Tree Improvement Branch

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One size doesn't fit all: seed characterstics

The genetic architecture of a species will have an impact on the sampling structure required to capture a species' genetic diversity. The species' seed characteristics will have a large influence on the efficiency, effectiveness and durability of ex situ seed collections (seed banks). Although ex situ conservation can refer to clone banks, progeny tests, and tissue cultures it is specifically seed which I will discuss. A primary benefit of seed banks is the efficiency of storage. For a species like white spruce a small handful of seed (110 grams) can represent over 50 000 unique genotypes! This efficiency allows for very large numbers of genotypes to be conserved relatively cheaply within a small space.

A primary determinant of durability relates to a species' seed storage characteristics. All of our north temperate conifers are considered **orthodox** species meaning their seeds can be dried to low moisture contents (<10%) and can be stored at sub-freezing temperatures. This is an incredible advantage with our major tree species. In BC, seed that is over 50 years old is still being used successfully for operational reforestation. Some conifers have been described as having the potential for a functional storage potential (germination >60%) of 100 years (Simpson *et al.* 2004). This estimate is probably realistic given the increased knowledge we have today concerning collection timing, post-collection handling, processing and storage of tree seed compared to when our oldest seedlots were originally collected.

It is good news for orthodox species, but some tree species in Canada are considered **recalcitrant** and cannot be dried or stored at sub-freezing temperatures. This does not mean that short-term storage is not possible with these recalcitrant species, but storage cannot involve drying to low moisture contents and sub-freezing temperatures. The most prominent recalcitrant genus is *Quercus* with all species exhibiting recalcitrant seed storage behaviour. Even though longevity of seed storage is limited with Qurecus many individuals have been successful storing acorns for up to three years with high moisture contents at temperatures just above freezing (see Bonner 2008 for a full review). Other notable recalcitrant Canadian trees are silver maple (*Acer saccharinum*) and butternut (*Juglans cinerea*). For butternut, embryonic axis with some cotyledon tissue dried to below 4.8% moisture content showed potential for storage at -196 ° C (Beardmore and Vong 1998). A few familiar ornamentals are also recalcitrant, sycamore maple (Acer pseudoplatanus) and the buckeye (*Aesculus)* and chestnut (*Castanea*) genera. Have I left out any Canadian tree species?

Some species are considered orthodox even though there longevity in storage is not very long-term. Good examples are species in the genera *Populus* and *Salix* which have seeds that have been reported to have short lifespans under natural conditions, but whose seeds can be stored for years if properly dried and stored at subfreezing temperatures. Even with conifers there is variability in seed longevity. In BC, western redcedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*) and our true firs (*Abies* spp.) display the most rapid seed deterioration. I don't think it is a coincidence that these are also species which contain resin vesicles in their seed coats. The role of these resin vesicles is unclear and very little research has been performed on them considering the ecological and economic importance of these species. Damage to these structures has generally resulted in reduced germination (Gunia & Simak 1968; Kitzmiller et al 1973). Is the reduced storage experiences with these species due to damage to resin vesicles or simply due to the presence of these structures? I'm quite amazed that these mysterious structures have not received greater attention given their importance to quality seed production.

Within orthodox species there can also be a wide range in seed deterioration between individual seedlots. It is often thought that the higher the initial germination the better the storage potential is. This has some validity as high initial germination is often the result of good collection timing, proper handling, and efficient, careful processing. On the other hand some 'shortcuts' in any of these activities may not have an impact immediately, but after some period of storage. The results of these shortcuts may also show up when seed is germinated under non-optimal germination conditions. Below average germination speed or vigour may be an initial clue that a seedlot will not have a long lifespan. Estimates of seed deterioration to calculate the number of viable seeds (conservation collections) or germination retest frequencies (operational collections) are currently based on a species average change in germination. My challenge is to refine this to an individual seedlot basis and this is problematic with new seedlots which only have one germination test result.

References

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