Effects of Substrate on Seed Dormancy and Germination of Edaphic Endemics

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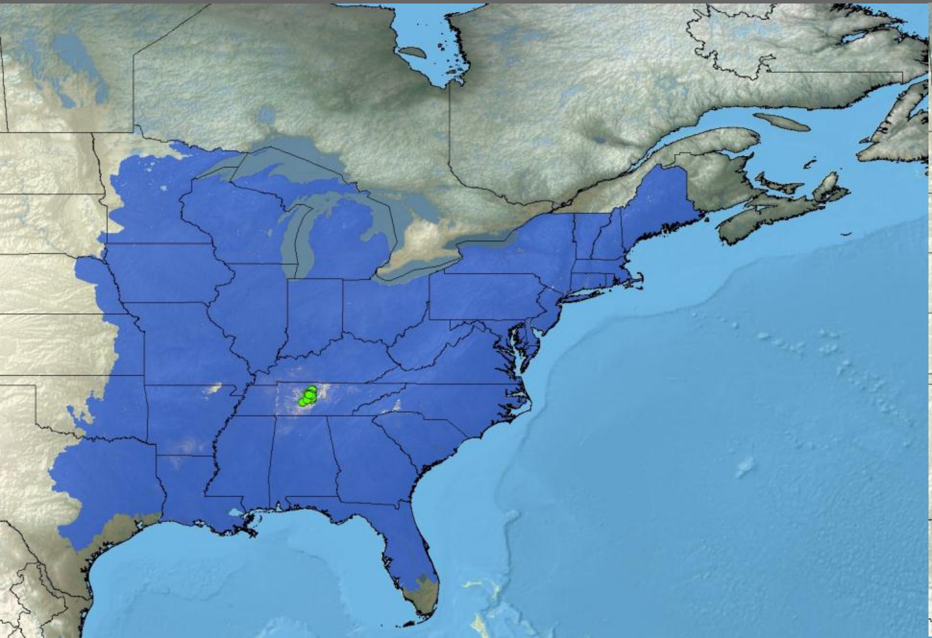
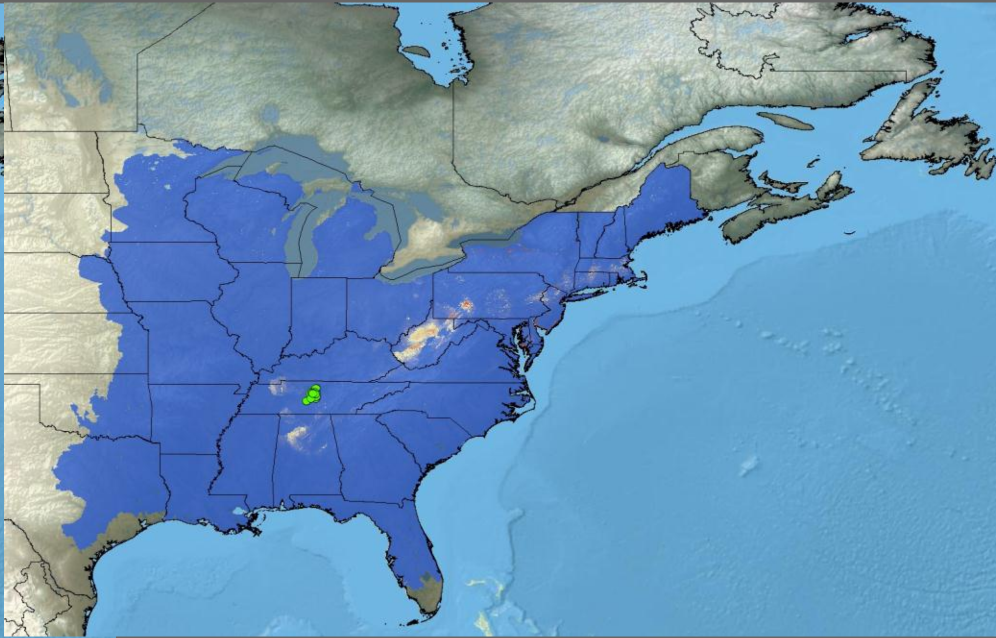
MISSOURI BOTANICAL GARDEN

