SEEDLING STANDARDS AND THE NEED FOR THEM[1]

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CLASSIFIERS, ORGANIZERS, STANDARD SETTERS

Human beings are creatures of order, at least creatures that attempt to understand their world by establishing an order to things. In this attempt at understanding; humans classify, organize, and set standards. The second law of thermodynamics states that "entropy (disorder) always increases in the universe." Human beings, it can be argued, in the understanding and shaping of their world, work against this law.

This order, as perceived in the natural world, leads to varied response on our part. Let me use an analogy to illustrate how I see these respond and how they will help us in the understanding of standards we use in forest seedlings.

Let's consider a child on the seashore - one of our beautiful Vancouver Island beaches - the child is doing what all children do on beaches - collecting sea shells. The child notices that all the shells are not the same and begins to organize the shells into groupings such as mollusks and bivalves. Then the child recognizes that the shells are not all the same size. The horseclams are much larger than the cockles and even within these there are many size classes. The child further values some shells more than others and decides that the biggest shell is also the best.

Our approach to seedlings is not significantly different from the child with shells on the beach. We organize, classify, and set standards for seedlings.

Today's talk is concerned with a look at this last area, ie. the standards we set for forest tree seedlings in British Columbia. These standards are values we place on the seedlings we grow.

Let's for a Moment Consider Some Other Products

In businesses the customer is all powerful. If the customer doesn't like your product there is little hope in attempting to convince the customer that they are wrong and don't really know what they want. As a example, let's look at apples. I have here a green apple. It happens to be a rather small green apple. I can vouch for the flavour - excellent. I also have a red apple - a rather large red apple. There is little hope of selling a customer a little green apples if they want a big red one. Or, let's look at possibly a better example. I have here two cucumbers - one straight and perfect - the other twisted and rather lumpy; by most customer standards just plain ugly. Now for the purpose of nutrition, there is no difference in these products, but one commands a high price and the other ends up on the waste heap.

What then of seedlings?—Certainly we organize our seedlings by species. Certainly we classify our seedlings within species by stock types and age. We also apply standards to our seedlings as to acceptable and target sizes; a value judgment.

Do we need standards?—In the strict biological sense we do not. The seedlings that germinate all have the potential to develop into trees, but not necessarily the trees that suit man's purposes. Conifers tend to produce large quantities of seed, however, and in the natural environment there is heavy attrition of seedlings and only a few grow into trees.

When culturing seedlings in a nursery, the bulk of the seeds do develop into seedlings. In the container culture different size plants are achieved primarily by selection of different container sizes. Within a stock type there is a distribution of seedling sizes. This distribution is generally a normal bell shaped distribution on the seedling characteristics of height and root collar diameter (RCD) (figs. 1, 2, 3, 4).

When setting standards the normal distribution must always be considered. If the range from the minimum to the maximum height is too narrow the result will not be to eliminate the tails of the population distribution, but a much larger part. When looking at the normal distribution and viewing the small plants in the left tail of the curve these plants are considered of poorer performance quality. This is true for each particular stock type. This is also true for forest seedlings as well and in a natural setting, these plants are likely to be out competed by their more vigorous neighbors. In a nursery environment they persist and form part of the population. There is always the argument that we are selecting the fastest growing seedlings in the nursery over a one or two year period and this does not necessarily select the fastest growing trees over a rotation. The depth of the

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[1]Kooistra, C.; Brazier, D. 1999. Seedling standards and the need for them. In: Landis, T.D.; Barnett, J.P., tech. coords. National proceedings: forest and conservation nursery associations—1998. Gen. Tech. Rep. SRS-25. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station: 111-115.
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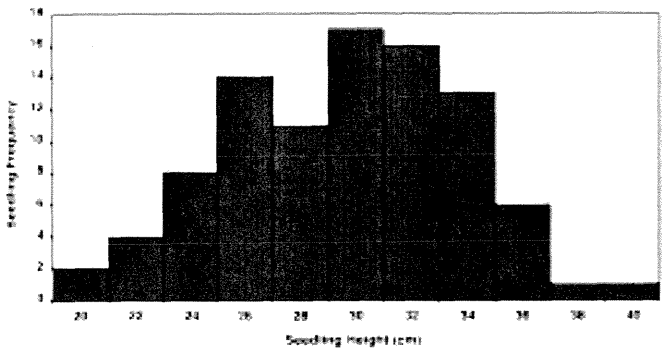

Figure 1—Height versus Frequency (Sx PSB 415D)

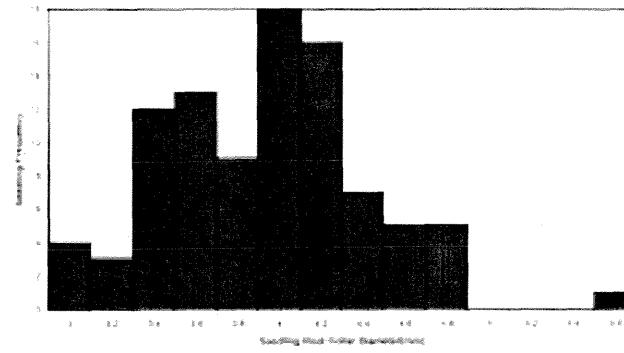

Figure 2—Root Collar Diameter versus Frequency (Sx PSB 415D).

