Effects of Pollen Limitation on Subalpine species germination: *Delphinium nuttallianum* & *Potentilla pulcherrima*

Angelique Acevedo[1], Elsa Godtfredsen[2], Marcello De Vitis[3], and Amy Iler[3]
Cornell University[1], Northwestern University[2], and Chicago Botanic Garden[3]

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Introduction

The majority of plant species are dependent on animal pollination for successful reproduction (Ollerton et al., 2011). If plants lack the ability to attract pollinators or the number of pollinators declines, plants can become "pollen limited" in which their female reproductive output is constrained by the amount of pollen they receive. The produced seed set can therefore be affected and often results in lower numbers of seeds or lower numbers of viable seeds (Pfister et al., 2011). If applied to a population-level, low germination or unviable seeds creates low density areas that are left vulnerable to ecological perturbation (Knight et al., 2005).

Plant competitive success is linked to quality (i.e. homospecific diverse pollen) and quantity of pollen load distributed to a recipient plant (Bosch et al., 1999). Pollen limitation can be hard to quantify but a commonly used method is to supplement pollen and assess impacts on reproductive success. If a plant population is pollen limited, pollen supplementation should increase female reproductive output.

Objectives/Hypothesis

To determine whether the **1. germination rates** and **2. number of germinated seeds** of two subalpine species, *Delphinium nuttallianum* and *Potentilla pulcherrima*, are affected by augmented and/or reduced pollen loads.

I hypothesize supplementation should lead to high germination rates and the highest total germination in comparison to reduced and control treatments.

Methods

Delphinium nuttallianum (DENU) and *Potentilla pulcherrima* (POPU) seeds were collected in the summer of 2020 at the Rocky Mountain Biological Lab (RMBL). Each group of plants experienced either reduced, supplemented or control (unchanged) pollen loads. These subalpine species had to go through dormancy alleviating conditions prior to germination — Cold stratification (CS) and Gibberellic Acid (GA). Then to test for germination rates, seeds were sown in agar filled petri dishes (5x5 seeds) and placed in incubation at 25C/15C. They were monitored twice a week to examine for visible radicle development. After 6 weeks, trials were called off, and tetrazolium tests (TZ) were conducted to test overall seed viability of the set.

We used a generalized linear model within the binomial family since over-dispersion was not present. We evaluated this model with a type II ANOVA.