NSF

Introduction

- Climate change resulting in shifting species distributions





Introduction

- Migratory capability of edaphic endemics
- Soil and climate
- Study system: *Leavenworthia*
  - Rare and highly endemic to limestone cedar glades
  - Winter annual life cycle
- Objective: to determine how dormancy levels and germination rates differ among three closely related species that vary in geographic range size and ecological amplitude.

Questions

Experiment 1: What is the rate of germination among species and populations?

Experiment 2: Can gibberellic acid substitute for time in breaking seed dormancy of winter annuals? Does substrate influence germination?

Experiment 3: Does edaphic specialization limit distribution in *L. stylosa?*

Leavenworthia stylosa

Leavenworthia torulosa

Leavenworthia uniflora

Photo credits: Patrick Alexander,
http://www.flickr.com/photos/aspidoscelis/

Geographic distribution of populations used in germination experiments.

Methods

- Seed collection

- Soil collection

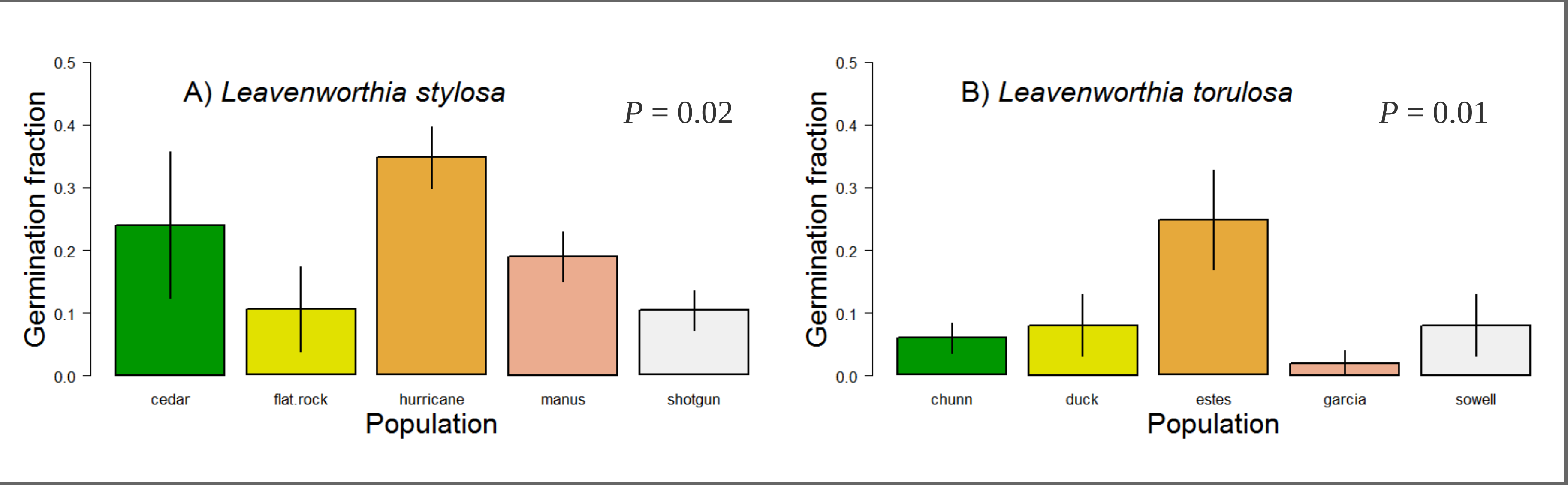
Photo credit:
http://www.flickr.com/people/billyplant/

