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IMPROVING GERMINATION IN TWO AUSTRALIAN ACACIAS

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SWAMINATHAN, C. & SWARNAPIRIA, R. 2001. Improving germination in two Australian acacias. Studies were conducted in 1998 to improve germination in two acacia species, namely, *Acacia crassicarpa* and *Acacia mangium* at the National Pulses Research Centre, Pudukkottai, India. Mature pods were collected from seven-year-old trees and seeds were extracted by manual shelling and sown after inundating them with hot (80 °C) and cold (26 °C) water, in polypots filled with nursery mixture. Germination and related attributes were evaluated. The results revealed that inundating seeds of both species with hot water enhanced germination and related attributes. Germination increased by five folds in *A. crassicarpa* and six folds in *A. mangium*. Inundating seeds with cold water showed a poor germination of only 15%. The germination indices, namely, germination value, germination energy and germination relative index, were also high in seeds inundated with hot water in both the species. It was concluded from the study that germination in both species could be increased to as high as 90% by inundating the seeds with hot water and soaking them for 24 hours.

Key words: Inundation - hot water - sowing - germination

SWAMINATHAN, C. & SWARNAPIRIA, R. 2001. Meningkatkan percambahan dua akasia Australia. Kajian dijalankan pada tahun 1998 untuk meningkatkan percambahan dua spesies akasia iaitu *Acacia crassicarpa* dan *Acacia mangium* di National Pulses Research Centre, Pudukkottai, India. Lenggai yang matang dikutip daripada pokok berumur tujuh tahun dan biji benih diekstrak dengan mengupas secara manual dan disemai selepas merendamnya di dalam air panas (80 °C) dan air sejuk (26 °C), di dalam polipot yang diisi campuran tapak semaian. Percambahan dan ciri-ciri yang berkaitan dinilai. Keputusan menunjukkan bahawa percambahan dan ciri-ciri yang berkaitan meningkat setelah biji benih kedua-dua spesies direndam di dalam air panas. Percambahan bertambah sebanyak lima kali ganda dalam *A. crassicarpa* dan enam kali ganda dalam *A. mangium*. Merendam biji benih di dalam air sejuk mempamerkan percambahan yang lemah iaitu sebanyak 15%. Indeks percambahan, iaitu nilai percambahan, tenaga percambahan dan indeks percambahan relatif juga tinggi dalam biji benih dalam kedua-dua spesies yang direndam air panas. Kesimpulan kajian ini ialah percambahan dalam kedua-dua spesies dapat ditingkatkan sehingga 90% dengan merendam biji benih di dalam air panas dan dibiarkan selama 24 jam.

Introduction

Seed management, an important variable for increased productivity, has so far received little attention in forest tree species. With the increasing demand for multipurpose tree seedlings dictated by the expanding social and agroforestry programmes, emphasis has now been placed on the production and management of high quality planting materials, which ensure early commencement of growth when outplanted and require less postplanting care (Swaminathan *et al.* 1993). *Acacia crassicarpa* is a small tree that grows to the height of 10–15 m. It bears oblong pods, more than 2.5 cm wide, and even larger phyllodes. The seeds are small, black, hard-coated spheres.

Acacia mangium is a fast growing tree and grows to a height of more than 15 m. It bears oblong pods of 2 cm wide and its phyllodes are larger, up to 20 × 10 cm in size. The seeds are spherical, black, tiny and hard-coated. Seeds of these two tree species, like those of other acacias, germinate poorly unless the impervious seed coat is pierced to facilitate moisture absorption by endosperm and embryo. The impervious seed coat can be made pervious by soaking the seed in hot water. Dipping in hot water and soaking in cold water overnight ensured quick and uniform germination in *A. tortilis* (NAS 1979). Vanangamudi & Srimathi (1991) reported the same results for leucaena, *Albizia lebbeck* and acacias.

Hence this study was carried out to find out the best seed soaking method to be adopted before sowing to increase germination in these two selected acacia species.

Materials and methods

Seed source

Mature pods were collected from seven-year-old woodlots of *A. mangium* and *A. crassicarpa* maintained at the National Pulses Research Centre farm situated at 10° 40' N, 78° 24' E at an altitude of 121 m asl. The seeds were extracted by manual shelling. Observations on seed weight and seed diameter were recorded (Table 1).

Table 1. Seed attributes of two selected acacia tree species collected from seven-year-old woodlots

Parameter	*Acacia crassicarpa**	*Acacia mangium**
100 seed weight (g)	1.74 ± 0.08	0.84 ± 0.004
Diameter (cm)	0.48 ± 0.14	0.30 ± 0.14

* Mean ± S.E.

