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Germination and storage of recalcitrant seeds of some tropical forest tree species

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Introduction

Seeds have been termed orthodox or recalcitrant by Roberts (1973) to describe their storage behavior. Orthodox seeds tolerate dehydration down to 5–10% (dry weight basis) without damage. Prepared in this manner, these seeds can be stored for long periods and their viability can be prolonged at the lowest temperature and moisture content possible. Recalcitrant seeds are highly hydrated and they cannot withstand intensive desiccation. They originate predominantly from tropical or subtropical tree species. These seeds can only be stored in wet medium to avoid desiccation injury and at relatively warm temperature, since most of them are sensitive to chilling (King and Roberts, 1979).

The aim of the present study was to analyze the germination of some recalcitrant seeds of tropical forest trees, and the effects of dry and wet storage on their viability.

Materials and Methods

Experiments were carried out with seeds of two Dipterocarps collected in Thailand at the Phu Khac Botanical Garden *(Shorea roxburghii)* and the Meak Lek Arboretum *(Hopea odorata),* and seeds of *Simarouba amara* (Simaroubaceae) and *Symphonia globulifera* (Guttiferae) collected in the dense forest near Kourou, French Guiana.

Germination tests were performed in darkness, at temperatures between 5 and 35°C, on cotton wool saturated with deionized water and placed in plastic rectangular boxes (18 cm long x 12 cm wide x 5.5 cm deep). 50–100 seeds were used in each test (10–25 seeds per box).

To study the effect of dehydration on viability, seeds were placed in open air at 20°C and 55% relative air humidity. Samples were periodically removed, weighed and placed for germination at 30°C. Viability was expressed by the maximal germination percentage. Moisture content was calculated on a fresh weight basis.

Wet storage was performed at 5, 8, 10, 12, 15 and 20°C, on cotton wool imbibed with deionized water after seed treatment with quinolate (copper oxyquinoleate). Viability was periodically tested by transferring seeds to 30°C.

All results concern seeds visually healthy at harvest time.

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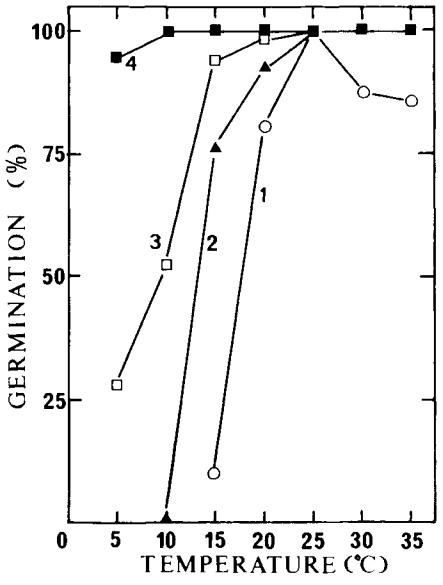

Fig. 1. Effect of temperature on the germinative capacity of *Simarouba amara* (**1**), *Symphonia globulifera* (**2**), *Shorea roxburghii* (**3**) and *Hopea odorata* (**4**) seeds.

Results

Germination of freshly harvested seeds

Freshly harvested seeds had no dormancy. In all cases, germination was best at relatively high temperatures (optimum at 25–30°C) (Fig. 1). Below 15°C, it was reduced *(Shorea roxburghii)* or impossible *(Symphonia globulifera* and *Simarouba amara),* but *Hopea odorata* seeds germinated even at 5°C.

Effect of dry storage

Initially, the mean moisture content of seeds was relatively high: 67% for *Symphonia globulifera,* 39% for *Simarouba amara,* 33% for *Hopea odorata* and 26% for *Shorea roxburghii.* All seeds were dead when their mean moisture contents decreased to about 8% for *Simarouba amara,* 15% for *Shorea roxburghii* and

