

Subcellular organization and metabolic activity during the development of seeds that attain different levels of desiccation tolerance

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Abstract

Water contents, desiccation tolerance, respiratory rates and subcellular characteristics of three contrasting seed types were studied during development. *Avicennia marina* (a tropical wetland species) and *Aesculus hippocastanum* (a temperate species) produce recalcitrant seeds and *Phaseolus vulgaris* produces orthodox seeds. During development, *A. hippocastanum* and *P. vulgaris* seeds showed a decline in water content and respiration rate with a concomitant increase in desiccation tolerance. These parameters did not change during the development of *A. marina* seeds once they had become germinable. There was a decrease in the degree of vacuolation and an increase in the deposition of insoluble reserves in *A. hippocastanum* and *P. vulgaris* seeds, while *A. marina* seeds remained highly vacuolated and did not accumulate insoluble reserves. Mitochondria and endomembranes degenerated during the development of *A. hippocastanum* and *P. vulgaris* seeds, but remained unchanged in *A. marina* seeds. The data are consistent with the hypothesis that extensive vacuolation and high metabolic rates contribute to desiccation sensitivity. However, the development of recalcitrant *A. hippocastanum* seeds is similar to that of orthodox *P. vulgaris* seeds. These data are in accord with the concept of seed recalcitrance being a consequence of truncated development. The results suggest that there may be three categories of seeds: orthodox seeds which develop desiccation tolerance, seeds which show similar development to orthodox seeds, but are shed before desiccation tolerance is well developed, and seeds which show no developmental trends giving rise to increased tolerance.

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