Sowing

Before sowing seeds were given the following treatments:
(1) variant 1: seeds were inundated with hot water (80 °C),
(2) variant 2: seeds were inundated with cold water (26 °C).

For variant 1, 200 ml water was heated until it reached a temperature of 80 °C, after which it was poured equally into two containers (100 ml/container) having 20 g seeds of each species for inundation. The seeds were left soaking in the water for 24 h. For variant 2, 20 g of seeds in each species were inundated with cold water (ambient temperature) for 24 h.

Experiment and design

After 24 h, 100 treated seeds of each species were sown in polypots measuring 20 × 10 cm filled with red soil:sand:compost at 2:1:1 ratio. Each treatment was

replicated four times and the experiment was set up in a completely randomised design.

Observations and analysis

Number of germinants was counted daily from the onset of germination up to 21 days thereafter (ISTA 1985). Seeds were considered germinated once cotyledons emerged above the soil (Bahuguna *et al.* 1987). From the daily counts the following parameters were computed:
(1) germination per cent,
(2) germination energy (Maguire 1962),
(3) germination value (Czabator 1962),
(4) germination relative index (Sreevatsawa & Sareen 1972).

Germination energy (GE) was calculated using the formula:

$$GE = \frac{X_1}{Y_1} + \frac{(X_2 - X_1)}{Y_2} + \ldots + \frac{X_n - X_n - 1}{Y_n}$$

where, X_n is the number of germinants on the nth counting day and Y_n is the number of days from sowing to the nth count. Germination value (GV) is the integral to find mean daily germination percentage (MDG) and peak value (PV). Final MDG is the cumulative percentage of full seed germination at the end of the test divided by the number of days elapsed since sowing date. PV is the maximum MDG obtained by dividing the maximum cumulating percentage reached at anytime during the test period by the number of days from sowing when that maximum was reached. Germination relative index (GRI) was computed using the formula $[\Sigma X_n (h - n)]$, where X_n is the number of germinants at nth count, h is the total number of counts and n is the count number. The data recorded were subjected to analysis of variance (Panse & Sukhatme 1967).

Results and discussion

Germination

Inundating seeds with hot water enhanced germination by five times in *A. crassicarpa* and by six times in *A. mangium* compared to cold water inundation, which registered a poor germination of only 15% in both the species (Table 2).

Germination indices

Inundation by hot water proved distinctively superior to cold water inundation for all the parameters evaluated in both species (Table 2). GE is a measure of the speed of germination and hence the vigour of the seed and of the seedling which it produces. The interest in GE stems from the theory, despite lack of experimental evidence, that only seeds which germinate rapidly in the laboratory will produce

Table 2. Germination and related attributes as influenced by inundation of seeds

Inundation	Germination per cent		Germination value (GV)		Germination energy (GE)		Germination relative index (GRI)	
	A. crassicarpa	*A. mangium*	*A. crassicarpa*	*A. mangium*	*A. crassicarpa*	*A. mangium*	*A. crassicarpa*	*A. mangium*
Cold water	15.0	15.0	1.90	1.84	0.78	0.74	434	404
Hot water	75.0	90.0	17.50	51.50	1.49	4.28	703	1986
LSD ($p < 0.05$)	12.5		6.8		0.57		30.0	

vigorous seedlings in the field (Aldhous 1972). This will then ensure early commencement of growth and less care is required when outplanted (Chakraborty 1989, Dinesh 1990). GE was high when seeds of both species were sown after inundation with hot water. For the GRI, maximum values were also observed in hot water inundation. GV combines total germination capacity and GE, and hence is a better measure of seed performance. It is an integrated measure of seed quality and has been used by several tropical seed workers (Costales & Veracion 1978, Swaminathan *et al.* 1991, 1993). In this study, GV of seeds inundated with hot water proved their superiority in both the tree species.

Comparing the two tree species, we observed that in all hot water inundation experiments, *A. mangium* had higher values for all the parameters evaluated compared to *A. crassicarpa*. The enhanced germination in seeds inundated with hot water (80 °C) might be attributed to piercing and softening of the impervious seed coat by the hot water and its infusion into the endosperm which facilitates embryo rehydration and faster germination. Hot water inundation is relatively an easier, cheaper and safer method compared to chemical soaking or acid wash and has been proven suitable for acacias, albizias and leuceana. This has been very well documented by a few workers (Suresh 1991, Vanangamudi & Srimathi 1991).

It is concluded that germination in *A. crassicarpa* and *A. mangium* can be maximised to as high as 90% by inundating the seeds with hot water and soaking them for 24 hours.

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