**Provenance and Parentage: How the Collection Locations of Seeds affect the Flower, Fruit, and Seed Traits of their Offspring in a Common Garden**

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**Overview and Introduction**

*Background*

The relationship between flowering plants and their pollinators are incredibly important for the reproductive success of the plant, the survival of the pollinators, and general ecosystem functioning (Elzinga et al., 2007). These interactions depend on the timing of life-history events, or phenology, of both the plants and pollinators. Phenology is a trait that can have variations with in and between species, and can be subject to the same gene flow that other genes are subject to (Elzinga et al., 2007). By using seven deciduous shrub species from temperate regions, I hope to investigate how climate and phenology affect the flower and seed traits of different organisms.

*Aims and Objectives*

1. Discover correlations between latitude and a variety of flower and seed characteristics.
   1. Seed size (mass, length, width) and collection site of the parents
   2. Flower size (mass, length, width) and collection site of the parents
2. To discover correlation between the phenology of seed ripening (collection at BBCH 79) and seed characteristics. Thinking about this statistically, I want to test whether the day of the year that the fruit reaches BBCH 79 can predict seed characteristics such as mass, length, and width.
3. Discover correlations between plant size and seed size to determine whether plant size is a predictor of seed size. This will allow me to control for (normalize for) plant size to determine whether phenology or provenance significantly contribute to seed size.

*Hypotheses*

1. I expect that:
   1. Seed size will decrease as provenance latitude increases (Moles & Westoby, 2003). Further away from the tropics, the seed size has been seen to grow smaller, most likely in relation to the shorter growing season.
   2. Seed size will decrease as provenance latitude increases. At higher latitudes there are shorter growing seasons, meaning that there will be smaller seeds from the higher latitude provenances since the gene flow may have shifted to favor smaller seeds that can survive on fewer nutrients.
2. I expect that the later in the growing season that a seed ripens (BBCH 79), the greater mass, length and width the seed will have, because the seed has had a longer time on the plant to grow and acquire nutrients.
3. It has been shown that larger, older plants produce larger seeds (Leishman, Westoby, & Jrado, 1995), and many of the plants that I will be collecting from are around a similar age. Therefore, I would expect that the larger plants (in width and height) would show larger seeds.

**Plan for Research**

*Design*

Using a common garden, I hope to establish that flower and seed traits are at least partially determined genetically based on their provenance. A common garden is when seeds are taken from various locations and planted in the same place in order to assess differences between populations. In our common garden, all of the plants were grown from seeds at around the same time so they are all approximately the same age. By having these plants whose seeds came from different locations, we are able to introduce genetic variation into the common garden and observe how these different genotypes express differently in the same environment.

*Methodology*

I will be observing and collecting samples from seven different species: *Myrica gale, Sambucus racemosa, Aronia melanocarpa, Amelanchier canadensis, Spiraea tomentosa, Spiraea alba,* and *Viburnum cassinoides*. I will collect 4-5 samples of each flowers and fruits/seeds from each individual (this may be a bit ambitious and will be adjusted accordingly). Once collected, the flowers and seeds will be massed on a balance and imaged via a dissecting scope. With these images, length and width measurements will be taken. This data will then be statistically analyzed using R to find any correlations or predictors of traits.

*Significance and Implications*

Different organisms may respond in different ways to climate cues. Since many plants rely on animal interactions for pollination and dispersal, losing these interactions would be detrimental to their population survival (Elzinga et al., 2007). Seed size (mass) has been shown to be able to predict the success of the seedling due to the greater amounts of nutrients available to the seedling (Ambika, Manonmani, & Somasundaram, 2014). Because phenology is multifaceted and affected by many different things, it is difficult to study exactly what affects it. This study aims to pinpoint how seed provenance can affect the flower and seed traits and the timing of life-history events. Studying phenology is also an important way to study climate change, and the effects that it has on different organisms.

Works Cited

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