve this speed and completeness of germination. These include many stratification, scarification, and other preplanting techniques (Schopmeyer 1974). Depending on the species, one or more of these methods are used routinely by commercial tree nurseries. However, when small lots of seed for research purposes are being used, maximum germination and uniformity are highly desirable, especially with limited number of seed.

Seeds of species like the oak *(Quercus)* and hickory *(Carya)* groups have hard seedcoats that may slow hydration or prevent complete germination. Such seedcoats must be split by the developing embryo during germination. Removal of the seedcoat has been known to enhance germination in certain species (Schopmeyer 1974).

Water oak is a very common species across the Coastal Plain of the southern United States, and we need to know how to handle seed for nursery growing and in preliminary studies, removal of seedcoats greatly increased the speed of germination. This study was established to determine the effectiveness of several seedcoat treatments in increasing the speed and completeness of germination of water oak (*Q. nigra* L.).

Methods

Acorns were collected in the fall of 1990 from one parent tree. From a large group (stratified 90 days), 320 acorns were selected and assigned at random to one of four groups: untreated controls, seeds with a hole drilled in their coat, seeds that had their seedcoat cracked, and seeds with their seedcoat completely removed (80 acorns per treatment).

For drilling treatment, the end of a small laboratory knife was used to drill a hole (approximately 2 mm in diameter) without injuring the internal seed material. The hole was positioned in the top half of the seed. The cracking treatment was done by carefully tapping the acorn with a small hammer just hard enough to crack the seedcoat, but not enough to injure the living seed material. The seedcoat was removed by creating a crack in the shell and then carefully peeling the entire seedcoat from the seed.

Seeds were then soaked in tap water for 48 hours, drained, and assigned to planting containers. The containers, large Styroblocks, were filled with a 1:1:1 mixture of peat, vermiculite, and perlite. Seeds were planted 2.5 cm below the surface of the medium. The experimental design was a randomized complete block design with the treatments assigned randomly within four blocks. These were then placed in a greenhouse with night temperature between 18 to 20 °C and daytime temperature 26 to 30 °C. Each block was hand watered every 2 days and when germination started, seedlings were counted every 2 days.

Czabator's formula (1962), which quantifies germinative energy by combining speed and completeness of germination, was used for evaluation of the treatments. Combining both speed and completeness of germination into a composite score termed germinative value (GV) eliminates the need of subjective value judgement. The formula GV = MDG x PV was used where:

MDG (mean daily germination) = percentage of full seed at the end of test divided by the number of days to the end of the test.
PV (peak value) = mean daily germination of the most vigorous component of the seed lot, a mathematical expression of the break of the sigmoid curve representing a typical course of germination.

Czabator's formula was used to quantify the germinative value of the seed in the different treatments. (Analysis of variance was used to determine significance among treatments.) Percentage germination was also computed for comparison purposes, as the percentage of all filled seeds that germinated. Seeds that did not germinate after the experiment were dissected to ensure that they were filled.

Results and Discussion

There were highly significant differences among the treatments for peak value, mean daily germination, and germination value (table 1). Removal had the fastest and most complete germination. The seeds that had their coats removed began germinating by day 9 after planting and 89% had germinated by day 15. The second-best treatment was the drilled hole treatment, which first germinated on day 11 after planting and had 40% germination by day 15. The seeds with cracked seedcoats first germinated on day 13 after planting and had 35% germination by day 15. Untreated control seeds performed poorest, with no germination until day 15 after planting, when 6% germinated.

Removal of the seed coat also resulted in the greatest increase over the control in percentage germination (table 1). The drilling treatment ranked second, cracking coat treatment third, and the untreated control seed had the lowest percentage germination. Peak germination value, mean daily germination, and germinative value followed the same pattern (table 1). Removal of the seedcoat increased the germinative value by 11 times compared to untreated control seed.

Speed and completeness of germination for water oak seed can be maximized by the removal of the seedcoat. Removal of the seedcoat exposes the seed and bad seeds are easily discarded. The germination barriers the seedcoat presents are no longer in place and thus germination is faster and more complete.

Removal of the acorn's seedcoat is not a procedure for commercial production but can be utilized when limited numbers are involved, as would be with unique genotypes and small numbers of seed. The speed and uniformity of germination quickly produces a uniform group of seedlings, which is desirable for research work or when special seed lots must be maximized because of small numbers.

Table 1—*Peak values (PV), mean daily germination (MDG), germinative value (GV), and percentage germination for treated water oak seed*

Treatment	PV	MDG	GV	Germination (%)
Control	1.12 c	0.72 c	0.81 c	36
Cracked seedcoat	1.90 b	1.12 bc	2.19 bc	56
Hole in seedcoat	2.68 b	1.50 ab	4.02 b	75
Seedcoat removed	5.00 a	1.80 a	9.00 a	90

Values with the same letter are not significant ($P < 0.05$).

Literature Cited

Czabator, F.J. 1962. Germination value: an index combining speed and completeness of pine seed germination. Forest Science 8:386-396.
Schopmeyer, C.S. 1974. Seeds of woody plants in the United States. Agric. Handb. 450. Washington, DC: USDA Forest Service. 883 p.