EFFECT OF PARENT TREE AND CROP YEAR ON SCOTS PINE SEED WEIGHT

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Abstract - Seed sizing has operational advantages in container nurseries because it helps assure a uniform number of seed per cavity and is reputed to increase total percent and rate of germination. However, the genetic base could be unnecessarily reduced if seed from certain parent trees is excluded. This does not appear to be a major risk with Scots pine.

Introduction

Many container seedling nurseries "size" their seed prior to stratification. "Sizing" means separating and using only the largest and heaviest one to two-thirds of a seed lot. According to current dogma, uniform seed size helps to insure uniform numbers of seed per cavity. Sizing also selects for those seeds that are full and have the largest endosperm capacity. It is hoped that sizing will result in faster and more complete germination, but there is some evidence that this may not happen. Helium (1966) found that heavy white spruce seed produced taller germinants with more cotyledons, but seed of average weight germinated 2-3 days faster than either the lightest or heaviest. (See also Simak and Gustafsson 1954).

Some geneticists are concerned that seed sizing reduces the genetic base, because seed size tends to be a characteristic of the parent tree (Helium 1976). Seed size, however, may also vary from one year to the next such that different trees produce heavy seed. When this is the case and seed crops are available almost yearly, then seed sizing would not discriminate against individual parent trees over a period of years nearly as much as it might in any one year. In addition, the small seed can be sowed in a bare-root nursery where accurate seed count and high germination is not as critical.

Study Background

In 1976, Ore Hellum of the University of Alberta at Edmonton described an experiment to me in which he weighed individual seed from 11 white spruce trees and used a frequency diagram to show that different parent trees produced seed of different mean weight. Collections from 5 of the same trees the following year, however, showed that the rank order of trees with respect to seed weight had changed. Helium's report stimulated me to examine our Scots pine collection of seed to see if his results could be verified with a different species and with more trees and more years of collection.

Materials and Methods

As part of our tree improvement program at Bottineau we have made annual collections of Scots pine seed which have been kept separate by year and by parent tree. We found we had 4 years of collection from 4 trees and 3 years of collection from 9 trees. We weighed 210 individual full seed from each year of collection from each tree. A two way analysis of variance was calculated for each of three groups of trees. This was the easiest analysis to perform, because not all of the 9 trees had been collected from in the same years.

Results

All three analyses gave the same result and all variables were highly significant. The parent tree was responsible for the largest amount of variation in seed weight, but year of collection also had a sizable effect. The fact that the tree x year interaction was also significant means that the rank order of mean seed weights of the various trees may change from one year to the next (figure 1).

The standard error within seed lots is about 12%. If the mean seed weight is 10 mg, then 67% of the seed weights will fall between 8.8 and 11.2 mg, and 95% will be between 7.6 and 12.4 mg.

Discussion

How important are these differences to the nurseryman? Let us suppose that for each year we collect equal numbers of seed from each tree and pool the lot. We then split the lot exactly in half at the median seed weight into a heavy and a light fraction. Please note that this is a limiting case which could only be accomplished by weighing each seed individually. Real world seed cleaners are not that good, and a portion of the light seed would end up in with the heavy seed and vice versa.

Table 1 shows the contribution each tree would make to the heavy and light fractions of each year's seed lot. If every tree had the same mean seed weight, there would be no differences in contribution to the light and heavy fractions. There are sizable differences, however, and yet in no case does seed from any tree fall exclusively into the light or heavy fraction. There is always some overlap, and a less-than-perfect seed separation would increase the overlap.

In general, although seed sizing does discriminate against trees with small seed, in this case it does not completely exclude their contribution to the next generation. Furthermore, the contribution of an individual tree to the light and heavy fractions varies from one year to the next and varies depending on the other trees with which its seed is mixed.

I conclude that seed sizing of Scots pine will not be a genetic disaster, because seed from few if any trees will be totally excluded from the next generation, especially if seed is collected from the same trees year after year.

