Tree Improvement Branch

Cone and Seed Improvement Program
BCMoF Tree Seed Centre

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Abnormal Germinants

In the estimation of the germination capacity (GC) of a seedlot only the normal germinants are included in the calculation. A normal germinant is generally defined as a seedling showing the potential to develop into a normal seedling under favourable conditions. If we have normal germinants, then we must have abnormal germinants (simply called abnormals hereafter) and this relatively scarce group is the subject of this article. Abnormals are defined by the Association of Official Seed Analysts -AOSA (2006) as "all seedlings that cannot be classified as normal seedlings" and by the International Seed Testing Association - ISTA (2007) in terms of specific defects defined in section 5.2.5.A. Of particular interest to us are defects of the primary root (I), hypocotyl (II) or the entire seedling (VII), but descriptions of defects to the cotyledons, primary leaves, and terminal bud are also included.

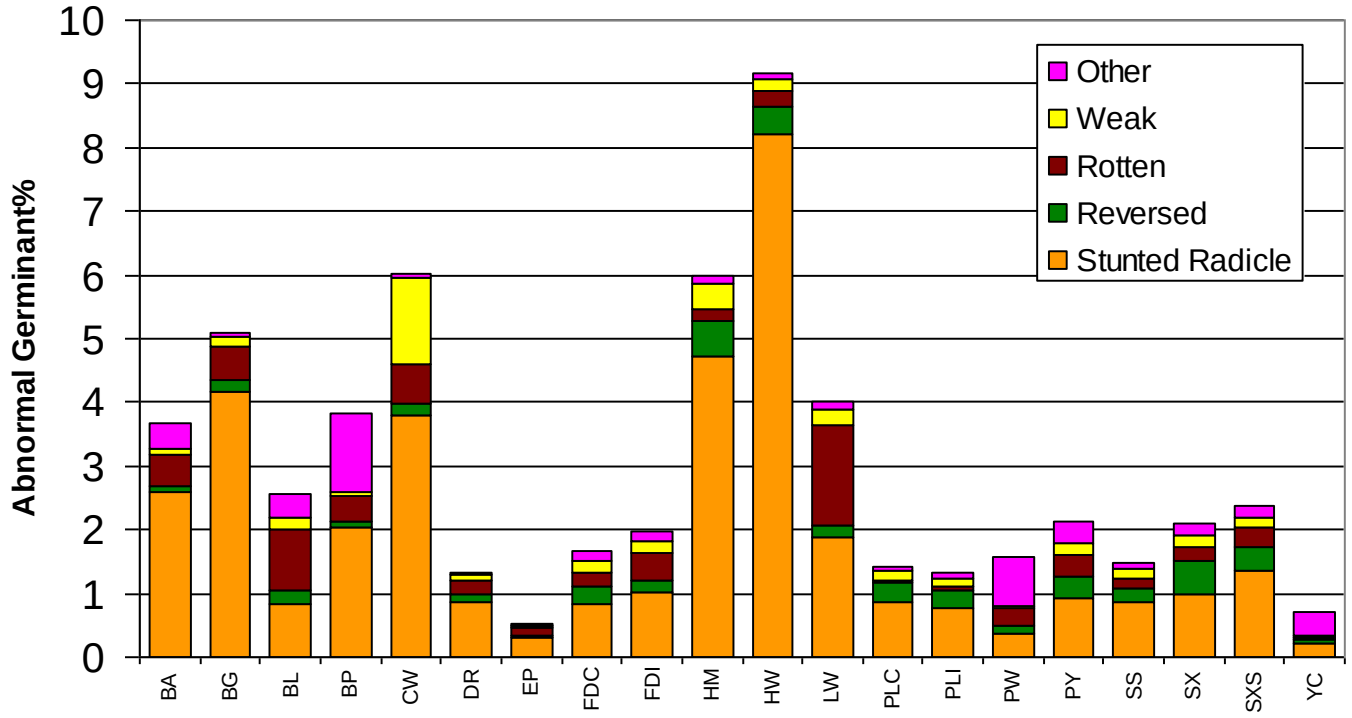
At the BC Ministry of Forests and Range Tree Seed Centre (TSC) we have been recording number of abnormals by test replicate using a set of standard abnormal types. Data from a total of 24 511 standard germination tests, performed since 1994, were analyzed for the occurrence of abnormals. Some seedlots are included multiple times in this analysis and all species presented were based on at least 100 germination tests. Across all species and germination test types, each germination test has an average of 2.8% abnormals identified (equals an average of 11.2 total abnormals identified in a 400-seed germination test). A listing of our abnormal types, a brief description, and their proportional contribution to the 2.8% is presented in Table 1 clearly showing that stunted radicles are the most common abnormal type. The four most common abnormal types account for roughly 94% of the identified abnormals. The remaining six types, accounting for 6% of the abnormals, will be grouped together as 'Other' to simplify comparisons across species.

