

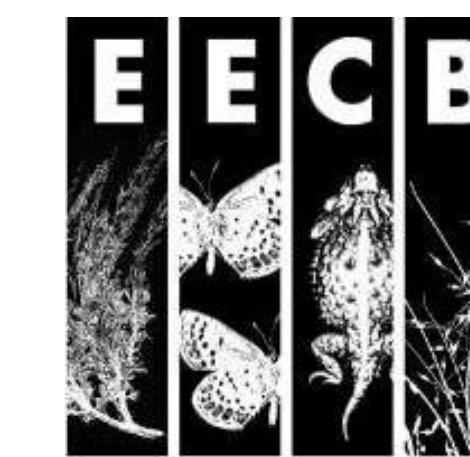


Maternal effects in grassland restoration using *Elymus elymoides*

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Background

- Drought, wildfire, and invasive species **inhibit seedling establishment** in grassland restoration
- Agricultural production** conditions used for native seed increase in restoration projects may confer detrimental **maternal effects** to offspring.
- Maternal effects occur when a mother's phenotype influences her offspring's phenotype **independent of her genetic contribution** to that offspring

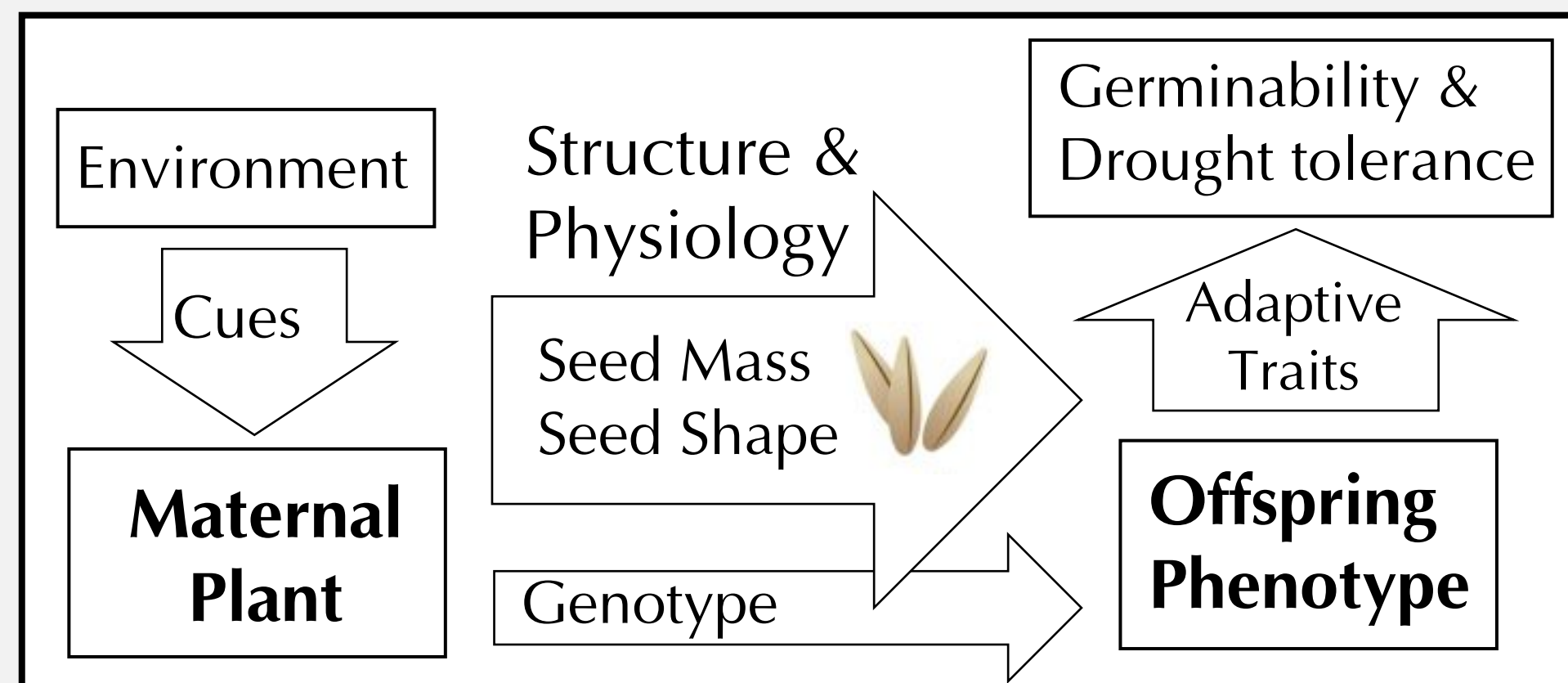


Figure 1. Maternal genotype and maternal environment influence on offspring phenotype through phenotype and structure, (adapted from Roach and Wulff 1987)