Figure 5. Flowering 1. *Delphinium nuttallianum* and 2. *Potentilla pulcherrima*

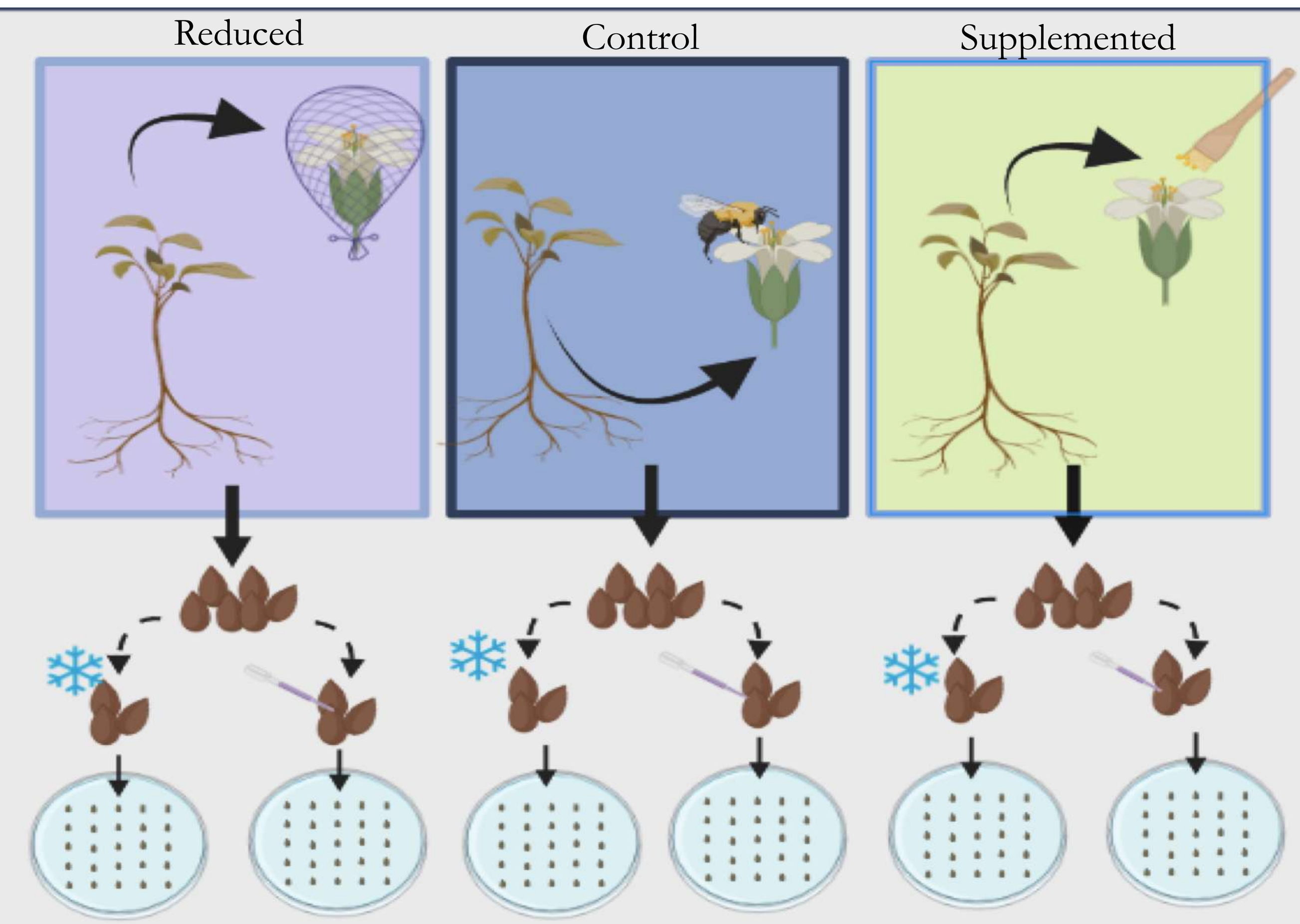

Figure 6. Illustrates the application of a reduced pollen treatment on a *Delphinium nuttallianum* plant.

