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Morphophysiological dormancy in seeds of three eastern North American *Sanicula* species (Apiaceae subf. Saniculoideae): evolutionary implications for dormancy break

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Abstract

Dormancy breaking and germination requirements were determined for seeds of the eastern North American (eNA) species *Sanicula canadensis*, *Sanicula gregaria* and *Sanicula trifoliata*, and the data compared to those available for the European–Asian (EurA) congener *Sanicula europaea*. Seeds of the three eNA species had underdeveloped embryos that were physiologically dormant, i.e., morphophysiological dormancy (MPD). Warm (25/15°C) followed by cold (5/1°C) stratification was effective in breaking dormancy in 100% of the *S. canadensis* seeds, but in only 29.3% of *S. gregaria* seeds and 43.3% of *S. trifoliata* seeds. Cold stratification alone broke dormancy in 38.7, 12.0 and 0% of *S. canadensis*, *S. gregaria* and *S. trifoliata* seeds, respectively. Thus, some seeds of *S. canadensis* and of *S. gregaria* that germinated have non-deep complex MPD, and others have deep complex MPD. All seeds of *S. trifoliata* that germinated have non-deep complex MPD. Within a phylogenetic context, the kind (level) of MPD may or may not differ between eNA *Sanicula* sister species because conspecific variation in the kind of MPD exists in seeds of *S. canadensis* and *S. gregaria*. Similarly, the kind of MPD in seeds of eNA *S. canadensis* and *S. gregaria* may or may not differ with the deep complex MPD in seeds of the EurA *S. europaea*. However, the non-deep complex MPD in all seeds of eNA *S. trifoliata* and deep complex MPD in seeds of *S. europaea* represent a distinct difference in this trait between two of the five clades comprising the genus *Sanicula*.

Keywords: Apiaceae, morphophysiological dormancy, *Sanicula*, Saniculoideae, seed germination.

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Introduction

Seeds of many temperate plant species are dormant at the time of seed dispersal, and specific temperature requirements must be met before they will germinate (Baskin & Baskin 1998). Furthermore, within the temperate forest biome, seeds of many herbaceous species contain underdeveloped embryos at the time of seed dispersal. In addition to being underdeveloped, embryos may be physiologically dormant, thus requiring a period of warm and/or cold stratification before the seed can germinate (Nikolaeva 1977). Embryo growth and breaking of physiological dormancy may be synchronous (Baskin *et al*. 1992), embryo growth may be delayed until after physiological dormancy break is completed (Baskin & Baskin 1990; Walck *et al*. 1999), or embryo growth may be completed during the first phase of physiological dormancy break, but radicle emergence does not occur until the second phase of physiological dormancy is broken (Phartyal *et al*. 2009; Vandelook *et al*. 2009). Seeds with underdeveloped embryos that require these dormancy breaking and germination treatments have morphophysiological dormancy (MPD), one of the five classes of seed dormancy (Baskin & Baskin 2004).

Nine kinds (levels) of MPD have been identified, and they are distinguished based on the temperatures required for embryo growth and dormancy break and their responses to gibberellic acid (Baskin & Baskin 2004; Baskin *et al*. 2008). Of the nine known levels of MPD, three

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