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Short communication

Dormancy and germination of *Areca triandra* seeds

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Abstract

The dormancy mechanisms of *Areca triandra* Roxb. Ex Buch-Ham seeds were studied by treating the intact or mechanically scarified seeds with scarification, chemical soaking and stratification. The results indicate that the seeds have exogenous and endogenous dormancy. The exogenous dormancy is imposed by the pericarp and it is the major limiting factor for germination. It can be broken by mechanical scarification, but not by chemical scarification in 98% H_2SO_4 for 30 min. Chemical treatments (soaking for 24 h in 100–200 mg/L GA_3, 0.2% KNO_3 and 0.1–0.3% $NaNO_2$, and for 12 h in 10% H_2O_2 or 20 min or 12 h in 15% H_2O_2) and stratifications, especially, cold stratifications for 30–120 days, broke the endogenous dormancy and significantly hastened germination of mechanically scarified seeds, although they did not increase the germination percentages.

Keywords: *Areca triandra*; Seed; Scarification; Chemical treatment; Stratification

1. Introduction

Areca triandra Roxb. Ex Buch-Ham is a rare clustering Arecaceae species with a slim and grass green trunk, dark green leaves and bright red fruits, so it is often planted as an ornamental for its high appreciation value. It is native to India and Malaysia, and has been introduced to many tropical and subtropical areas. In South China, it is an important ornamental tree planted along streets. Its fruit is orange or bright red when ripe and is an ovoid indehiscent drupe with two main parts: pericarp and seed. The seed is oval with one flattened end. Many gardeners, nurseries and growers experienced low germination in fresh *A. triandra* seeds if without any pretreatments because of dormancy.

In general, there are two types of seed dormancy: exogenous and endogenous (Leadem, 1997). Seeds with exogenous dormancy usually have pericarp and/or seedcoat impermeable to oxygen and/or water, and occasionally, germination inhibiting chemicals in epidermis or adjacent interior membranes. Under natural conditions, the seeds remain on or in the ground without germinating until they have weathered sufficiently, to allow penetration of water, exchange of gases, or release of inhibiting chemicals. Treatments to break exogenous dormancy include scarification, hot water, dry heat, fire, acid and other chemicals, mulch, water, cold and warm stratification. Endogenous dormancy is caused by physiological conditions to delay germination. Seeds with endogenous dormancy germinate poorly or not at all, and they require moisture and either high or low temperatures or both in sequence, or after-ripening to break dormancy. In some cases, use of some chemicals can substitute part or all of the after-ripening or stratification requirements. Seeds of some species have both exogenous and endogenous dormancy. They need treatments for the impermeable coating structures first, and then for endogenous dormancy (Bewley and Black, 1994; Leadem, 1997).

Almost all species, including *A. triandra*, in Arecaceae family can only regenerate from seeds in natural environments (Koebernik, 1971; Nagao et al., 1980). Low seed germination has been a problem in stand establishment of *A. triandra* on sites where its seeds are sown and in seedling production in nurseries. However, the mechanism of seed dormancy for this species is unknown. The objectives of this study were to investigate this mechanism, and to find methods to break dormancy for achieving rapid, uniform and high germination.

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2. Materials and methods

Fruits of *A. triandra* were collected from more than 10 individual trees during the summer and fall of 2002 from South China Botanical Garden at Guangzhou City, China (22°N and 112°E) where the annual average rainfall is 1600 mm; temperature, 21 °C; relative humidity, 77%. They were washed immediately after harvesting to get rid of the fleshy epicarps. In this paper, an intact seed includes four parts: pericarp consisting of sarcocarp and endocarp, testa, embryo and endosperm. The moisture content of fresh seeds was 40.56 ± 0.28%. It was determined by [(fresh weight − dry weight)/fresh weight] × 100, where fresh and dry weights were based on the weights of 4 samples, 20 seeds each, before and after oven drying at 103 ± 2 °C for 17 ± 1 h. Seeds received different treatments (scarification, chemicals and stratification) that are described below, before they were used in germination tests.

2.1. Scarification treatments

Scarification was applied to intact seeds and included mechanical and chemical scarification. The mechanical scarification was careful removing part of the pericarp at the hilum side of the intact seeds with a sterilized sharp machete without damaging the embryos. The chemical scarification was soaking the seeds in 98% H_2SO_4 for 30 min.