Experiment 1

- Germination tested for all populations of each species
- Seeds placed on filter paper in Petri dishes and wrapped in Parafilm
- Germination chamber: 15/10°C thermoperiod and 14 hr photoperiod

Results: Experiment 1

- For *L. stylosa* and *L. torulosa*, significant differences in germination fractions among populations

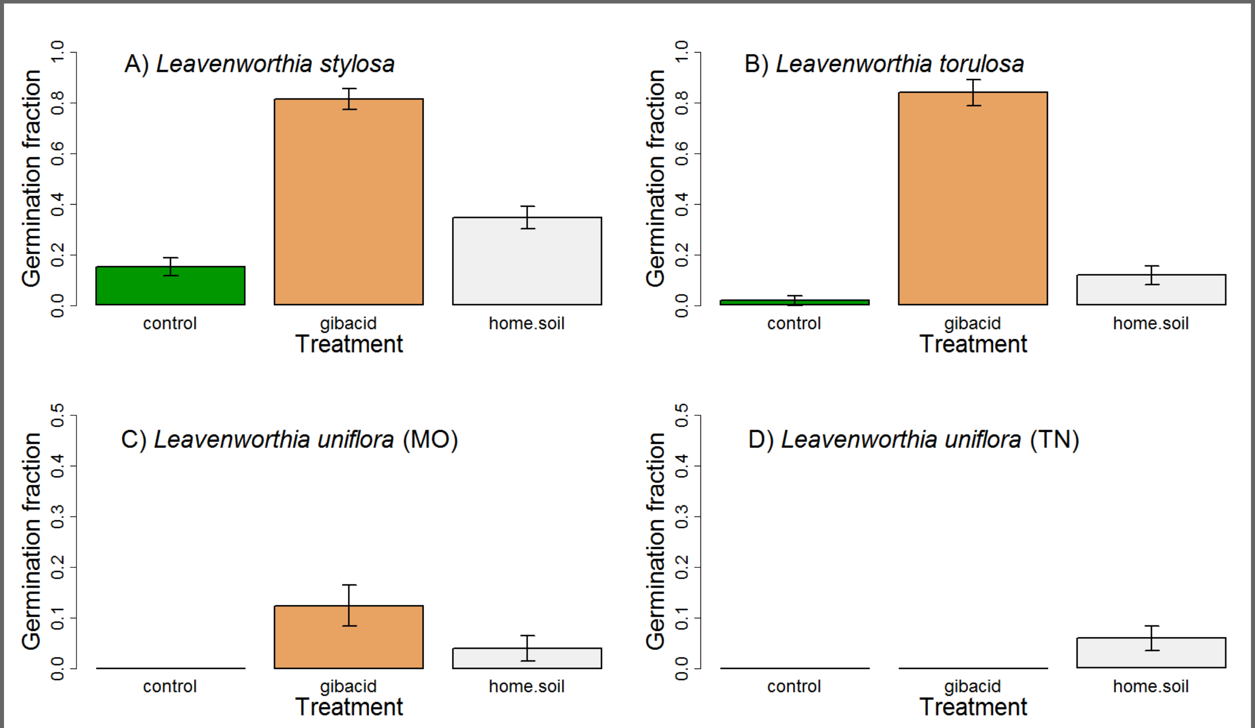


Experiment 2

- Three populations of *L. stylosa*, one population of *L. torulosa,* and one population each of *L. uniflora* (MO) and *L. uniflora* (TN)

- Germination tested on filter paper (control), home soil, and filter paper after being soaked in gibberellic acid for 21 hours