Table 1. The abnormal germinant classes and their relative contribution to the abnormal total across all species and test types.

Classification	**Description**	**Proportion**
Stunted Radicle	Radicle emergence, but failure to reach length of 4X seed coat. Tip often blunt and darkened.	63.1%
Rotten	Tissues have become decayed.	11.4%
Reversed	Cotyledons emerging first.	10.2%
Weak	Radicle emergence, but failure to reach length of 4X seed coat. Radicle may be thin and spindly displaying low vigour or extremely small for species of interest.	9.0%
Megagametophyte Collar	Megagametophyte restricting normal radicle emergence, often appearing as a collar or extremely swollen tissues.	2.2%
Pregermination	Germination prior to pre-treatment completion	1.8%
Other	Assessed as not able to produce a viable	1.3%

	seedling, but failing to clearly fit a category (i.e. emergence of two embryos).	
Twisted	Hypocotyl tightly twisted (360°), germinant unlikely to form a normal seedling.	0.2%
Stunted Hypocotyl	Radicle may appear normal or absent, but hypocotyl is short or blunt for species of interest.	0.2%
Thickened Hypocotyl	Radicle appears normal, but hypocotyl is thickened in comparison to radicle.	0.2%

The occurrence of abnormals varies greatly by species and Figure 1 presents the proportions of the top four abnormal types and "Other" across our BC tree species[1]. Western hemlock (Hw) clearly has the highest proportion of abnormals (9.2%) and is also the species with the highest proportion of stunted radicles (90%). Other species averaging above 5% abnormals are mountain hemlock (Hm = 6.0%); western redcedar (Cw = 6.0%); and Grand fir (Bg = 5.1%) and the only other species exhibiting above average abnormal counts are western larch (Lw = 4.0%); Noble fir (BP = 3.8%); and Amabilis fir (BA = 3.7%). All of the remaining species average below 2.4% abnormals per germination test. Stunted radicles account for more than 50% of the abnormals in all species except subalpine fir (Bl = 32%); western larch (Lw = 47%); western white pine (Pw = 23%); yellow pine (Py = 44%); interior spruce (Sx = 48%) and yellow-cedar (Yc = 32%).



Abnormal germinants are present in virtually all seedlots and therefore have an impact on a seedlots estimated germination capacity. Some classes are easily identified (i.e. Reversed, Rotten), yet some of

[1] The BC Tree Code List can be found at this link http://www.for.gov.bc.ca/hre/becweb/Downloads/Downloads_SpeciesList/treecode_45.doc

the classes can be quite subjective such as Weak, Twisted and Other. In addition to quantifying the frequency of abnormal germinants, we will also be creating an abnormal germinant classification guide to assist with standardization. Stunted radicles are especially interesting due to their frequency and somewhat mysterious origin. I think that at least some of these stunted radicles are simply due to damage to the root apical meristem allowing existing cells to expand, but not permitting cell division to continue. We are hoping to perform some histological examinations to confirm this.

The other pertinent question is whether our assessment of abnormal germinants corresponds to those seeds fate in the nursery (i.e. inability to produce a viable seedling)? This is not an easy question to definitely answer, but the generally good correspondence between test and nursery germination for western hemlock (Hw), mountain hemlock (Hm), and western larch (Lw) is reassuring[2]. Large differences between germination tests and the nursery exist for western white pine (Pw), red alder (Dr), and subalpine fir (Bl), but these species have below average numbers of abnormal germinants. It is possible we are underestimating abnormals in these species, but there are a variety of other factors (i.e. actual stratification length, seed treatment, germination conditions, and culling standards) that can play as large a role in the production of acceptable seedlings.

I'd be interested to hear how other jurisdictions deal with the assessment of abnormal germinants and their frequency. It's a great opportunity to contribute to our 50th edition of the Newsbulletin in December.

REFERENCES

AOSA. 2006. AOSA Rules for Testing Seeds. Published by the Association of Official Seed Analysts. Stillwater, Oklahoma.

ISTA. 2007. International Rules for Seed Testing. Edition 2007. Published by the International Seed Testing Association. Bassersdorf, Switzerland.

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[2] 2008 Sowing Request Quality Assurance Results – Dave Kolotelo, TicTalk, December 2008 http://www.fgcouncil.bc.ca/tictalk_2008-final2-web.pdf