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Dormancy and Germination Pre-treatments in Willamette Valley Native Plants

Abstract

Seeds from 30 species of grasses and forbs native to Pacific Northwest prairies were tested for physical and physiological dormancy. The physical dormancy was determined by mechanically and chemically scarifying seeds. Physiological dormancy was evaluated with cold stratification before germination. Experiments were analyzed individually with ANOVA analysis, and by seed lots through time using multiple regression. Three of the tested species had too little germination to determine what kind of dormancy was present. Physical dormancy was found in three legumes that required a treatment to break the hard seed coat. These species, *Lotus unifoliolatus*, *Lupinus albicaulis*, and *Trifolium willdenovii* also had increased germination following cold stratification. This can be taken as evidence of physiological dormancy. Physiological and physical dormancy together is considered combinational dormancy. Another eight species had increased germination after cold stratification. This included both species that did not germinate without cold stratification (*Aquilegia formosa, Camassia leichtlinii, C. quamash, Heracleum maximum, Lomatium nudicaule, Perideridia oregona*, and *Sidalcea campestris*), and species with germination proportions that increased following stratification (*Eriophyllum lanatum*, and the legumes). Four annual forbs (*Clarkia purpurea, Collomia grandiflora, Gilia capitata, and Madia gracilis*) had increased germination when seeds were cold stratified, but the response was more consistent with a low temperature requirement for germination than physiological dormancy. The remaining 12 species germinated with no pretreatments. Understanding the germination requirements of these species will aid in their propagation for restoration and the provisioning of ecosystem services and may help explain the ecology of these species on the landscape.

Introduction

The time of year a seed germinates can have a significant effect on seedling growth and survival (Shabba and Qian 2008). Plants may have more time to grow larger and produce more offspring when seeds germinate earlier in the growing season (Verdu and Traveset 2005). However, in a variable environment where early emergence might expose seedlings to harsh conditions, mechanisms that prevent germination can increase the likelihood of long term survival (Pake and Venable 1996). Plants have evolved a number of mechanisms that maximize germination at optimal times. Plants can have particular tolerances for temperature or light that increase the likelihood of germination at the right time (Baskin et al. 1993, Hardegree 2006). Some species have seed dormancy, where even under appropriate conditions a seed will not germinate. There are many manifestations of seed dormancy in the plant kingdom, but botanists have classified them into dormancy types based on the specific mechanisms that prevent germination (Baskin and Baskin 2004). Seeds with underdeveloped embryos that need time to develop before germination are considered to have morphological dormancy (Scholten, et al. 2009). Seeds with impermeable layers that prevent the embryo from imbibing water and commencing germination have physical dormancy (Baskin et al. 2004, Rolston 1978). Other species experience physiological changes that affect the ability of the seed to germinate. These physiological dormancy mechanisms often are cued to environmental conditions that signal the beginning or ending of favorable germination seasons. In fact, periods of cold and warm temperatures can cause seeds to cycle between dormant and non-dormant states depending on the time of year (Baskin et al. 1993, Meyer and Kitchen 1992). Two other classes of dormancy involve combinations of these mechanisms. Morpho-physiological dormancy includes both an underdeveloped embryo and a physiological mechanism; combinational dormancy includes both physical and physiological dormancy.

The particular triggers that cause a seed to change dormancy states can differ between species. In some species, a period of warm temperatures brings seeds out of dormancy and they germinate when cooler temperatures arrive at the beginning of winter (Baskin and Baskin 1991). Other species require a period of

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