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A controlled deterioration test for *Arabidopsis thaliana* reveals genetic variation in seed quality

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Summary

Several ecotypes (Landsberg *erecta*, Enkheim, Cape Verde islands and C24) and mutants (*aba1-1*, *abi3-7*, *gal-1* and *tt4-1*) of *Arabidopsis thaliana* L. were subjected to a variety of seed quality tests to assess genetic variation. The wild type (Landsberg *erecta*) and two mutants (*abi3-7*, *tt4-1*) gave close to 100% germination at 25°C whilst other genotypes and mutants showed varying degrees of dormancy. A controlled deterioration assay was developed to compare genotypes with regard to their storability. Equilibration of the seeds at 85% relative humidity and subsequent hermetic storage at 40°C was more discriminatory in identifying differences in storability than was equilibration at 75% relative humidity followed by storage at 40 or 50°C. With longer deterioration treatments, germination was reduced and average germination time and frequency of abnormal seedlings increased. This test revealed clear differences in seed stress tolerance amongst genotypes. Additional differences in seed quality were observed in germination tests performed at sub-optimal conditions, such as low temperatures (10 and 15°C) or under osmotic stress (-0.25 MPa and -0.50 MPa). The observed differences in seed quality and the assays developed can be used to identify genes involved in different aspects of seed quality.

Introduction

Crop productivity depends on the initial establishment and growth of the seedlings. This results from the interactions between climatic and soil conditions and the ability of the seedling to withstand sub-optimal field conditions. Moreover, seed lots may react differently to similar conditions and stresses, reflecting differences in seed vigour. Seed vigour defined by the International Seed Testing Association (ISTA), is “the sum total of those properties of the seed which determine the level of activity and performance of the seed or seed lot during germination and seedling emergence” (Hampton and TeKrony, 1995).

Ageing during storage has been recognised as a major cause of reduced seed vigour and viability. Ageing is accompanied by physiological and physical damage to cell membranes (Powell, 1986, 1988), as well as by respiratory and hormonal changes, impaired RNA and protein synthesis, and accumulation of toxic metabolites (Priestley, 1986). Such deterioration results in reduced speed and uniformity of germination, a decreased tolerance to environmental stresses, and reduced seedling emergence and growth (Roos, 1980; Powell *et al.*, 1984; Hampton and Hill, 1990).

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