Results

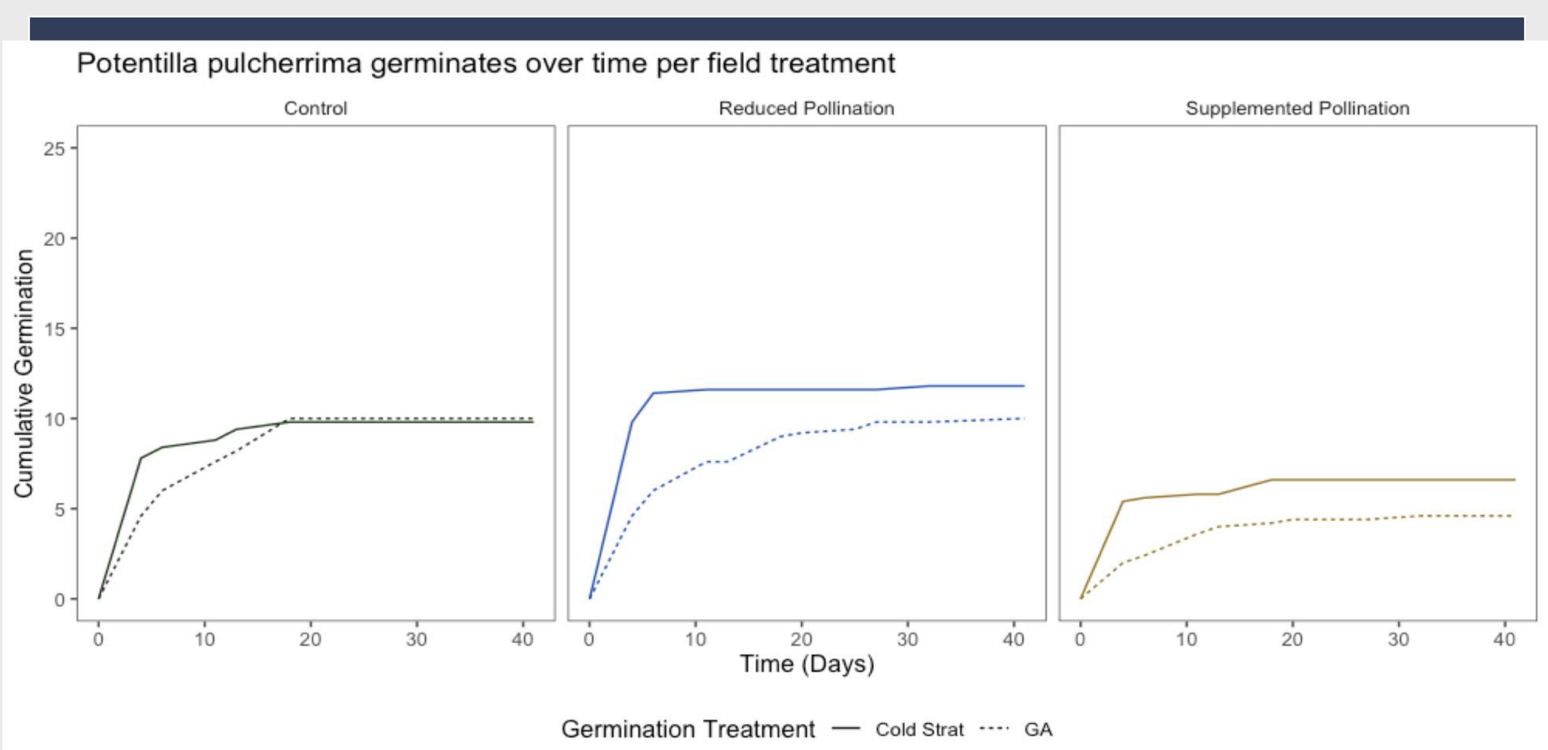

Figure 3. Visualization of POPU seed germination for each germination treatment (GA and Cold Stratification) and pollination treatments (Supplementation, Reductions, and Control) over 41 days.

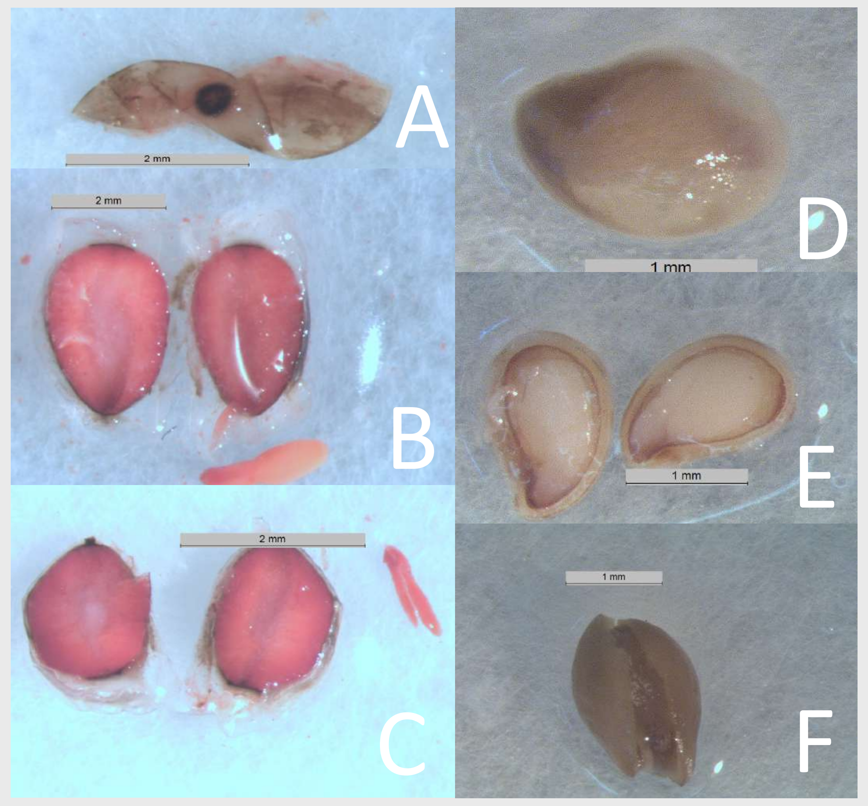

Figure 1. A and E are DENU and POPU, respectively, nonviable seeds with whited endosperms and unviable embryos. D and F show POPU unviable seeds. B is a DENU unviable seed with only an unviable embryo, and C is a completely viable DENU seed.