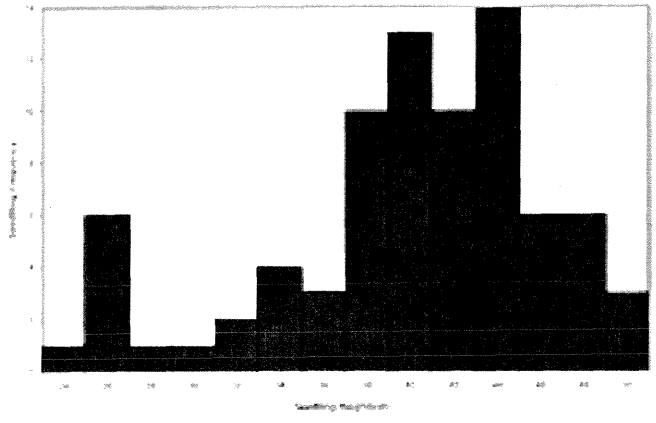

Figure 3—Height/Frequency (CW PSB 410).

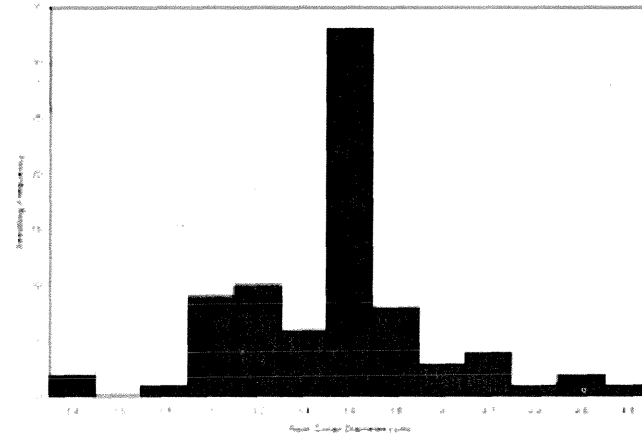

Figure 4—Root Collar Diameter versus Frequency (Cw PSB 415D).

breeding program, however, allows the selection of the fastest growing seedlings in the nursery and in the field. My expectation is that in future most nursery production will be grown by families. This will eliminate the culling of slightly slower growing families, but culling will still happen within the family population.

While it is true larger stock types tend to perform better, this is not primarily a standards issue. Larger stock types resulting from larger containers provide the plant with more soil media to grow in and with greater spacing for each plant, thus allowing for a larger amount of active foliage and a greater amount of products of photosynthesis, thus greater biomass.

WHY SET STANDARDS?

If biologically not strictly required, why make value judgments on a group of seedlings? The reason is that we place value on high survival and rapid and reliable growth. In the forest environment great quality seedlings result in enhanced survival and performance. In the nursery high quality seedlings result in satisfied return customers and in better utilization of space as over sowing can be reduced.

Standards can only be set by understanding both the limitations of the field performance and the nursery's capability to produce such a standard in a given stock type.

It should be noted that if the field requires a large size seedling to meet it's performance objectives, this can not be ordered in a small stock type with the hopes of achieving this end. The ordering of appropriate stock types is of major importance to success and requires continual extension activity to support field staff in the ordering stock.

We make value judgments in establishing standards for seedlings because we wish to obtain good performance of these seedlings in the field. Through trials and research it has been observed that out of a given population, larger balanced seedlings perform best. The recent remeasurement of a long term trial has again shown that even after 15 to 17 years the initial differences of size in interior spruce are still evident and significant.

We also establish these standards to encourage the nursery community to achieve a goal. This is the reason why in BC we have not only set the minimum standard for a

species/stock type, but also have set target standards. The goal is to focus nursery managers and growers on producing stock that not only meets the minimum standard, but also meets or exceeds the target standard. Keeping these standards high, but attainable has helped the nursery industry in BC produce seedlings of high quality while removing those of lower performance potential.