Preliminary Findings

- Agriculturally grown field-collected seeds the largest, followed by resource-rich nursery growing conditions**

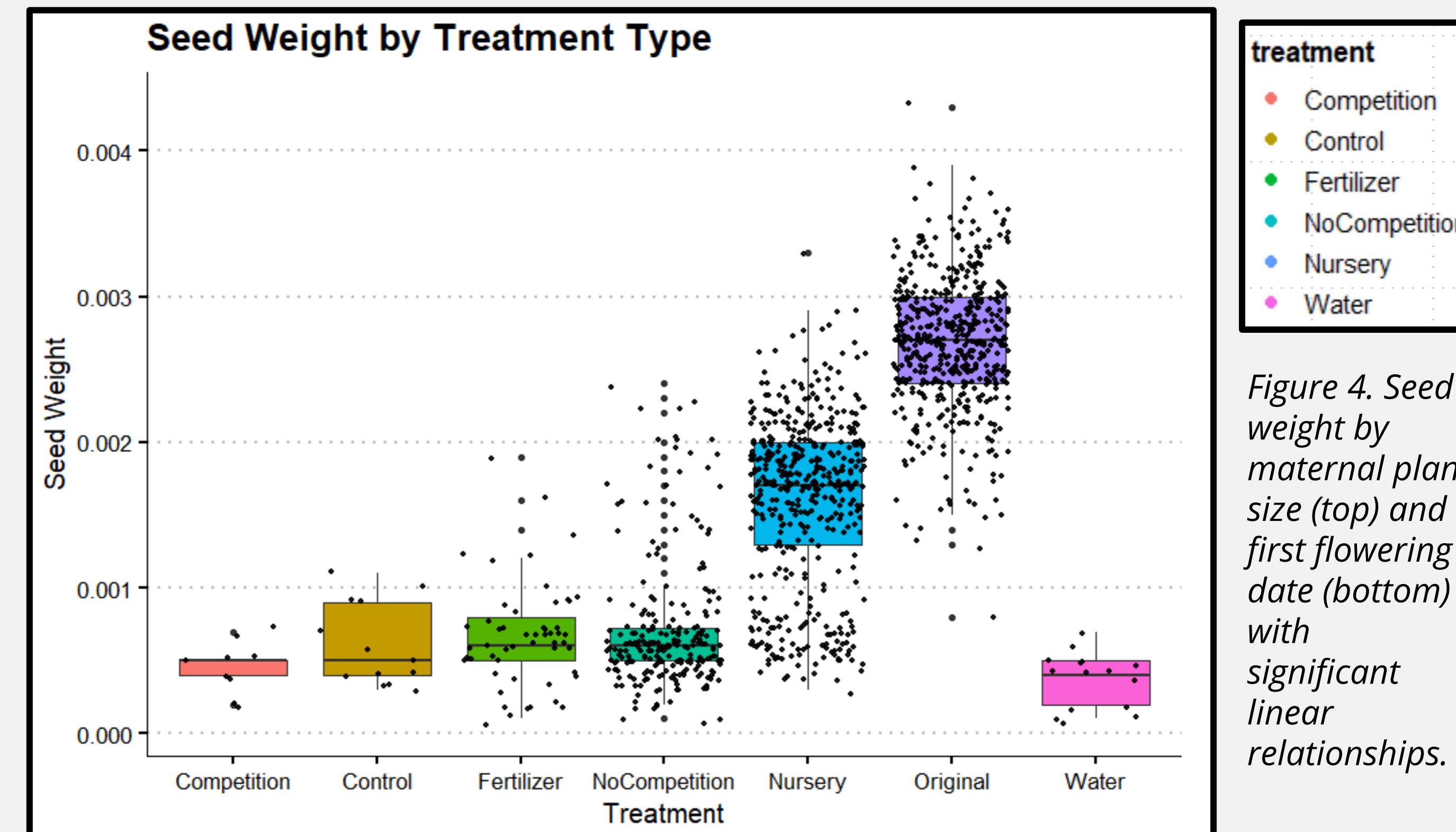


Figure 3. Seed weight (g) by treatment type for Sonoma seeds, showing dramatically larger seeds in both the nursery treatment and original G0 seed compared to other treatments.