2.2. Chemical treatments

Chemical treatments were applied to mechanically scarified seeds. A total of 20 mL stock solution was made for each of benzyladenine (BA), KNO_3, $NaNO_2$ and H_2O_2 with distilled water, and GA_3 with 95% ethanol. These stock solutions were then diluted with distilled water to different concentrations of test solutions. Chemical treatments were soaking seeds in beakers containing 50 ml of the testing solutions at 25 °C in the dark as follows: 24 h in GA_3 at 100, 150, 200, 250 and 500 mg/L; in BA at 5, 10, 15, 20 and 25 mg/L; in KNO_3 at 0.1 and 0.2%; in $NaNO_2$ at 0.1, 0.2 and 0.3%; 20 min or 24 h in H_2O_2 at 5, 10, 15 and 20%; 30 min in 98% H_2SO_4. After soaking, seeds were rinsed in deionised water prior to germination tests.

2.3. Stratification

Mechanically scarified seeds were allowed to imbibe for 24 h in distilled water at ambient temperature and subsequently transferred to sealed plastic boxes containing moist sand. These boxes were placed in a refrigerator set at 4 °C for 30, 60, 75, 120 days and 10–15 °C for 60 days.

2.4. Germination tests

Quadruplicate samples of 40 seeds were randomly chosen from seeds in all the above treatments and untreated dehulled seeds. The untreated dehulled seeds were used as controls. All the treated and untreated controls, except the seeds soaked in GA_3 solutions, were firstly soaked in distilled water for about 24 h, and all the seeds were surface-sterilized by soaking in 0.1% $HgCl_2$ for 15 min and subsequently rinsed thoroughly with sterilized water. All seed samples were then placed in 12 cm-diameter glass petri dishes, one sample per petri dish, to germinate in an incubator at a constant temperature 30 °C with a 12 h daily photoperiod at 2000–3000 lx provided by cool white fluorescent lamps. The petri dishes contained 0.9% agar. Seed germination was defined as the appearance of a radicle over 5 mm in length. Germinated seeds and rotted seeds were counted every other day and removed. The germination tests lasted 120 days or less if there were no more seeds to germinate.

2.5. Statistical analysis

Germination percentage (GP) was calculated as [(the number of germinated seeds)/the number of sampled seeds] × 100. To measure germination speed, germination index (GI) was calculated by $\sum$(Gt/Dt), where Gt is the number of germinated seeds after *t* days (Dt). GP was transformed to arcsine of the square root of GP in degrees before analysis in order to obtain an approximately normal distribution. The transformed GP and GI were subjected to one-way analysis of variance using Excel (Microsoft, Inc., 1985–1999), and LSD test was used to determine if there were significant ($p < 0.05$) differences among treatment means. However, original GP data are presented in our text.

3. Results

3.1. Scarification treatments

The mechanically scarified seeds started germination after 3 days of incubation and reached GP 90% and GI 5.46 after 75 days, respectively. They germinated signifiantly more and faster than intact seeds and chemically scarified seeds (Fig. 1). The intact seeds started germination after 34 days and had GP

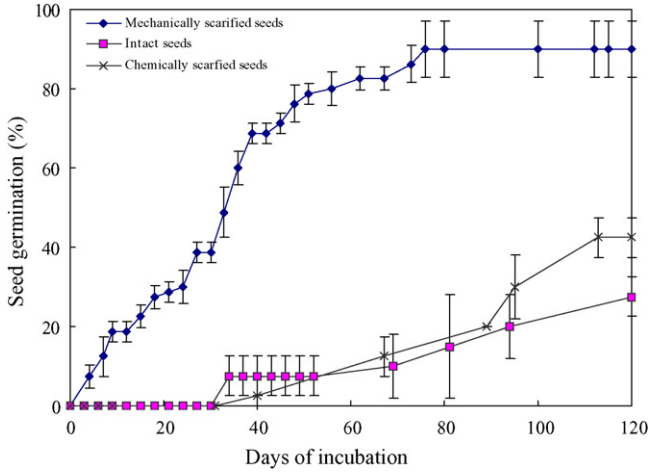

Fig. 1. Germination of scarified *A. triandra* seeds over time. Vertical bars represent standard deviation.