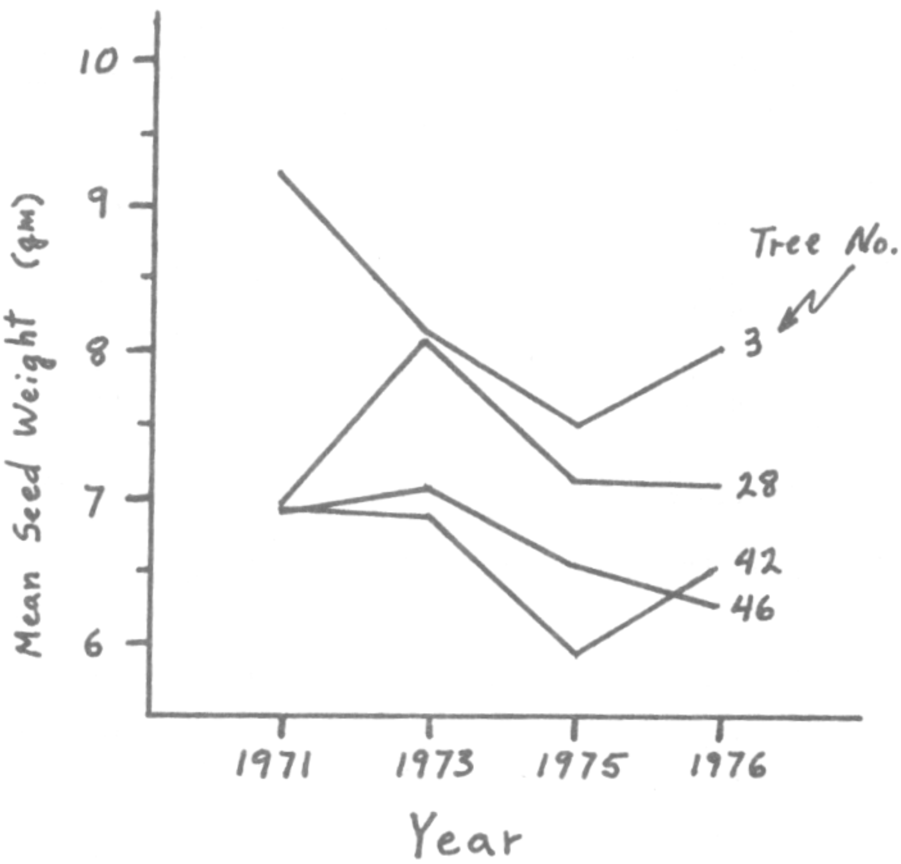

Figure 1.--Mean seed weight of single tree seed collections plotted against year of collection shows interaction between parent tree and year of collection, because the lines are not evenly spaced and even cross. Essentially parallel lines would indicate no interaction.

Table 1.--Seedlot composition assuming equal numbers of seed from each parent tree are pooled for each year of collection and each seedlot split into heavy and light fractions of equal size.

Year of Collection:		1971	1973	1975	1976
Median Seed Weight (mg):		7.35	7.75	7.15	7.55
Tree #	Seedlot Fraction	Percent			
3	Light	1	5	4	5
	Heavy	33	17	18	24
11	Light	1	9	7	-
	Heavy	33	13	16	-
22	Light	-	11	8	6
	Heavy	-	11	14	22
28	Light	22	9	8	20
	Heavy	11	13	14	9
31	Light	23	15	17	-
	Heavy	10	7	6	-
42	Light	28	20	20	23
	Heavy	5	3	2	6
43	Light	-	14	14	20
	Heavy	-	9	9	9
46	Light	25	13	19	25
	Heavy	8	9	3	4
51	Light	-	4	3	2
	Heavy	-	18	18	26

This is only a partial answer, however. Scots pine is not a major timber species in this country, and similar work needs to be done to assess the genetic impact of seed sizing on other species. In the West annual seed crops are usually not available, and nurseries are heavily dependent on good seed years at 3 to 8 year intervals. This increases the impact of the parent tree effect.

How much of an operational advantage does seed sizing give? There is no question about the desirability of eliminating all trash and foreign matter from the seed and having it uniform in size and weight to make seeding equipment operate as smoothly, reliably, and accurately as possible.

Does heavy seed germinate better? Obviously, we must deal only with full seed, but there are degrees of fullness. Shrinkage of the female gametophyte away from the seed coat wall can be seen on X-ray pictures and often indicates a loss of viability.

We have in progress an experiment in which the number of hours to germination are recorded for individual seeds of known weight. Regression analysis will determine the relation between germination time and seed weight, parent tree, and *year* of collection. We should have an answer for Scots pine soon, but there is a definite need for hard data on other species.

References

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