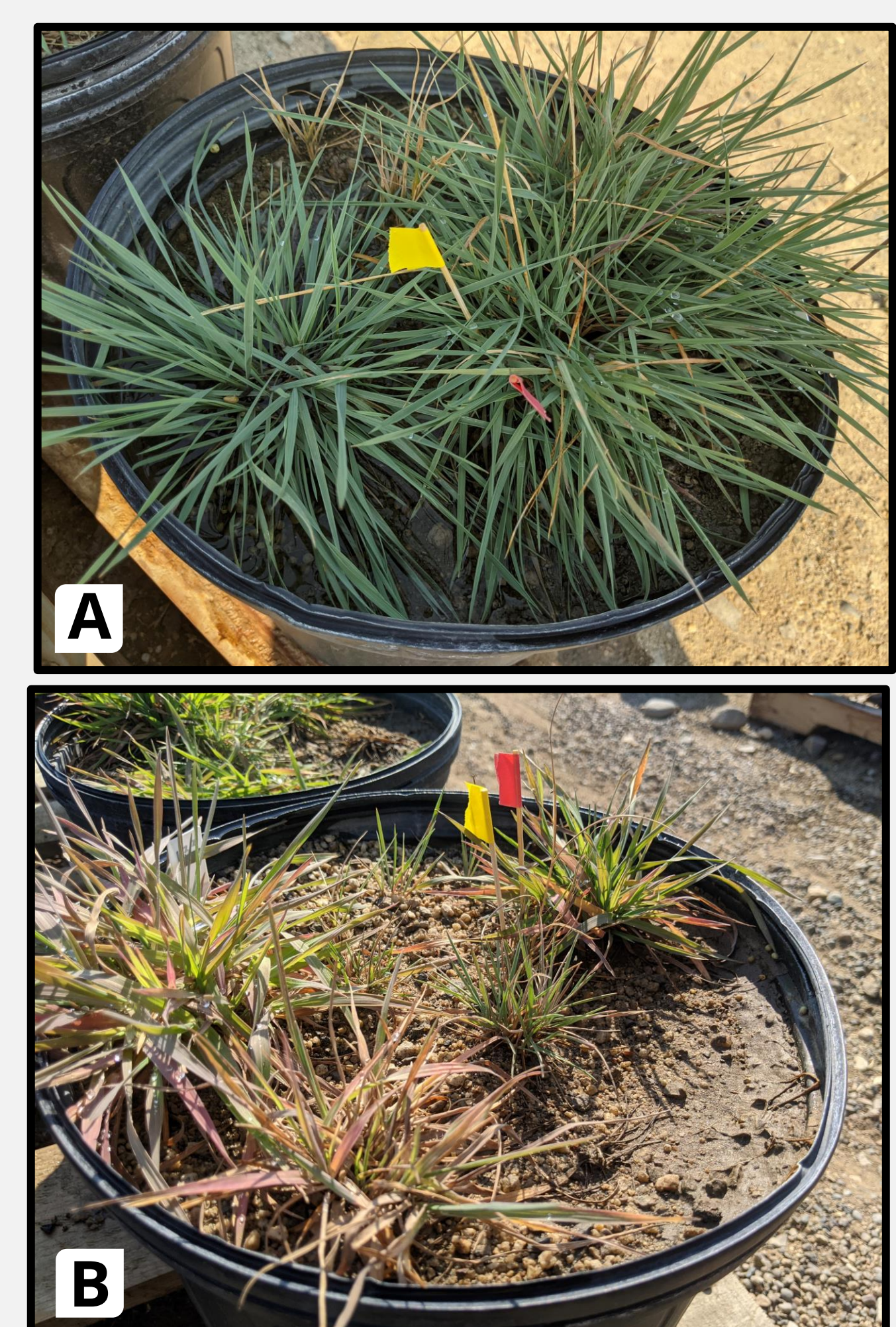
