

Study objective

The main objective of this study is to assess the effect of variable stratification periods on the rate of germination for a suite of temperate herbaceous species from forest edge/gap and open field environments.

Main Questions:

1. What is the relationship between stratification time and germination rate? Is there an optimum stratification periods above which germination is compromised?
2. More specifically, using the thermal time germination model, how do different stratification periods alter t_b for the taxa in the study?
3. Does germination rank between species in a given community (forest edge and open) change due to variable stratification periods? What are the implications of these rank order changes for competition and community assembly in a changing climate?
4. Do the trends above differ between life histories, invasion status, evolutionary history or habitat type?

Methods and Treatments

Overview: Seeds of herbaceous taxa are imbibed in distilled water for 24 hours and placed onto damp filter paper in petri dishes (20-40 seeds per dish). Cohorts are sequentially removed from a cold stratification chamber and put into two growth chambers (lower temperature) and (higher temperature) for incubation. Germination fractions are recorded every 2 days.

Treatments

Cold stratification temperature: All seeds will be stratified at 4 degrees C. This is within the range of reported optimum stratification temperatures (1-10 C, Bewley2013) for a variety of taxa. This temperature has been used successfully by the lab for bud dormancy break on several occasions.

Stratification duration: For most taxa in the study, there are enough seeds for 10 different stratification periods. The recommended stratification periods of the taxa range from 28-84 days, with the majority requiring between 42 and 56 days. In order to parameterize the change in t_b in the thermal time model and assess whether there is an optimum stratification threshold, I will use periods well below and above the optimum. Sequential removal from stratification every 10 days allows for the coverage of a large stratification window while still providing enough resolution to plot a fine scale germination time course for each species. The stratification periods will be 0, 10, 20, 30, 40, 50, 60, 70, 80, 110 days (to investigate an upper limit).

Incubation conditions: Our goal is to simulate realistic germination conditions for taxa germination in the temperate Northeast. My treatments simulate May growing conditions in western Massachusetts (Harvard Forest) with day/night temperature fluctuations and 14 hour photo period. To understand the interaction between stratification and incubation temperature I chose a higher temperature scenario (reflecting historical extremes) and a lower temperature scenario (reflecting historical averages).

The 75 percent quantile of max May temperature at Harvard forest is 23. The 50 percent is 17.

The 25 percent quantile of daily temperature fluctuations at Harvard forest is 11 degrees.

I will use 25/15 and 20/10. Matching the Harvard forest fluctuations and germination trial conventions (see Meyer).

Incubation period: As per Baskin and Baskin, germination trial (incubation period) will not exceed 25 days.

Predictions

1. Many species will show no germination at no, or low stratification periods during the germination periods.
2. Increasing stratification periods will increase germination rate (shorter time to germination) for any species with physiological dormancy. For non-dormant species, stratification will not affect germination rate. Increasing stratification period will also allow PD species to germinate more readily under the cooler temperature regime.
3. Excess stratification will not have detrimental effects on germination, but at some level or stratification, germination rate will plateau.
4. Stratification will reduce t_b for all species
5. the strength of the responses predicted above will vary by species.
6. Germination rank will change between treatments.
7. Generally, invasive, annual and open field species will have faster germination rates.