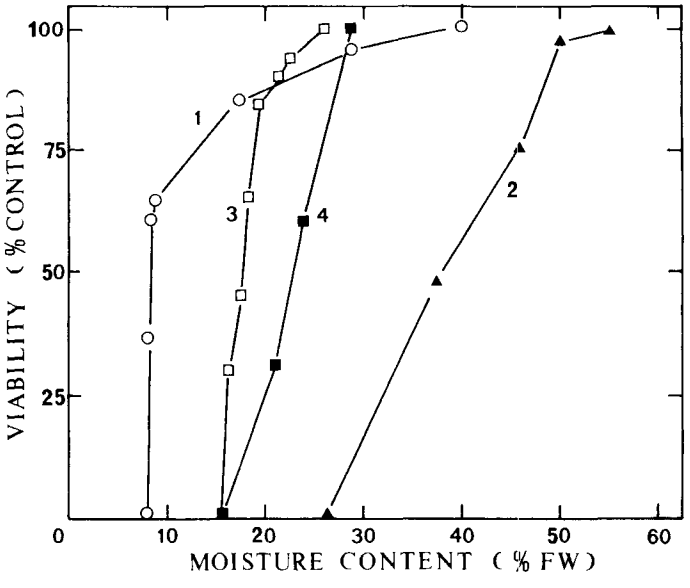

Fig. 2. Relation between moisture content (fresh weight basis) and viability of *Simarouba amara* (**1**), *Symphonia globulifera* (**2**), *Shorea roxburghii* (**3**) and *Hopea odorata* (**4**) seeds.

Hopea odorata and 26% for *Symphonia globulifera* (Fig. 2). *Simarouba* seeds remained viable at relatively low moisture content, but they produced abnormal seedlings.

Effects of wet storage

Seeds often started to germinate during storage. Moreover, seeds or seedlings were easily injured by chilling when the temperature decreased below 10°C for *Shorea roxburghii,* 15°C for *Symphonia globulifera* and 20°C for *Hopea odorata* and *Simarouba amara* (Fig. 3). At temperatures that do not result in chilling injury, seedling growth was too fast to allow extended storage. Storage duration did not exceed 2–3 months except for *Symphonia globulifera* (2–3 y at 15°C).

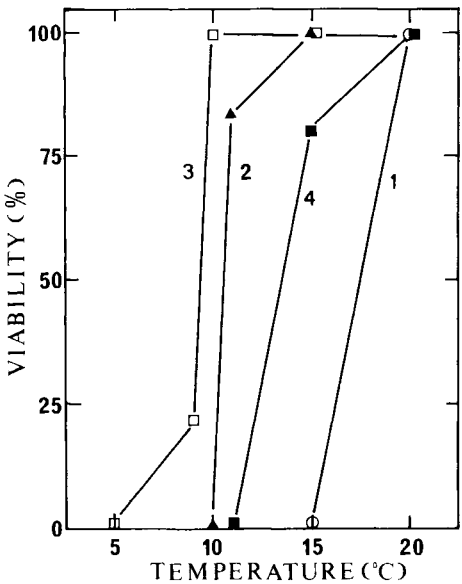

Fig. 3. Effect of temperature of wet storage on viability of *Simarouba amara* (**1**), *Symphonia globulifera* (**2**), *Shorea roxburghii* (**3**) and *Hopea odorata* (**4**) seeds.

Discussion and Conclusion

Seeds of *Shorea roxburghii, Hopea odorata, Symphonia globulifera* and *Simarouba amara* are not dormant and, as for many other tropical species (Côme, 1982), they germinate easily at high temperatures. However, seeds of *Hopea odorata* are also able to germinate at relatively low temperatures (5°C). They are highly hydrated and lose viability when the moisture content decreases. They are typical recalcitrant seeds whose sensitivity to desiccation depends upon the species (King and Roberts, 1979; Corbineau and Côme, 1988). Dry storage is impossible and wet storage is difficult, because the temperature must be low enough to prevent germination or reduce the rate of seedling growth, but a relatively low temperature is linked to a risk of chilling injury. So far, long-term storage methods for recalcitrant seeds of tropical forest trees do not exist. Use of solutions with a suitable osmotic pressure to avoid germination and growth or of cryoprotective agents to enable seeds or young seedlings to withstand low storage temperatures are perhaps possible approaches to increase storage life.

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