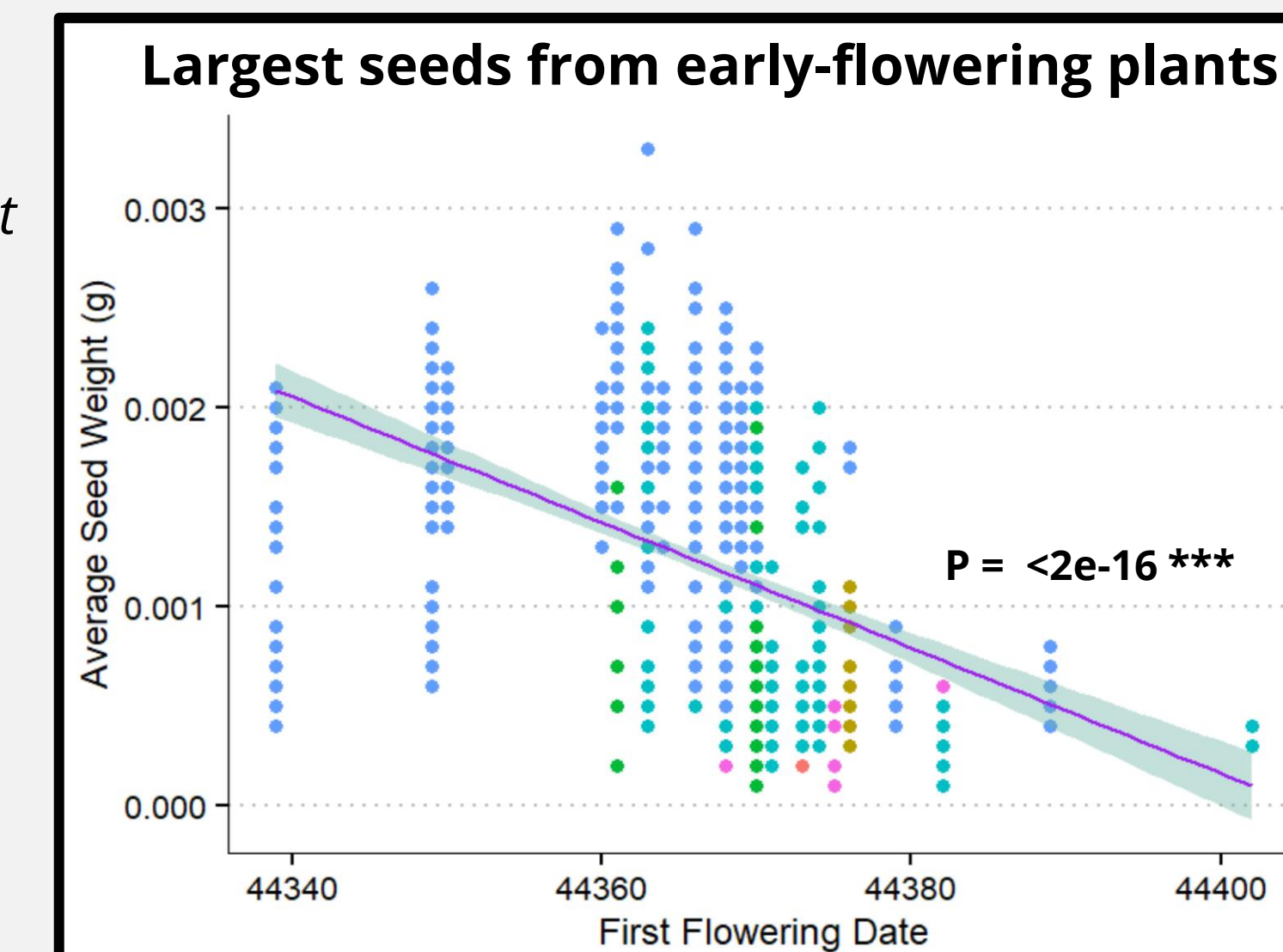