MORPHOLOGICAL STANDARDS

The primary morphological standards are height and root collar diameter. These are published by the Ministry of Forests every year for each species, stock type and age. They are based on what is needed in a stock type for it to perform well in the field and what is realistic to expect that particular container to produce in the nursery for that species and age. In this, the work by Eric Van Steenis of the

Species	Stock Type	Height (cm)			RCD (mm)	
		Cull	Target	Maximum	Cull	Target
Pine, Lodgepole (Pll)(Plc)	PSB/PCT211A	6	11	16	2.0/2.2*	2.3/2.5*
	PSB/PCT 310B/313B	6	12	19	2.2/2.4*	2.6/2.8*
	PSB/PCT 410	7	13	20	2.4/2.6*	3.0/3.2*
	PSB/PCT 415B	8	14	21	2.5/2.7*	3.1/3.3*
	PSB/PCT 412A	8	15	22	2.6/2.8*	3.2/3.4*
	PSB/PCT 415D (E)	8	15	23	2.8/3.0*	3.4/3.6*
	PSB/PCT 615A	10	18	26	3.2/3.4*	3.8/4.0*
Pine, Ponderosa (Py)	PSB211A(E)	7	11	–	2.2	2.5
	PSB313B	8	13	–	2.4	3.0
	PSB410	8	14	–	2.6	3.2
	PSB415B	9	15	–	2.8	3.5
	PSB412A	9	16	–	2.9	3.6
	PSB415D	10	17	–	3.0	3.8
Pine, White (Pw)	PSB313B	6	13	20	2.4	3.0
	PSB410	8	14	23	2.6	3.2
	PSB415B	8	15	25	2.8	3.4
	PSB412A	9	15	25	3.0	3.6
	PSB415D	10	17	28	3.2	3.8
Spruce, Sitka and Crosses (Ss, Sxs)	PSB211A(E)	12	17	22	2.0	2.4
	PSB310B (E)	12	18	24	2.1	2.5
	PSB313B	14	22	30	2.2	2.6
	PSB410	16	25	35	2.4	3.0
	PSB415B	17	26	35	2.6	3.2
	PSB415D	18	30	40	3.0	3.8
	PSB615A	30	45	60	3.8	4.8
Spruce, White/Engelmann & Crosses (Sw,Se,Sx,Sxw)	PSB/PCT211A (E)	10	15	20	2.2	2.6
	PSB/PCT310/313B	11	18	25	2.2/2.4*	2.8/3.0*
	PSB/PCT410	12/10(PR)	19/17(PR)	27	2.4/2.6*	3.0/3.2*
	PSB/PCT415B	13/11(PR)	22/20(PR)	28	2.6/2.8*	3.3/3.5*
	PSB/PCT412A	14/12(PR)	24/22(PR)	35	2.8/3.0*	3.6/3.8*
	PSB/PCT415D	14/12(PR)	26/24(PR)	40	3.0/3.2*	3.8/4.0*
	PSB/PCT512A	15	27	40	3.3	4.0/4.2
	PSB/PCT515A	16/14(PR)	28/26(PR)	42	3.2/3.4*	4.3/4.5
	PSB/PCT615A	20	40	50	4.0	5.0

Figure 5—Morphological standards for Lodgepole pine and White/Englemann spruce.

BC Ministry of Forests has been very useful in relating stem basal area to the cavity spacing on the container and cavity diameter. An example of a current set of standards for Lodgepole pine and white/Englemann spruce are given in figure 5.

These types of morphological standards were successful in pushing the BC forest nursery industry to improve the size and uniformity of the seedling crops. These Height/RCD scattergrams show the type of crops that can be grown (figs. 6 and 7). The tightly clustered population around the targets and within the minimum/maximum specifications indicates a high quality crop. These scattergrams are also very helpful in determining the impact of any change in the culling standards.

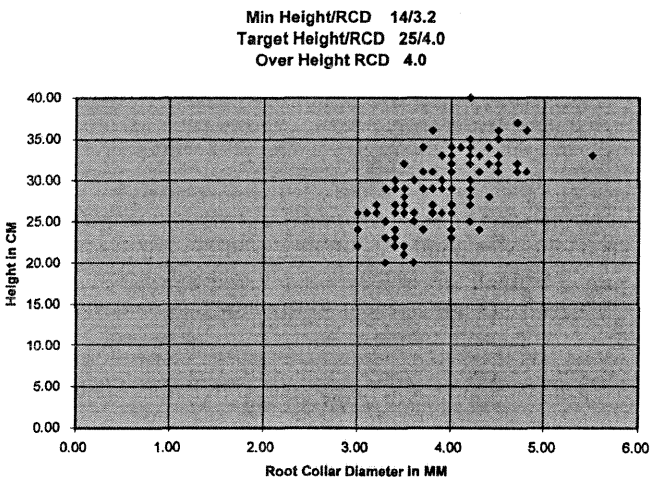

Figure 6—Scattergram Interior Spruce PSB 415D.