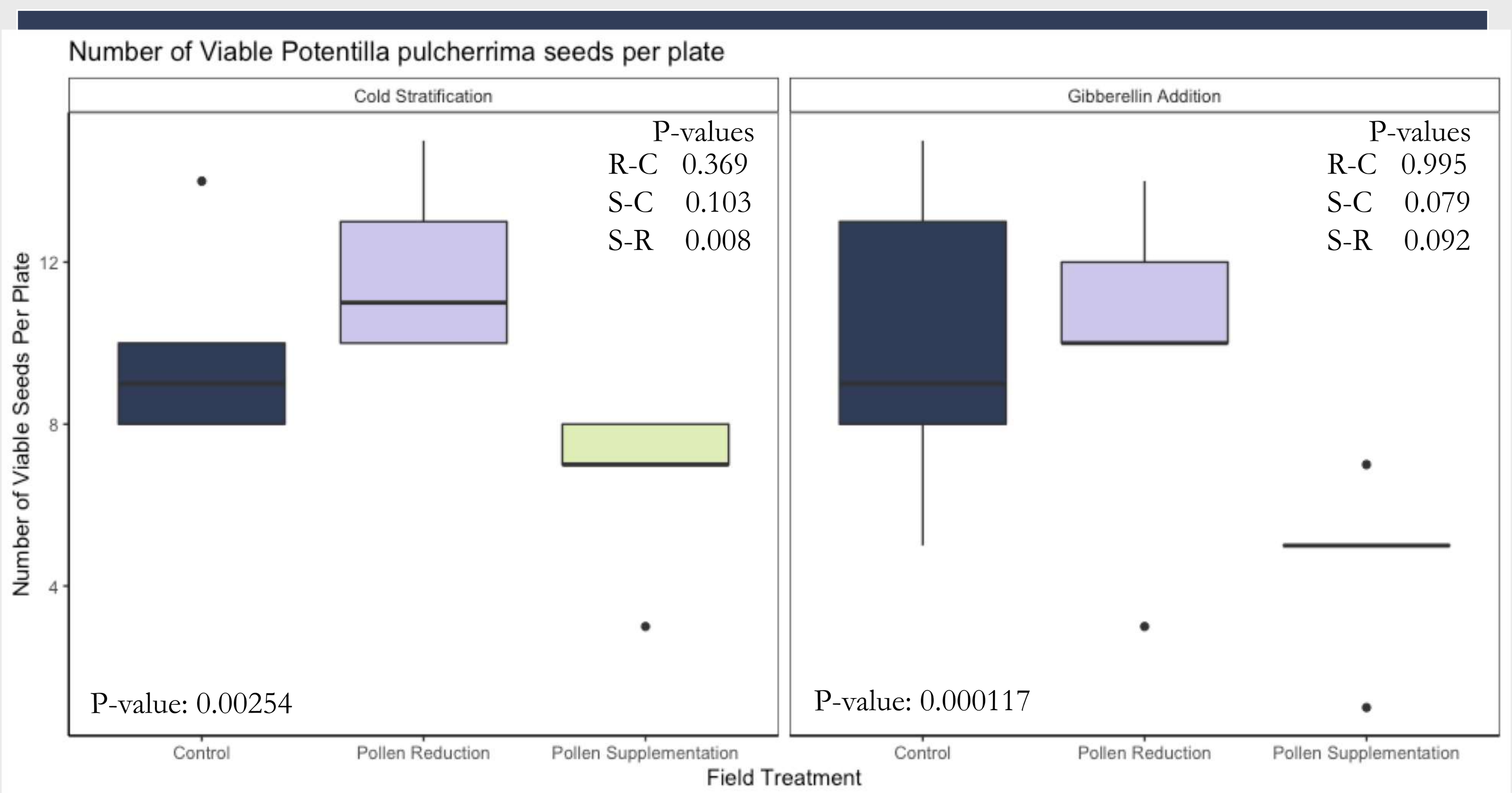

Figure 2. The proportion of *Potentilla pulcherrima* seedlings that germinated is shown (germination trials shifted to viability tests after being adjusted for nonviable seeds). Seeds have gone through either Gibberellic Acid (200 ppm) and Cold Stratification (6 weeks) pre-treatments with their respective pollen loads.

