

## Induction and Release of Secondary Dormancy Under Field Conditions in *Bromus tectorum*

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### Introduction

*Bromus tectorum* L. is a facultative winter annual grass originally from Eurasia. During the past century, this species has become highly invasive in the western United States, where it has displaced millions of hectares of native vegetation. Seeds of *B. tectorum* lose primary dormancy through dry after-ripening, and nearly all seeds are capable of germinating in response to autumn precipitation. We have successfully characterized and modeled the loss of primary dormancy and germination in both laboratory and field studies (e.g., Christensen et al. 1996; Meyer and Allen 2009). However, a fraction of *B. tectorum* seeds may enter secondary dormancy in the soil and carry over across years as a component of the soil seed bank. Field studies were conducted to characterize the induction and release of this secondary dormancy.

### Methods

After-ripened samples of locally-collected *B. tectorum* seeds were placed in one of three contrasting microenvironments (buried under 0.5 cm of soil beneath 2 cm of previous-year *B. tectorum* litter, on the soil surface beneath 2 cm of litter, or on the surface of 2 cm of litter) at the xeric Whiterocks study site on two autumn dates (early September and mid-November). Field germination, post-retrieval laboratory germination, and seed viability were determined for replicated subsamples of seeds retrieved from the field at weather-dependent intervals over the course of one year.

### Results and Conclusions

Seeds placed on top of the litter failed to germinate in the field, became very dormant over the winter, and remained dormant during the following spring and summer (Figure 1, top panels). Over the course of one year, up to 90% of the seeds that became secondarily dormant were killed by the generalist seed pathogen *Pyrenophora semeniperda*, which is being examined in separate studies as a possible biocontrol for *B. tectorum*. In contrast with seeds on top of the litter, seeds that were buried in soil or placed beneath the litter in September had completely germinated by November. Seeds buried or placed on the soil surface in November did not experience early autumn rains, and these seeds became moderately dormant during the winter (Figure 1, middle and lower panels). A fraction of these late-planted seeds germinated in spring, particularly in the buried samples, while remaining fractions became largely non-dormant during the spring (buried seeds) and summer (seeds under litter). These data illustrate that variations in microenvironmental conditions largely determine secondary dormancy responses for this species, and help to explain the wide range of germination outcomes observed in the field. Depending on its position in the seed bank and on timing of the first effective precipitation in the fall, a seed may germinate, remain germinable, or enter secondary dormancy. Release from secondary dormancy is a gradual process, similar to release from primary dormancy; it is likely that these processes are governed by similar physiological mechanisms. In contrast, the mechanism of secondary dormancy induction in this species is not well understood.

### References

- Meyer S, Allen P (2009) Predicting seed dormancy loss and germination timing for *Bromus tectorum* in a semi-arid environment using hydrothermal time models. *Seed Science Research* 19:225-239.
- Christensen M, Meyer S, and Allen P (1996) A hydrothermal time model of seed after-ripening in *Bromus tectorum* L. *Seed Science Research* 4:11-18.

Figure 1. Germination or change in dormancy status in the field for initially nondormant seeds of *Bromus tectorum* placed on the surface of litter (top two panels), beneath litter (middle panels), or buried in soil beneath litter (bottom panels). Seeds were placed in the field in early September (left hand panels) or mid-November (right hand panels), retrieved on the dates indicated, then incubated at 15C. Viability loss (killed seeds) was almost entirely due to attack by the fungus *Pyrenophora semeniperda*.