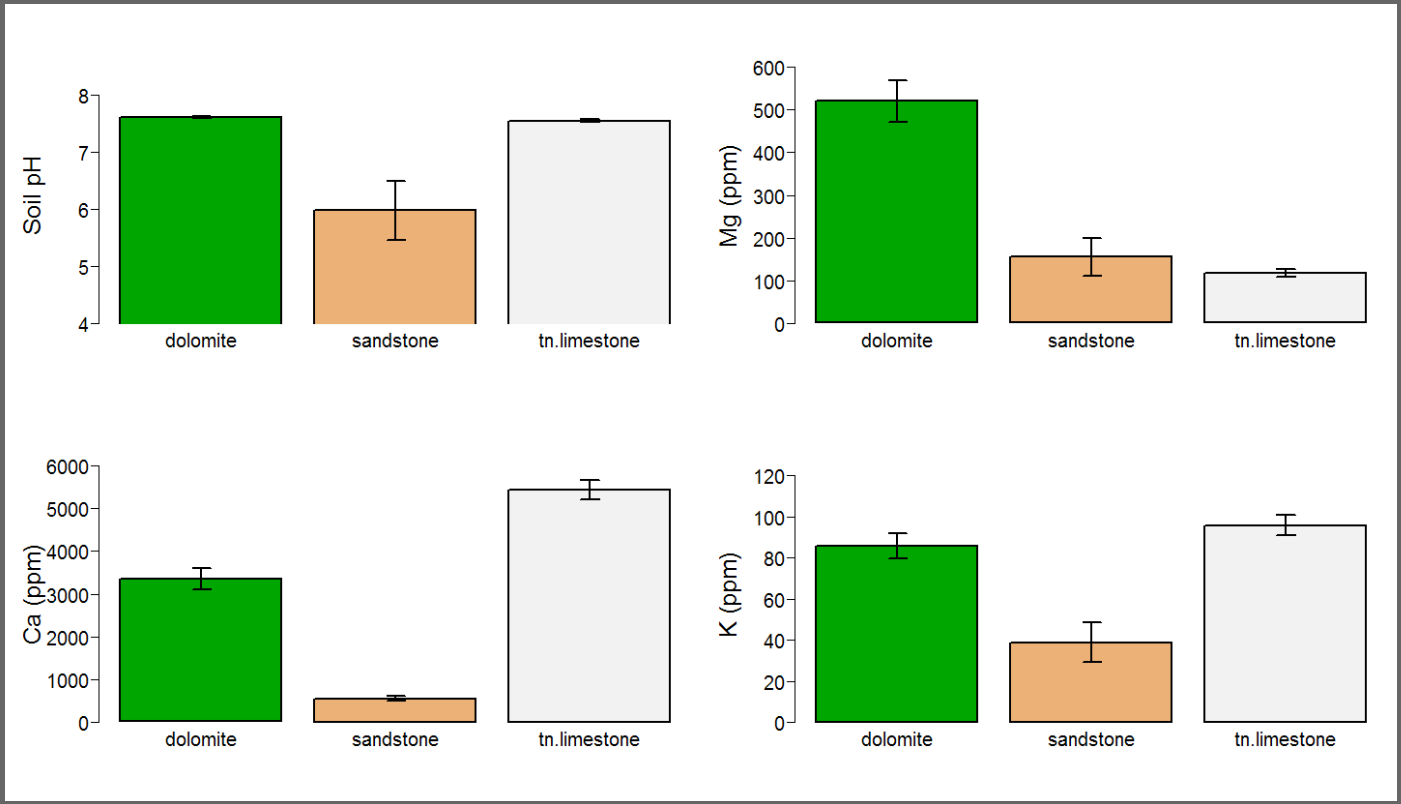
Results: Experiment 2



- 2 months of afterripening, not much germination
- *L. stylosa* and *L. torulosa* germinated to highest fractions with gibberellic acid
- Sensitive to substrate
  - Positive reaction
- *L.* uniflora lowest germination
  - More dormant

