Effects of Artificial Aging on Domestic and Wild Seeds

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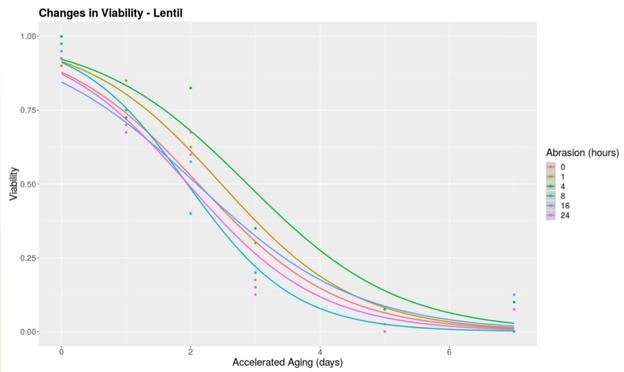
Introduction

Studying the effects of environmental factors on seeds could take years. Accelerated aging tests can be used to shorten the aging process of a seed to around one week. This process involves exposing the seed to high temperature and high relative temperature to simulate the weather a seed might experience and accelerate metabolic aging[1]. Because the seed coat might be very impermeable preventing moisture from affecting the embryo, mechanical abrasion was used to simulate the physical aspect of aging and weaken the seed coat. After the mechanical abrasion, it is expected that the results of the accelerated aging will be more accurate. In this project, the effects of accelerated aging on a wild fabaceae species - *Lupinus polyphillus* (garden lupine)- and a domesticated fabaceae species -*Lens culinaris* (lentil)- are tested.

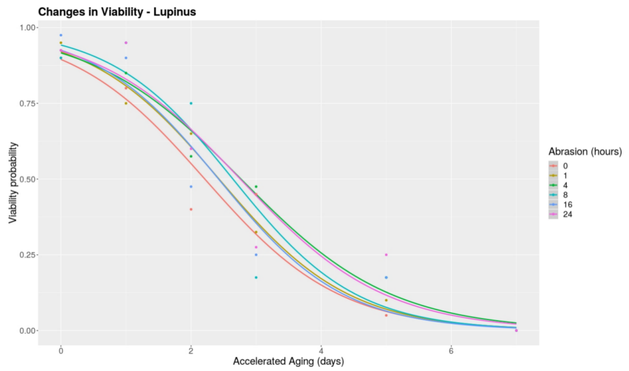
Methods

The materials used in the experiment included 720 *Lupinus polyphyllus* seeds, 720 *Lens culinaris* seeds, a rock tumbler, a plastic box with three different levels, and an incubator. Before the experiment, all the seeds were surface-sterilized in a solution of 0.5% sodium hypochlorite for 15 minutes. The 720 seeds from each species were divided into six groups of 120 seeds and exposed to different levels of abrasion by placing them in a rock tumbler with sand for: 0 hours, 1 hour, 4 hours, 8 hours, 16 hours, and 24 hours. The purpose of the rock tumbler is to mechanically wear down the seed coat to simulate natural physical deterioration. Each group of 120 seeds was further divided into six groups of 20 seeds to undergo accelerated metabolic aging for different time periods: 0 days, 1 day, 2 days, 3 days, 5 days, and 7 days. For this purpose, the bottom level of the plastic box was filled with deionized water and the second level had wet paper towels around the inner walls. This was done so when the box was exposed to heat, the water would evaporate and raise the relative humidity inside the box. The seeds were put in the second and third level of the box and placed inside the incubator until the internal environment stabilized at 45 degrees Celsius of temperature and high relative humidity (~97%). After each seed went through the entire process, they were all tested for viability using the tetrazolium staining test.

Seed Viability



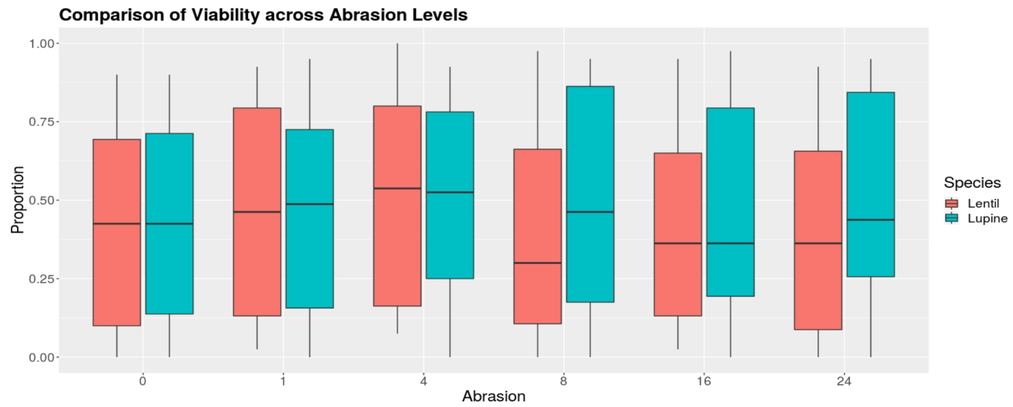
(Top Left) As accelerating aging increases, viability decreases for lentil seeds, showing that accelerated aging has a significant effect on viability



(Top Right) As accelerating aging increases, viability decreases for lupinus seeds, showing that accelerating aging has a significant effect on viability

	Viability	
	Lupine	Lentil
Intercept	2.36***(1.98, 2.74)	2.24***(1.88, 2.61)
Accelerated Aging	-0.97***(-1.11, -0.82)	-0.93***(-1.07, -0.79)
Abrasion	0.01 (-0.02, 0.04)	-0.02 (-0.05, 0.01)
Interaction	0.001 (-0.01, 0.01)	-0.0002 (-0.01, 0.01)

(Left) The confidence interval for accelerating aging in both species contains zero which means it has a statistically significant effect on viability. The confidence interval for abrasion in either species does not contain zero which means it does not have statistically significant effect on viability



(Top) When comparing viability across abrasion level, the mean proportion of viable seeds between lentils and lupine are very close to each other, in some cases exactly same, showing that abrasion has no significant effect on viability

(Left) Four lentil seeds. (Right) Four Lupine seeds

Conclusions

Contrary to our expectations, abrasion did not have a significant effect on the aging of either species. This might be due to the seeds having been obtained from a commercial source, so they might have been already permeable. A visual assessment of the graphs shows a slightly greater effect of abrasion on lentil seeds.

The only significant factor affecting the viability of seeds was accelerated metabolic aging. Logistic regressions showed that both species started losing viability rapidly at around 3 days of accelerating aging, with most seeds having died after five days. Coefficients for all regressions were very similar. The only abnormalities were observed at seven days. While all the lupine seeds were dead, some lentils seeds had survived.

References

1. TeKrony, Dennis M. “Accelerated Aging Test: Principles and Procedures.” Seed Technology (2005): 135-146

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