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ORIGINAL PAPER

Effect of long-phase stratification treatments on seed germination in ash

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Abstract

• ***Introduction*** Ash (*Fraxinus excelsior* L.) seeds require warm treatment followed by cold treatment to release dormancy and this is most effective if carried out in a medium. The objective of this study was to determine if long periods of warm treatment would enhance germination at 15 (8-h light)/5°C (dark) and 15°C (same lighting conditions) in ash seeds of north-western European origin.

• ***Materials and methods*** Ash seeds were fully imbibed (57% moisture content (MC)) or adjusted to 45% MC either in a medium or without a medium for 10–30 weeks of warm treatment, followed by 10, 20 or 30 weeks of chilling.

• ***Results*** Germination increased at both germination temperature regimes as the duration of warm treatment increased up to 18 (with medium) or 20–30 (without medium) weeks, well after the embryo had completed development (14 weeks). The response to 20 or 30 weeks of chilling was better than that of 10 weeks of chilling, but the impact of chilling was smaller than that of warm treatment.

• ***Conclusion*** Seed MC did not significantly affect germination, but it reduced mould growth. A long warm treatment (followed by cold treatment) without a medium is the recommended treatment for ash seeds.

Keywords Warm treatment · Seed lot · Germination temperature · Chilling · Embryo growth

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1 Introduction

Common ash (*Fraxinus excelsior* L.) seeds[1] become deeply dormant, and this must be broken before germination can occur. The dormancy mechanism is complex. At the time of dispersal in the autumn, the embryo of the ash seed is not fully developed (morphological dormancy) and only occupies about half the embryo cavity. Most embryo development occurs during the year following dispersal, predominantly in response to warm temperatures during the summer (Nowag 1998). Once the seed is mature, the seed coat and other structures, such as the pericarp, restrict growth of the embryo (mechanical dormancy) (Suszka et al. 1996). The seed coat also restricts gas exchange. In addition, a period of chilling is required to release dormancy in the mature embryo (physiological dormancy) (Villiers 1975). The requirement for a period of warmth followed by chilling means that germination does not occur until the second spring following dispersal. Germination may be delayed by slow decomposition of the seed coat or by the seed not receiving adequate warmth during the summer or sufficient chilling during the second winter (Suszka et al. 1996).

Seeds used in artificial regeneration can be allowed to break dormancy naturally outside or alternatively artificially in an incubator or growth chamber (Obroucheva and Antipova 2000). Clearly, it is more difficult to optimise temperatures under ambient conditions outside, so it may be preferable to carry out the pretreatment under controlled conditions. The ISTA (2006) standard treatment for the

[1] Ash seeds are contained in fruits called samaras. Samaras are wing-like structures, about 40 mm long and 6 8 mm wide. Each samara contains one seed. For convenience in this paper, the term seed will be used to refer to the samara.