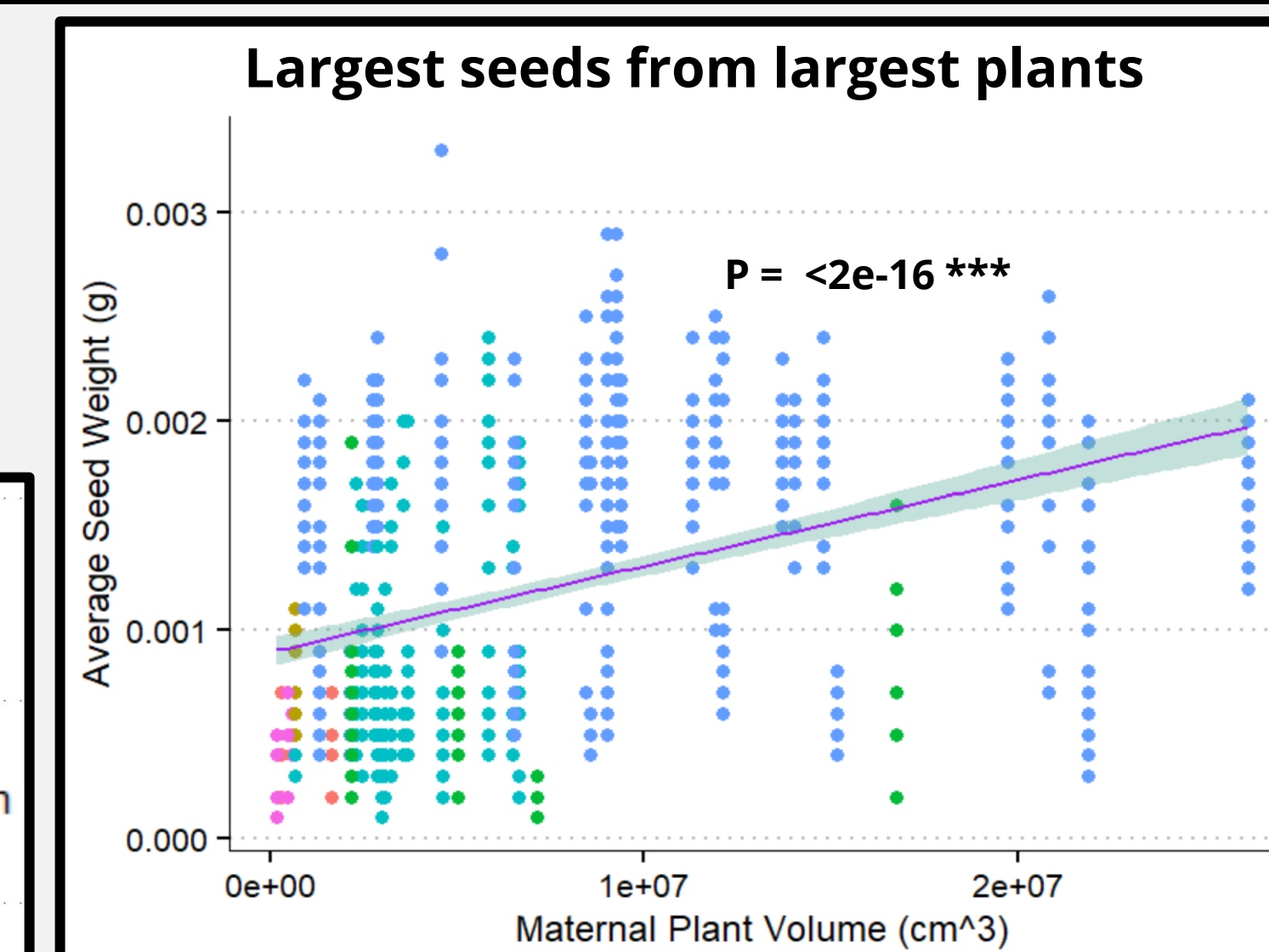


