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Environmental regulation of dormancy loss in seeds of *Lomatium dissectum* (Apiaceae)

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• *Background and Aims Lomatium dissectum* (Apiaceae) is a perennial, herbaceous plant of wide distribution in Western North America. At the time of dispersal, *L. dissectum* seeds are dormant and have under-developed embryos. The aims of this work were to determine the requirements for dormancy break and germination, to characterize the type of seed dormancy, and to determine the effect of dehydration after embryo growth on seed viability and secondary dormancy.

• *Methods* The temperature requirements for embryo growth and germination were investigated under growth chamber and field conditions. The effect of GA_3 on embryo growth was also analysed to determine the specific type of seed dormancy. The effect of dehydration on seed viability and induction of secondary dormancy were tested in seeds where embryos had elongated about 4-fold their initial length. Most experiments examining the nature of seed dormancy were conducted with seeds collected at one site in two different years. To characterize the degree of variation in dormancy-breaking requirements among seed populations, the stratification requirements of seeds collected at eight different sites were compared.

• *Key Results* Embryo growth prior to and during germination occurred at temperatures between 3 and 6 °C and was negligible at stratification temperatures of 0·5 and 9·1 °C. Seeds buried in the field and exposed to natural winter conditions showed similar trends. Interruption of the cold stratification period by 8 weeks of dehydration decreased seed viability by about 30 % and induced secondary dormancy in the remaining viable seeds. Comparison of the cold stratification requirements of different seed populations indicates that seeds collected from moist habitats have longer cold stratification requirements that those from semiarid environments.

• *Conclusions* Seeds of *L. dissectum* have deep complex morphophysiological dormancy. The requirements for dormancy break and germination reflect an adaptation to trigger germination in late winter.

Key words: Apiaceae, cold stratification, *Lomatium dissectum*, morphophysiological dormancy, secondary dormancy, seed germination.

INTRODUCTION

Lomatium dissectum (fernleaf biscuitroot) is a perennial plant within the Apiaceae family. This species is native to western North America, where it has a wide distribution and occupies habitats with dissimilar characteristics (Hitchcock and Cronquist, 1973). There are two varieties of *L. dissectum* listed on the USDA Plants Database (http://plants.usda.gov), *L. dissectum* var. *dissectum* and *L. dissectum* var. *multifidum*. *Lomatium dissectum* var. *dissectum* is more common west of the Cascade Mountains in areas with a mesic climate and average annual precipitation of >1000 mm. In contrast, *L. dissectum* var. *multifidum* is more frequent east of the Cascade Mountains in semiarid habitats, where it is found at elevations ranging from 800 to 2200 m. Independent of variety or location, *L. dissectum* flowers in early spring and produces fruits (schizocarps) that ripen in early summer (Hitchcock and Cronquist, 1973). At the time of dispersal, *L. dissectum* seeds (mericarp fruits) are dormant and have under-developed, linear embryos. These embryos are approximately one-eighth of the seed length and increase several-fold in length inside the seed before germination.

The presence of under-developed embryos is common among Apiaceae species. However, the type of dormancy and the conditions that promote embryo growth and germination vary among species within this family. Types of seed dormancy found within the Apiaceae include morphological and morphophysiological dormancy (MPD). Seeds of *Pastinaca sativa* and *Conium maculatum* exhibit morphological dormancy (Baskin and Baskin, 1979, 1990*b*). In these species, favourable conditions of moisture and temperature lead directly to embryo growth and ultimately to germination (Baskin and Baskin, 2004). More often species with under-developed embryos have additional requirements to break dormancy. These species are considered to have MPD; which is divided into eight types depending on the temperature requirements for dormancy break and embryo growth, and the ability of gibberellic acid (GA_3) to overcome dormancy (Baskin and Baskin, 2004).

At least, four types of MPD have been reported in the Apiaceae. Seeds of *Chaerophyllum tainturieri* and *C. procumbens* have non-deep simple MPD (Baskin and Baskin, 1990*a*; Baskin *et al.*, 2004). Warm moist conditions during summer first break physiological dormancy, while warm moist conditions during the autumn are associated with embryo growth and germination. Among species that

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