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Seed quality for conservation is critically affected by pre-storage factors

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Abstract. The quality of seed-conservation collections, and hence their value for species reintroduction or restoration, is critically dependent on factors operating in the period between the point of collection and arrival at environmentally controlled processing and storage facilities. The timing of the acquisition of desiccation tolerance and seed longevity in air-dry storage, in relation to mass maturity and the time of natural seed dispersal, varies across species. In some wild plant species, seed quality continues to improve up to, and possibly beyond, the point of dispersal. Holding immature berries of *Solanum dulcamara* L. and capsules of *Digitalis purpurea* L. under natural conditions enabled comparison of seed quality between seeds stored under natural conditions and those dried rapidly under seedbank dry-room conditions. While seeds from fully ripe (post-mature) capsules of *D. purpurea* were insensitive to different post-harvest drying treatments, seed quality declined when mature berries of *S. dulcamara* were held under natural conditions. These results emphasise that the selection of post-harvest treatment will not only depend on the maturity of collected seeds but also may vary across species depending on the fruit type. Except for subtropical and tropical coastal locations, ambient daytime conditions during the main seed-collecting season (November–February) across Australia can be expected to result in tolerable rates of seed deterioration for the duration of seed-collecting missions. However, because seed moisture levels can be considerably higher than when equilibrated with ambient relative humidity, post-harvest handling decisions should ideally be informed by measurements of seed moisture at the time of collection, and subsequently seed moisture should be monitored during transit.

Introduction

The justification for conserving threatened plant species as seeds has never been more compelling. To combat loss of biodiversity, the Conference of the Parties of the Convention on Biological Diversity in 2002 adopted the global strategy for plant conservation (GSPC). Among the 16 outcome-oriented targets of the GSPC, to be achieved by 2010, Target VIII calls for '60% of threatened plant species in accessible *ex situ* collections, preferably in the country of origin, and 10% of them included in recovery and restoration programmes' (http://www.biodiv.org/programmes/cross-cutting/plant/targets.shtml).

Given that seedbanking is a straightforward and cost-effective technology and at least 90% of the world's plant species are suited to this method of *ex situ* conservation (Hong *et al.* 1998), achieving such a target would appear to be simple. Although, in many countries, initiatives such as the Royal Botanic Gardens, Kew, Millennium Seed Bank Project are indeed making a significant contribution to the achievement of Target VIII, there are inherent difficulties in securing high-quality seed-conservation collections. The present paper will review some of the threats to seed-collection quality that arise during the period between collection and processing and storage under ideal conditions. First, we review issues related to the variation among species in the relative timing of the acquisition of seed-quality traits. Then we present data on two contrasting UK species that reveal the beneficial effects on seed quality of post-harvest treatments that result in delayed seed-drying. The final section addresses the effects of environmental conditions and the condition of seeds themselves at the time of harvest on the potential rate of deterioration during the immediate post-harvest period.

Variation in the acquisition of seed-quality traits

The ability to germinate, withstand desiccation to a low moisture content, and remain alive during subsequent storage are seed-quality traits that are acquired during the course of development and maturation. The relative timing of the development of these traits in relation to the time that seeds attain maximum dry weight (mass maturity) and the time when seeds or fruits are dispersed varies among species (Fig. 1). In some species seeds acquire the ability to germinate when fresh, before they acquire desiccation tolerance. However, in cereals such as barley and wheat the reverse is true, and in rice (*Oryza sativa* L.) immature seeds germinated to higher levels when they were dried than did fresh seeds (Aldridge and Probert 1993), this probably being related to the presence of seed dormancy. In many species the ability of seeds to withstand desiccation to the moisture levels used in long-term conservation is acquired around the time of mass maturity. In contrast, desiccation tolerance is acquired before

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