Desiccation sensitivity of excised embryonic axes of selected amaryllid species[†]

Sershen, Patricia Berjak and Norman W. Pammenter*

School of Biological and Conservation Sciences, University of KwaZulu-Natal, Durban, 4041 South Africa

Abstract

The present study assessed the desiccation sensitivity of the excised embryonic axes of the following *Amaryllidaceae* species: *Scadoxus puniceus*, *Amaryllis belladonna*, *Nerine huttoniae*, *N. humulus*, *N. bowdenii*, *N. filifolia*, *Haemanthus humulus humulus*, *H. coccineus*, *H. deformis*, *H. bakerae*, *Brunsvigia gregaria*, *Brunsvigia orientalis*, *Boophane disticha*, *Strumaria discifera*, *Crinum macowanii* and *C. bulbispermum*. Excised embryonic axes were rapidly dehydrated (flash-dried). Curves of water content $(g\,g^{-1})$ and viability (%) versus drying time (min) were used to interpolate the water content (WC) and drying time (DT) values corresponding to 80% viability (WC/DT, $V = 80$) for individual species, and used to compare desiccation sensitivity between developmental stages and among years, provenances, species and genera. The seeds of all 16 species were shed with high axis water contents (2.25 ± 1.34 to $6.95 \pm 0.89\,g\,g^{-1}$) and were sensitive to desiccation, with WC $V = 80$ values ranging from 0.13 to $3.15\,g\,g^{-1}$. Germination in amaryllids is unusual in that part of the cotyledon, to which the embryonic axis is attached, grows right out of the seed. It is at this stage that the axes were found to be more desiccation-sensitive in six out of nine species investigated. Seed fresh mass (SFM), axis shedding water content (SWC) and the degree of desiccation sensitivity were species characteristic. SWC, SFM and drying time were not significantly related to desiccation sensitivity. Parent plants were not confined to any particular biome type, occurring in areas characterized by seasonal dry spells. Parent plant habitat and seed characteristics were not useful in predicting the degree of desiccation sensitivity across species belonging to the same family.

Introduction

Recalcitrant seeds are usually shed at water contents greater than $0.40\,g\,H_2O$ per g dry matter $(g\,g^{-1})$ (Pammenter and Berjak, 1999), and are metabolically active even when in a relatively quiescent phase of development (Berjak *et al.*, 1989; Farrant *et al.*, 1989). While orthodox seeds can withstand dehydration to water contents as low as $0.05\,g\,g^{-1}$, recalcitrant seeds lose vigour with relatively little drying (Chin and Roberts, 1980; Hong and Ellis, 1996), although slight, short-term dehydration is tolerated by recalcitrant seeds of some species and, paradoxically, can enhance metabolic activity (Pammenter *et al.*, 1998). However, desiccation tolerance *sensu stricto* never develops (Finch-Savage, 1992; Vertucci *et al.*, 1994), and any further drying always results in rapid loss of vigour and viability (Berjak and Pammenter, 2004).

However, the accumulation of damage resulting from aqueous-based deleterious reactions in recalcitrant seeds can be reduced when water is removed sufficiently rapidly (Berjak *et al.*, 1990, 1992; Pritchard, 1991), and generally the more rapid the dehydration, the lower the water content – within limits – to which these seeds can be dried without viability loss (Pritchard, 1991; Potts and Lumpkin, 1997; Pammenter *et al.*, 1998). Even though production of large seeds is common amongst recalcitrant-seeded species, extremely rapid drying rates can be achieved when the excised embryonic axes are dehydrated, as originally shown by Normah *et al.* (1986).

Even though the majority of known recalcitrant-seeded species are dicotyledonous trees of tropical origin, several monocotyledonous species, e.g. *Cocos*

*Correspondence
Fax: + 27 31 260 1195
Email: pammente@ukzn.ac.za