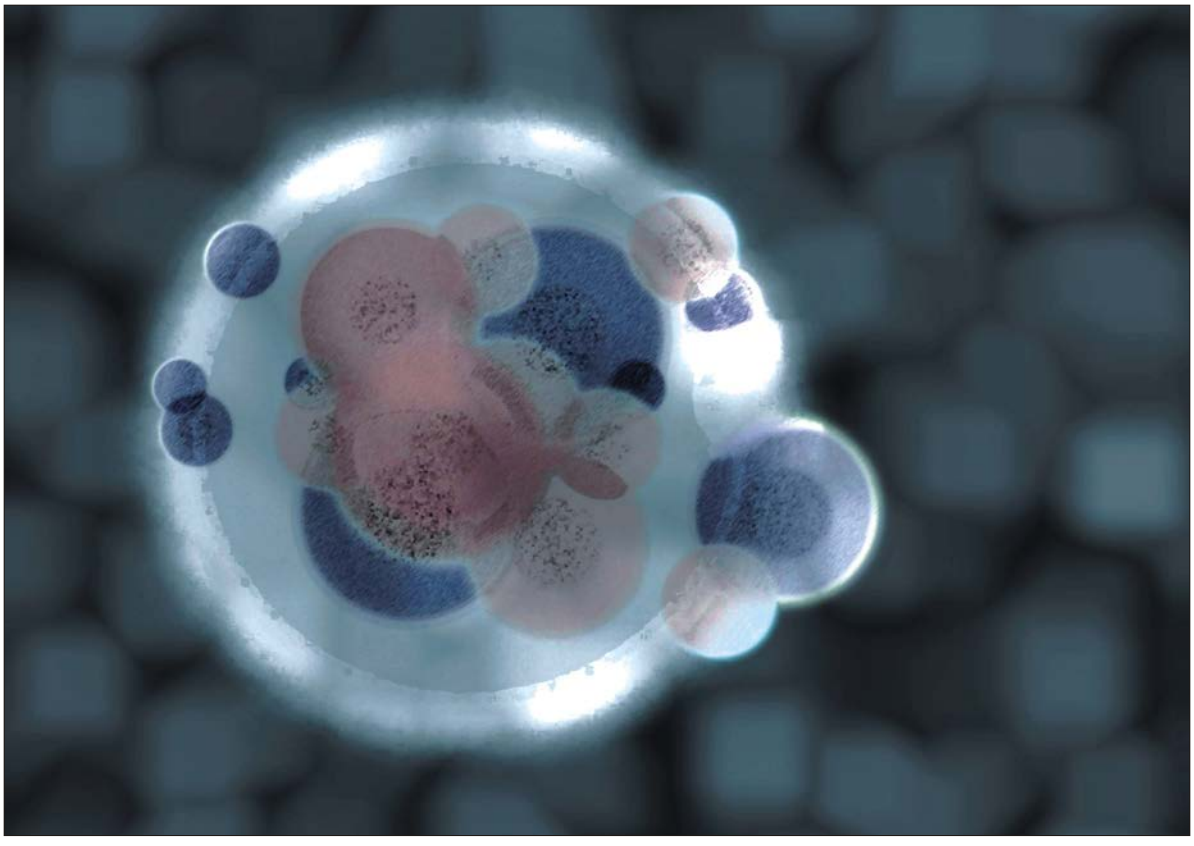

Journal of Biological Sciences

ISSN 1727-3048

science alert

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Journal of Biological Sciences 5 (3): 309-311, 2005
ISSN 1727-3048

Seed Treatments for Enhancing Germination of *Colophospermum mopane* Seeds: A Multipurpose Tree in Botswana

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Abstract: Laboratory trials were carried out to evaluate the effects of concentrated sulphuric acid (98%), mechanical scarification, hot water, cold water and dry heat on the germination capacity of five-years-old *Colophospermum mopane* seeds. The results showed that treating five-years-old *C. mopane* seeds with concentrated sulphuric acid (98%), mechanical scarification, cold water and dry heat had no effect on the germination capacity of mopane seeds. Simmering hot water significantly decreased germination capacity. The results showed that *Colophospermum mopane* seeds stored for five years still attain germination percentage above seventy. It is concluded that *C. mopane* in Botswana have no hard seed coat or impervious seed coat and physiological dormancy as an adaptation to arid and desert conditions.

Key words: *Colophospermum mopane*, seed dormancy, hot water, germination

INTRODUCTION

Colophospermum mopane tree is indigenous to Botswana. The species is locally known as mophane and exhibits a peculiar pattern as it is only found in the north and eastern parts of the country. Mopane is widely distributed in southern Africa growing in Angola, Botswana, Malawi, Mozambique, Namibia, South Africa, Zambia and Zimbabwe[1,2] occurring in pure stands in hot, dry low-lying areas on alluvial or lime rich soils[3].

Colophospermum mopane is a multipurpose tree species that provides many benefits of great economic importance in southern Africa. The tree produce valued timber which is used for construction and fencing[4,5]. The tree provides excellent fuel wood and produces very good charcoal[6]. The heartwood is attractive, dark, reddish brown in colour, hard and termite resistant and often used for implements[3,7]. The tree is browsed by elephants[8-14]. The leaves are eaten by domestic animals during drought[9,15]. The leaves retain their nutritional value after falling on the ground.

