Abstract

Seeds of all species lose their viability during long-term storage under controlled conditions. The aim of this study was to identify the factors influencing the seed germination as well as seedling emergence and growth of seven ecologically valuable forest tree species: *Malus sylvestris* (L.), *Pyrus communis* (L.), *Sorbus aucuparia* (L.), *Prunus avium* (L.), *Prunus padus* (L.), *Cornus sanguinea* (L.), and *Pterocarya fraxinifolia* Poir. (Spach.). After collection, seeds in pericarps were dried in room conditions to ca. 11% of moisture content (MC), and subsequently desiccated further (over silica gel) to ca. 8% and 5%. In the case of *P. fraxinifolia*, the tested MC range was 2.8–29.6%. Next, the sealed seed lots were stored at -3°, -18°, or -196°C (in liquid nitrogen; LN) for up to 3 years. After storage, the seeds were stratified and their germination, seedling emergence capacity, as well as oxidative stress level in germinating seeds and 3-month-old seedling were determined. Concentrations of hydrogen peroxide (H_2O_2), products of lipid peroxidation (thiobarbituric acid reactive substances, TBARS), and ascorbic acid (AsA) were assessed. In one-year-old seedlings, we measured their height, root collar diameter, the nitrogen content of roots, and the total surface area of fine roots.

Seeds of *M. sylvestris* desiccated below 4.9% of MC showed reduced germination and seedling emergence levels, irrespective of storage temperature. Seeds of *P. avium* were susceptible to lower storage temperatures (-18° or -196°C), as germination and seedling emergence after 3-year storage were then significantly lower in comparison with the control, regardless of their MC. The preferred conditions for the storage of *S. aucuparia* seeds for up to 3 years are: MC below 11.1% and temperature of -3°C. In the case of *P. padus* and *C. sanguinea* seeds, germination and seedling emergence were at similar levels, regardless of the storage conditions and storage time used. I demonstrated for the first time the feasibility of cryogenic storage of seeds of *C. sanguinea, S. aucuparia* (safe MC range: 5.5–11.1%), and *P. fraxinifolia* (safe MC range: 2.9–18.6%). The seed storage conditions did not significantly affect the height and root collar diameter of one-year-old seedlings. Biochemical studies of germinating seeds and seedlings showed that depletion of AsA was the main reason for the poor quality of *M. sylvestris* seeds desiccated to 4.9% MC and stored in LN. Lower *P. avium* seedling emergence was negatively correlated with higher concentrations of H_2O_2, and the oxidized form of AsA. Seeds of *P. padus* were characterized by a balanced proportion of oxidized and reduced forms of AsA, regardless of the storage conditions. Seedlings of *P. padus* tolerated relatively high concentrations of H_2O_2 and TBARS. We observed small but significant effects of seed MC on the nitrogen content of roots and the surface area of fine roots of one-year-old seedlings. The

seedlings developed from the seeds of *P. avium* stored at a MC of 11.2% were characterized by a larger surface of fine roots and a lower nitrogen content. An inverse relationship was observed for *P. padus* seedlings.

Although all the examined species belong to the same category of seed storage behavior (*orthodox*), we have shown some remarkable differences in their response to storage conditions, both at the biological and biochemical level in seeds and seedlings. Strong desiccation of the seeds, especially in combination with a very low LN temperature, was not favorable for the viability of the stored seeds in some species (*M. sylvestris*, *P. communis*, *P. avium*). Nevertheless, the applied storage conditions for the seeds of the tested species for up to 3 years, in a wide temperature range, did not significantly affect the quality of the seedlings developed from them.