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The effects of moisture and oxygen on the accumulation of chromosome damage in relation to loss of viability in stored onion (*Allium cepa* L.) seed

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ABSTRACT

It was shown that when onion seeds are germinated at a constant temperature (23°C) in 12-hour photoperiods, there is: (i) a diurnal rhythm of cell divisions with peaks occurring at the end of the light period; (ii) an increase in mitotic activity with increasing length of the root tip in which mitosis is initiated when the root is approximately 2.0-2.6 mm; and (iii) a overall gradual decline in mitotic activity with time. These three tendencies can be described by a single equation.

Under *dry* storage conditions, there is a linear relationship between seed viability and the frequency of aberrant cells plotted on probability scale, irrespective of storage temperature or moisture content. Similarly, there is a quantifiable relationship between seed viability and the proportion of seeds which produce morphologically abnormal roots under these conditions. This is not linear, but of a form which suggested that there is a similar period before death in any seed in a population when it would produce morphological abnormalities if it germinated.

In *moist* storage, there is also an increase in the frequency of aberrant cells with loss of seed viability, but for any given percentage viability the frequency of aberrations is less than in dry seeds. Under these conditions, there is no evidence of increase in morphologically abnormal roots with decrease in viability.

Oxygen is deleterious to seed survival at low moisture contents and beneficial at the high moisture content, but it does not affect the relationship between percentage viability and the amount of chromosome damage, or the frequency of morphological adnormalities.

Under both dry and moist storage, it was found that chromatid-type aberrations are the most frequently induced and, of these, the most predominant is the single-fragment aberration. The evidence suggests that some of the aberrations, particularly single fragment, may get repaired in moist seeds.

A pre-storage hydration treatment is capable of increasing seed longevity. Contrary to previous reports, the presence of disodium-phosphate at 10^{-3} M or 10^{-4} M during pre-storage hydration does not further improve survival; and pre-treatment with 10^{-1} M Butylated hydroxytoluene in acetone killed a small proportion of the seeds, but had no detectable effect on the subsequent longevity of the survivors during storage.

Mechanisms of damage and repair of genetic stability in aged seeds, and the practical implication of the results for the long-term conservation of seed germplasm are discussed.