Figure 5. Comparison of A) nursery treatment pot and B) competition treatment pot. yellow flags indicate target maternal plant.

Methods

- Collect *Elymus elymoides*, a common restoration species, **from two populations**: one wild collection (LV) and one previously increased at an agricultural facility (SO)
- Grow under an **extreme range of environments** using 6 experimental treatments: varying water, fertilization, inter & intra specific competition

Generation 0

- Grow seed in experimental treatments
- Measure maternal plant traits
- Harvest seed

Generation 1

- Measure seed traits
- Plant seed in greenhouse common garden
- Measure plant traits

Generation 2

- Harvest seed from year 2 production garden plants
- Measure and compare seed traits

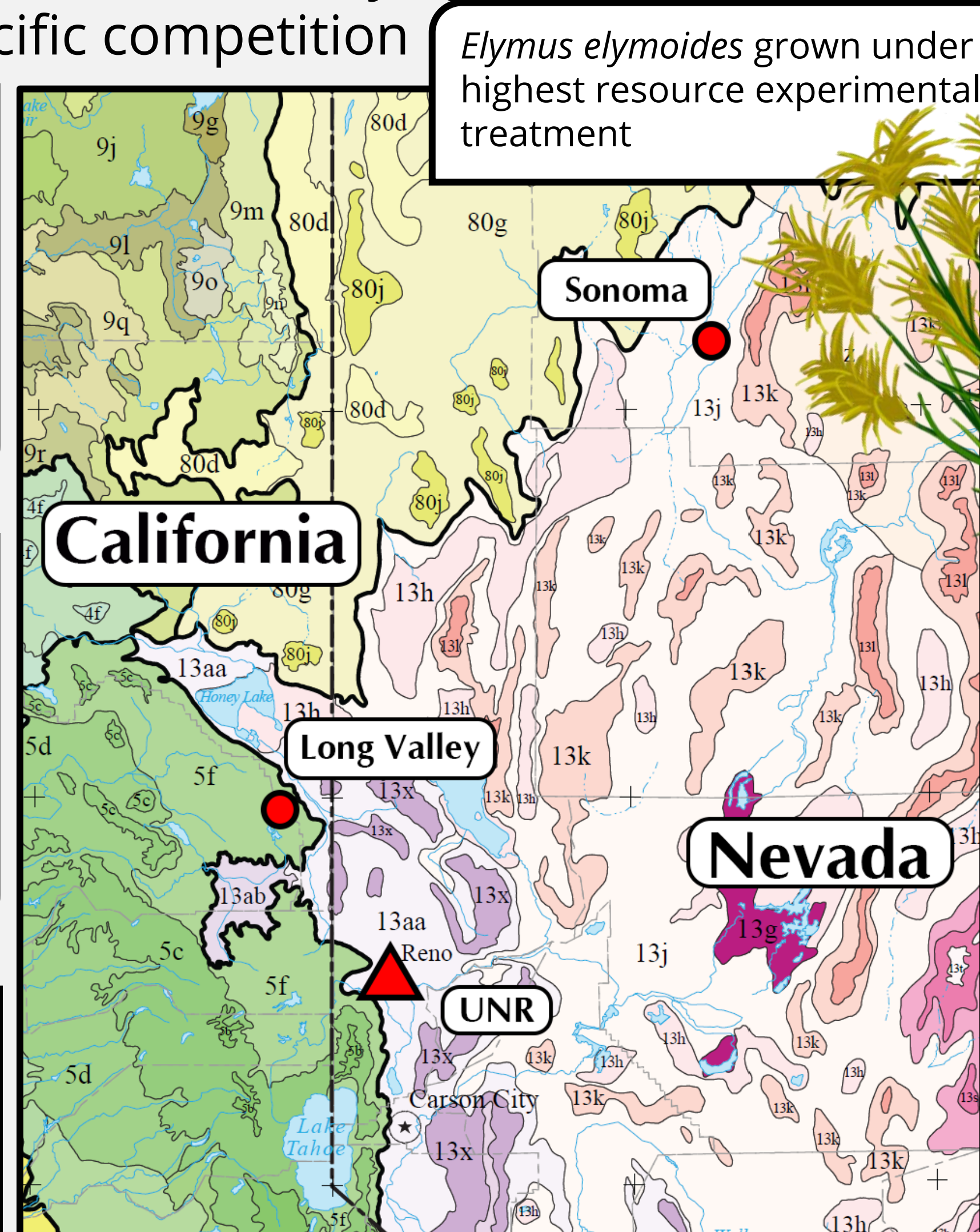


Figure 2. Map of collection locations (Long Valley and Sonoma) and experimental garden (UNR) shown with EPA III ecoregions. Long Valley occurs in ecoregion 5f, Sonoma in 13j, and UNR experimental garden in 13aa (US EPA 2016)

Research Questions

How is the **competitive ability** of *Elymus elymoides* affected by its maternal growing environment?

- Which **aspects** of the maternal growing environment most strongly affect seedling performance?
- Which **seedling traits** are most strongly affected by maternal growing environment?
- How does **seed source** affect these interactions?

Elymus elymoides grown under lowest resource experimental treatment



Figure 7. A) Resource-rich production garden conditions (Moses Lake WA) vs B) A typical arid, degraded Great Basin restoration site (Garnerville, NV) (Benson and Benson 2021).

Discussion

By quantifying these effects in restoration populations, we can provide **direct recommendations** to restoration growers to **improve seed characteristics** by optimizing maternal environmental conditions.