The tree hosts a sap-sucking insect (*Arytania mopani*) that produces a sweet waxy cover on mopane leaves and the waxy is eaten by people. It also hosts a tiny bee (*Plenina denoita*) that produces edible honey. *Colophosepermum mopane* is a host to mopane worm, the larvae of the moth (*Gonimbrasia belina*). The moth lays eggs on mopane trees. The worm is a famous protein rich human food and economic resources in southern Africa[6,14-16]. The mopane worm is a well established and provides seasonal employment to rural households in Botswana[17].

Seed germination is a critical stage in the development and life cycle of many arid and semi-arid plants. It ensures the reproduction and consequently controls the dynamics of the population[18]. Several uncontrolled factors may influence germination percentages in arid and semi-arid natural environments particular seed dormancy. Seeds are pre-treated to break dormancy and speed up germination and to improve irregular germination that is spread over a long period of time resulting in seedlings of uneven size.

The present study was carried out to investigate the effect of sulphuric acid, hot water, cold water, dry heat and mechanical scarification on the germination of *colophosperm mopane* seeds.

MATERIALS AND METHODS

Experimental site: The experiment was carried out in the Plant Physiology Laboratory in the Crop Science and Production Department, at Botswana College of Agriculture, Gaborone, Botswana. The Botswana College of Agriculture is on latitude 24°34'S and longitude 25°54' E with an altitude of 994 m above sea level located at Sebele, 10 km north of Gaborone, along the north to

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south highway. Seeds were obtained from the Botswana National Tree Seed Centre in Gaborone, Botswana. The seeds were collected from Majwaneng village in the Central District of Botswana in 1998.

Experimental design and procedure: The experiment used a Randomised Complete Block Design with six treatments and three blocks. A total of 900 seeds were used for this experiment. 50 seeds represented each treatment in each block.

Treatment 1: In the sulphuric acid (98%) treatment seeds were put into a 500 mL heat resistant non-corrosive beaker and sulphuric acid (H_2SO_4) was poured slowly on the side of the beaker to a level were seeds were covered (200 mL). The seeds were left for 5 min after which the seeds were removed and drained off into another beaker. The seeds were thoroughly washed and rinsed to remove all the acid. The seeds were then germinated in petri dishes containing moist cotton wool.

Treatment 2: In the mechanical scarification seed coats were slightly cracked using a hand leaving a small crack on the seed coat. Seeds were then germinated in petri dishes containing moist cotton wool.

Treatment 3: In the hot water treatment, water was boiled to a temperature of 98.5°C The water was then poured slowly into a 500 mL heat resistant non-corrosive beaker containing seeds. The seeds were left in hot water for 5 min after which the seeds were removed and drained off into another beaker. The seeds were rinsed in cold tap water and thereafter germinated in petri-dishes with moist cotton wool.

Treatment 4: In the cold water treatment seeds were soaked in distilled water for 24 h at room temperature after which they were germinated in petri-dishes with moist cotton wool.

Treatment 5: In this treatment seeds were put in an oven preheated at 80°C. Seeds were left for 5 min inside the oven after which they were cooled in cold water and germinated using the procedure described in treatments 1 to 4.

Treatment 6: In this treatment (control) seeds were germinated using the procedure described in treatments 1 to 4. Seed germination was monitored every day for three weeks and germinated seeds were removed from dishes after counting. Germination here refers to the protrusion of the radicle.

Data analysis: Analysis of variance was performed on the data collected using the general linear models (Proc GLM) procedure of the statistical analysis system program package. Treatment means were separated using the Duncan Multiple Range Test.

RESULTS AND DISCUSSION

After two weeks cold-water treatment showed the highest germination percentage (78%) followed by dry heat (73%), concentrated sulphuric acid (72%) and mechanical scarification (70%). These four treatments were not significantly different from the control (70%) at 5% significant level (Table 1). Treating seeds with hot water for 5 min significantly decreased germination of *colophospermum mopane* seed compared to cold water, dry heat, sulphuric acid, mechanical scarification and control (Table 1).

For seeds to germinate moisture, warmth and oxygen are essential[19]. Seeds of some trees and shrubs species are ready for sowing as soon as they are collected and others pass through periods of dormancy[20]. Dormancy is a condition where healthy and well-developed seeds do not always germinate when sown at optimal temperature and moisture[21]. Seed dormancy prevents immediate germination but also regulates the time, condition and place that germination will occur[22]. In Botswana due to the erratic, unreliable, semi-arid and desert conditions most tree and shrub species develop one or more forms of dormancy as a survival mechanism to preserve the species[22]. The most frequent encountered type of dormancy in dryland regions is exogenous which is associated with mechanical, physical, or chemical properties of the pericarp or seat coat[23,24].

The results of the present study showed that *Colophospermum mopane require no* pre-pre-treatment. The results also showed *Colophosepermum mopane* seeds do not have any type of dormancy in Botswana. The seed coat is permeable and seeds will germinate when the environmental conditions (water, temperature are aeration) are permissive for germination.

Table 1: Mean percents of total germination of different treatments (sulphuric acid, mechanical scarification, hot water, cold water and oven heating) on five years old *Colophospermum mopane* seeds

Treatments	Means (germination %)
Sulphuric acid	72a
Mechanical scarification	70a
Hot water	15b
Cold water	78a
Dry heat	73a
Control	70a

Values followed by the same letter are not significantly different from each other ($p>0.05$)

From the results of this study it can be concluded that *C. mopane* seeds do not require any pre-treatment to induce germination. The results also showed that mopane seeds do not have any dormancy. *Colophospermum mopane* seeds stored for more than five years can still attain germination percentage of seventy. Therefore, present study recommend no pre-treatment for mopane seeds.

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