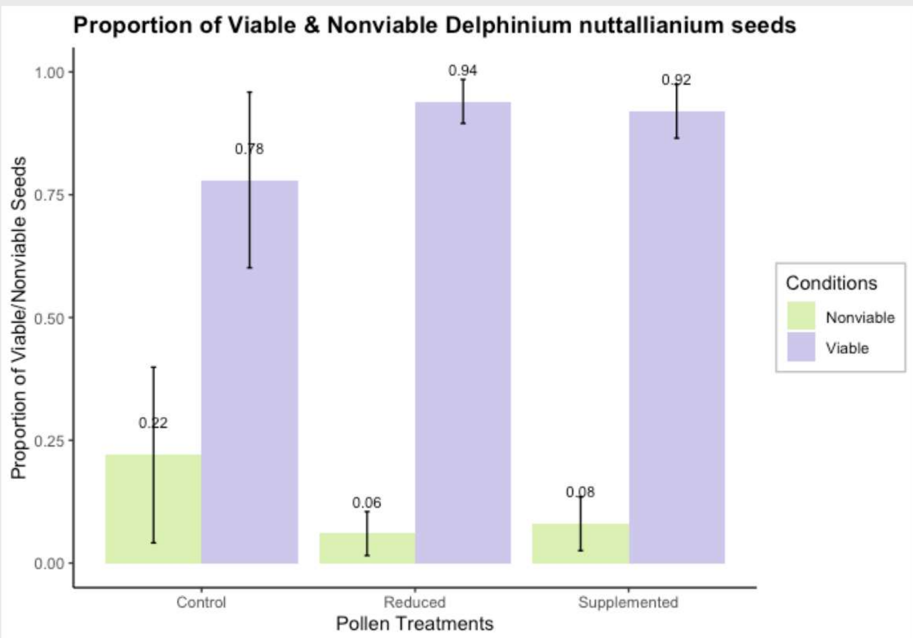

Figure 4. Proportion of DENU viable seeds for CS treated seed sets that were either pollen supplemented, reduced, and controlled **(n=50 each treatment)**

Discussion

Pollen treatments have significantly altered the seed viability of *Potentilla pulcherrima* with pollen supplementation having the lowest number of germinated individuals. Control and reduced pollen had statistically similar viabilities (Fig. 2). Germination trials became viability tests when TZ revealed that 0% of ungerminated seed sets were viable.

- It is possible that manual application of pollen does not provide the same degree of quality/quantity of pollen as natural pollinators do.
- It is also possible that there were other limiting factors affecting seed production (i.e. poor soil quality) that outweighed the benefits of a high abundance of pollen (Totland, 2001).

The germination rate of GA seed sets was the lowest across all treatments indicating that Cold Strat. is the optimal pretreatment for breaking POPU's Physiological dormancy (Fig. 3).

It became increasingly evident that the likelihood of *Delphinium nuttallianum* germinating was low. Tetrazolium tests (TZ) were conducted and it was found that there was a 78-94% of viability across all pollen treatments (Fig 4).

- Seed viability was not inhibiting germination.
- It is also possible that the maternal delphinium plants were exposed to sub-optimal conditions (i.e. a warmer winter or early spring) that sent fertilized seeds into a two year dormancy phase. (Pfister et al., 2011).
- There also has yet to be explicit classification for *Delphinium nutallianum's* dormancy, but these trials hint at Morphophysiological Dormancy (MPD).

Conclusions

1. Pollen supplementation does not lead to high numbers of germinates/germination rates (POPU), but more studies should be done to expand these results.
2. DENU may require MPD pre-treatments to germinate.

References

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Contact: Angelique Acevedo, aaa449@cornell.edu