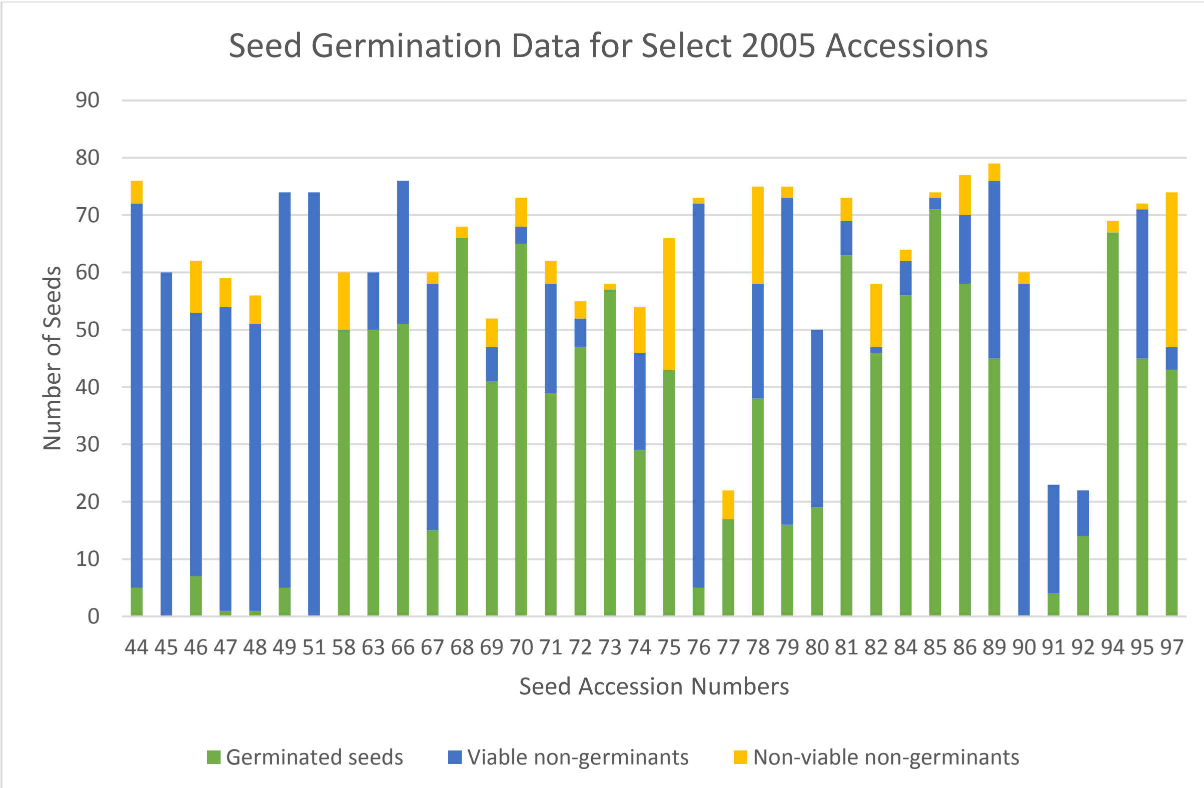
Testing Seeds in the Bank for Viability

For many plant species, little is known about the long-term viability of their seeds when subjected to dry, cold conditions for longer than a few seasons. We do know, however, that seeds of some species recovered from archaeological excavations have germinated after several hundred years of dormancy and agricultural crop seeds can be stored dry in banks for long periods of time with little effect on their germination potential. For most temperate plant species, removing moisture from their seeds and freezing them will extend their life for decades. These seeds are considered to have orthodox seed storage behavior. However, there are a few species such as oaks and hazel nuts that are intolerant of extreme desiccation and cannot be stored long-term in the conventional manner. These seeds are considered to have recalcitrant storage behavior. Scientists have set optimal temperatures for orthodox seeds at -20°C and optimal water content between 15% and 24% RH. Under these conditions, free and bonded water in cellular cytoplasm is reduced to the point that ice crystals will not damage the cytoplasm and cell reactions are slowed to retard the aging process.

For most of our early Seed Bank collections, a portion of the collection was sent to the global Millennium Seed Bank Project in the UK. This facility is equipped to test the viability of their seed accessions when first admitted and every ten years afterwards. They do this by taking samples of seeds and subjecting them to germination assays. Our regional seed bank can rely on their data to track the viability of our shared collections since we treat our seeds in a similar manner. Some of our early collections, however, were not sent to the Millennium project so we did our own testing for those taxa.

The results, for the most part, were encouraging. Testing involved removing a sample of seeds from seed packets in the vault and treating them with gibberellic acid. Gibberellic acid is a natural hormone found in plants that promotes germination in dormant seeds. Instead of waiting for this process to happen in nature, which is often triggered by a cold period such as winter, directly treating seeds with gibberellic acid in the laboratory has a similar affect without the wait. We then place the treated seeds in a growth chamber with specific temperature and light regimes comparable to growing conditions for each species. Species that exhibit physiological dormancy (a common dormancy strategy for many temperate plants) usually respond well to this sort of treatment. Seeds of most species tested showed good germination (green on the graph). Some seeds that did not germinate yet appeared to be viable (blue on the graph) were saved for further testing, if the volume of seeds was sufficient. If seeds appeared to be viable and did not germinate, chances are we failed to fulfill the requirements necessary to break their dormancy . Seeds that did not germinate and thought to be non-viable are indicated in yellow on the graph.



Seeds that appeared viable but did not germinate (blue bar) were divided in half and submitted to cold, dry conditions and cold, wet conditions for a few months. These treatments more closely mimic those conditions found in nature. They were then tested for germination using the same criteria as before. Our goal here was to try and break seed dormancy by using a more natural approach to breaking dormancy instead of artificially treating the seeds with giberillic acid. Results were mixed.

Some species showed improved germination, especially for those submitted to cold and wet stratification (data not shown). One species in particular, #76 *(Cinna arundinacea)* performed very well with additional cold, wet stratification showing 100% germination for all viable, non-germinating seeds.

Other species, such as #45 *(Sanguinaria canadensis)*, continued to show no germination after additional stratification. The literature suggests that removal of the eliasome attached to each seed improves germination of this species. The eliasome is a fleshy appendage to the seed that is attractive to ants as a food source, therefore acting as a dispersal mechanism for the species. If removing the eliasomes triggers a decrease in dormancy of this species, perhaps that is the reason for poor germination.

Sanguinaria canadensis seeds with eliasomes.

We will continue explore the mysteries of seed dormancy and longevity to improve the effectiveness of long-term preservation of seeds in seed banks.