Potentially Adaptive Traits

We will compare potentially adaptive traits and drought tolerance among seeds from different maternal environments

- Maternal plant traits**
 - Measure maternal plant size
 - Track phenology
- Seed traits**
 - Weigh seeds
 - X-Ray seeds and process Images
- Germination & drought trials**
 - Track germination timing
 - Drought trials after 6 weeks

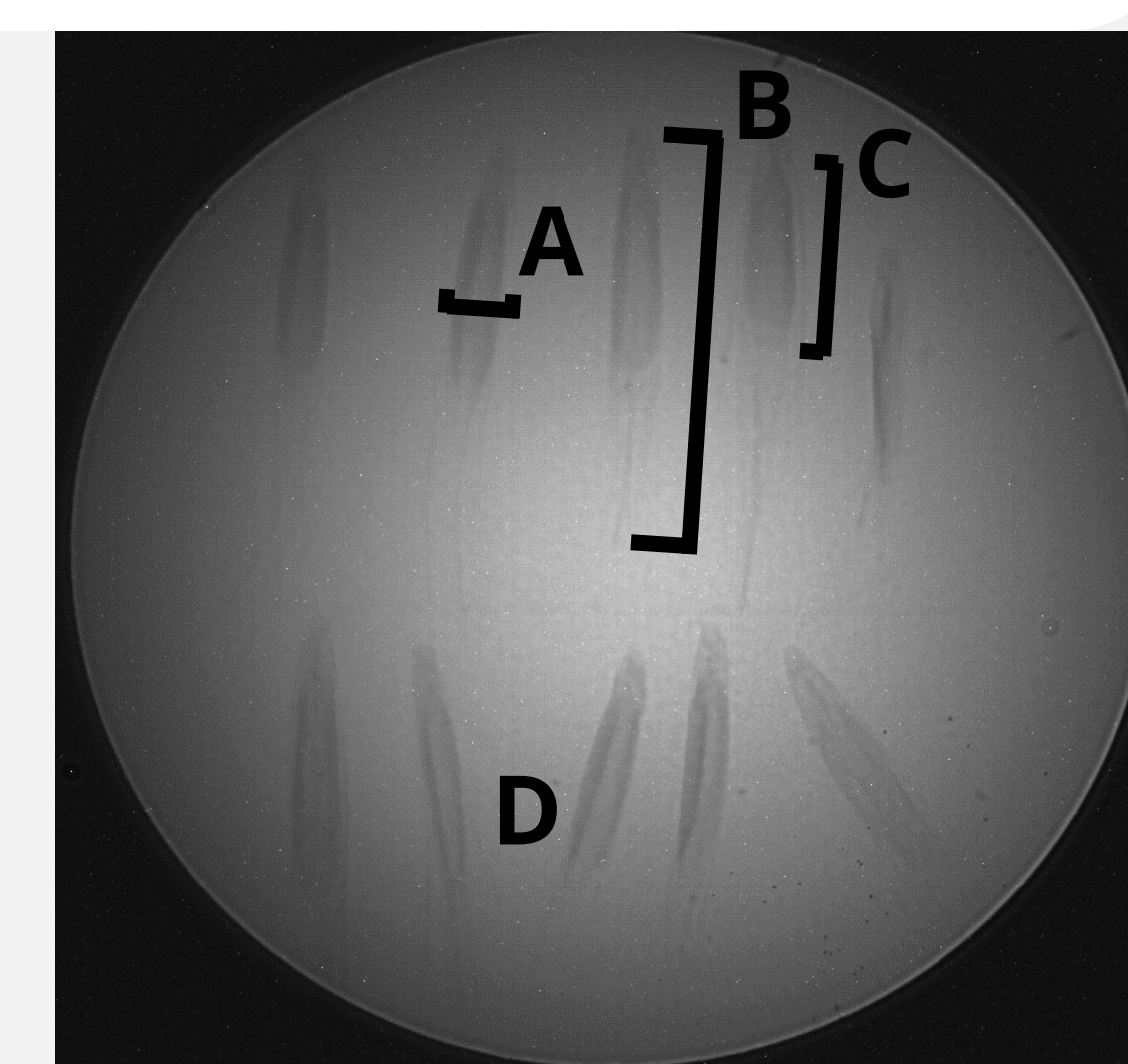


Figure 6. X-ray image of G0 Sonoma seeds, sharpened using unsharp masking filters. A) Seed width (measured at the widest point), B) Seed length (measured from tip to base of awn), C) Endosperm, and D) Seed shape.

Acknowledgements

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