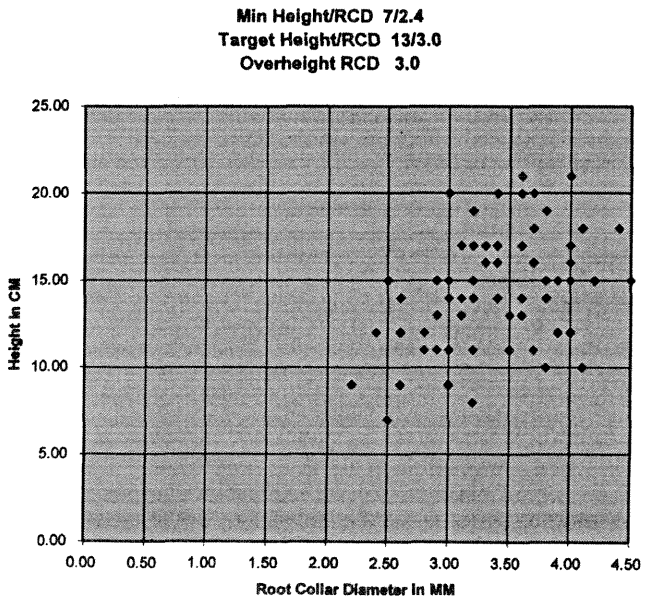

Figure 7—Scattergram Lodgepole Pine PCT 410.

While shoot root ratios have been used in the past, less attention is paid to these today. Rather we have seen an increasing interest in the height - root collar diameter ratio as a measure of a seedling's sturdiness. This ratio, sometimes called Sturdiness Ratio, is important when considering resistance to the physical impacts of vegetation or snow press.

The values of setting a morphological standard(s) for the production of a seedling are as follows:

1. The standard is set in part to ensure the seedling has enough biomass and in the correct balance to meet the site conditions of the forest planting environment.
2. The standards, as published, are a useful guide to field staff when selecting a type of seedling that is required to meet specific planting site conditions. Effectively field staff can select the seedling size that is desired and then order the corresponding container size.
3. The standards are also useful as a contractual tool to determine what seedlings meet conditions for payment. For this reason, height and RCD usually form part of contract specifications in BC. Field staff can count on a uniform product since all seedlings must fall within the minimum and maximum morphological parameters. These measurements are also quick and non-destructive.

PHYSIOLOGICAL STANDARDS

To determine an acceptable state of seedling it is also important to look at its physiology. In BC we have a number of tests to determine this and help guide in the acceptance of seedlings for planting stock.

Root Growth Capacity

The prime physiological test is the root growth capacity test. A sample of the seedlings is placed in an ideal growing environment for seven days before the new root growth is evaluated. The standard we use here relates to the scale developed by N. Burdett and on a scale from 0 to 5 with 5 being excellent and 0 meaning no root growth. On seedling samples that have 0's in them or are less than 2 on the scale, re-testing is recommended. If it remains low in the second test, advice is given to plant seedlings at a higher density, anticipating some mortality, or it may be recommended that the seedlings be discarded.

Prestorage Storability Determination

The standard we use to determine the seedling readiness for storage is the Storability Test developed by D. Simpson and W. Binder of our Research Branch. This test can have a major positive impact on the success of long-term over winter storage because it determines the state of dormancy and frost hardiness of a seedling in relation to fall lift and the placement of seedlings into storage. It is recommended that representatives of all seedlings by species, elevation, and latitude be passed through this test. The standard set is such that seedlings are lifted and stored only once the seedlings passes the storability criteria of the test.

Variable Fluorescence

During the growth phase of seedlings, few tests have been developed to determine seedling health. One method that has recently become available is a variable fluorescence determination. If it is suspected that seedlings have been damaged or appear in poor condition, this test can provide data on the vigor of the photosynthetic system of the plant. Standards for this test show those seedlings that are healthy, stressed and/or dying.

Operationally the EARS (Institute of Environmental and Remote Sensing) PPM (Plant Photosynthetic Meter) is used. This instrument is lightweight, portable, and able to do a larger number of samples on a battery charge. This meter is extremely effective at quickly identifying damaged or dead tissue. The readings are simple numbers and thus can be interpreted directly without the use of charts or formulas.

Others have incorporated more differing physiological tests that involve the use of stress and monitor the seedling response. BC Research has pioneered this area, but they are not widely used in the province to date.

CONCLUSION

The setting of standards is a human activity of applying a value judgment to the natural world. In seedlings these standards have helped us achieve reforestation success in survival and field performance. It has also been beneficial in providing nurseries with goals that through utilizing innovation, are being achieved and high quality forest seedlings are being produced.

Finally, let us return to the seashore. The child on the beach has made value judgments on the groups of shells collected. The biggest clam shell is best, but all of the collection are OK if the shells are not chipped or broken, or too small. Even the mid size shell holds appeal. We use scientific measures to provide the judgment criteria we use in morphological and physiological standards. We recognize the best shells, we accept the large part of the collection, but reject the broken, chipped and smaller stock as unacceptable to our goals.

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