Experiment 3

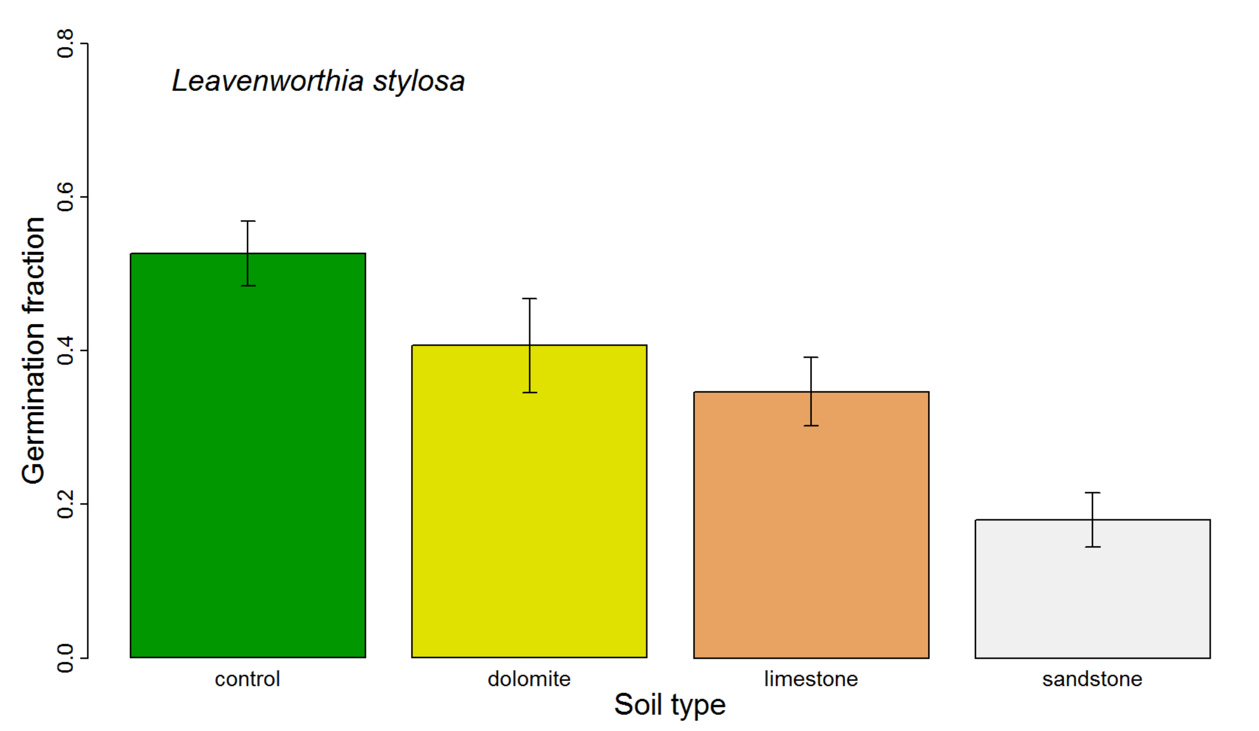
- *L. stylosa* was tested on dolomite, limestone, and sandstone glade soils
- limestone > dolomite > sandstone



- Sandstone more acidic
- Calcareous soils higher nutrient concentrations
- Dolomite higher Mg concentrations

Results: Experiment 3

- Seeds germinated to significantly lower rates across all soil types relative to the control (potting soil)
- Germination fractions on calcareous soils were nearly twice as great than on sandstone



Discussion

Experiment 1:

- Closely related species disperse seeds with different dormancy levels.
- Populations within species also disperse seeds with varying dormancy levels, so using just one population for germination studies could be misleading.

Experiment 2:

- Gibberellic acid is effective at substituting for time in breaking seed dormancy in winter annuals.
- Calcareous specialists are sensitive to substrate at the germination stage of their life cycle.

Experiment 3:

- *L. stylosa* germinates poorly on nutrient acidic soils.
- Distribution limits can begin to form at the earliest life history stage.
- *L. stylosa* appears to be able to germinate on calcareous soils outside its current distributional range, so while it is an edaphic specialist it might be able to occupy other soils, providing more climatic adaptability.

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