RECOMMENDATIONS FOR CALIBRATING MECHANICAL SEEDERS

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Calibration of mechanical seeders can be influenced by seed weight changes with fluctuating atmospheric humidity.

Because of its effectiveness and low cost, aerial seedling (following mechanical scarification) is commonly employed as a method of regenerating jack pine (*Pinus banksiana* Lamb.). In Ontario, the Brohm seeder (*2*) is the standard seeding device, and it is calibrated by using a calculation based on the number of seeds per gram to obtain a desired number sown per hectare. Observed differences between actual sowing rate and the rate set on the seeder (Riley, L.F. 1977. Canadian Forestry Service, Sault Ste. Marie, Ontario, pers. commun.) prompted a search for sources of the discrepancy. One such source is seed moisture content.

The uptake of moisture by seed is known to vary with temperature and relative humidity (R.H.) of the air. Barton (*1*) showed an increase in longleaf pine (*Pinus palustris* Mill.) seed moisture from 8.1 to 13.4 percent when the seed was taken from storage and placed in a chamber at 20° C and 76 percent R.H. Similarly, Harrington (3) found that moisture content of wheat seeds increased from 6.5 to 14.5 percent when R. H. changed from 15 to 75 percent.

The following note summarizes laboratory tests to establish the amount of moisture fluctuation in jack pine seed at two different levels of R.H. and of black spruce (*Picea mariana* [B.S.P.] Mill.) at one level of R.H. Such moisture fluctuations cause variation in seed weight and, hence, variation in sowing rate if a sample of the seed is not weighed and counted just prior to calibration.

Test 1

Two lots of jack pine seed (one treated with aluminum plus latex, one untreated) were taken from air-tight plastic containers stored in a refrigerated room with a temperature of 0.5° C and an R.H. of 20 percent.

Sixteen 100-seed replicates of treated and untreated seed were weighed immediately and placed in uncovered petri dishes. The untreated seed was divided into two groups of eight 100-seed replicates per group. Group A was placed in a room with a temperature of 21° C and an R.H. of approximately 40 percent. Group B was placed in a small chamber with a temperature of 21° C and an R.H. of approximately 100 percent. Similarly the treated seed was divided into two groups of eight 100-seed replicates. The procedure for these groups (C and D) was similar to that for groups A and B, respectively.

All seedlots were weighed periodically over the 65-hour test period. Moisture contents were calculated as a percentage of oven-dry weights.

At 100 percent R.H., seedlots in groups B and D absorbed moisture rapidly. Within 4 hours the untreated seedlots more than doubled their moisture content and at the end of the experiment the initial moisture content of the seed was quadrupled (table 1), i.e. from 7.4 to 34.9 percent. Although the untreated seedlots had a lower initial moisture content than the treated seedlots, there were no great numerical differences between their moisture contents at 100 percent R.H. by the end of the test.

At 40 percent R.H., the moisture content of both untreated and seeds in groups A and C dropped to 4.9 and 5.1 percent respectively, apparently reaching an equilibrium moisture content (based on further testing) for those conditions.

Test 2

Using untreated seed only, two 100-seed replicates of jack pine were placed outdoors under an open-ended shelter to allow a flow of air over the seed. Moisture content of the seeds was determined periodically over a 48-hour period. The moisture content was observed to increase as R.H. increased to 90 percent (light rain), to decrease after rainfall ceased as R.H. decreased to 52 percent, and to increase again with the recurrence of rainfall (table 2).

Test 3

To examine the moisture uptake qualities of larger samples of seed, two seedlots of jack pine, one un-

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treated, the other treated as before, were each measured into three replicates. Each replicate contained a 1 gram and a 30 gram sample. On average, 1 gram of untreated seed contained 319 seeds, and 1 gram of treated seed contained 277 seeds. In addition, three replicates of 1 gram and 30 grams samples of untreated black spruce seed were tested. The seed samples were placed in individual dishes (4.5 cm diam x 6.5 cm depth), which were then placed, uncovered, in a chamber at approximately 100 percent R.H. Dishes were removed periodically over a span of 137 hours, weighed and replaced immediately in the chamber.

Since there was not enough seed from seedlots used in tests 1 and 2, the untreated and treated jack pine seeds used in the 30 gram samples of test 3 were from a different seedlot than the 1 gram samples.

The results (table 3) support the initial tests with small samples and confirm the increase in seed moisture content under conditions of high atmospheric humidity. Moisture absorption expressed as a percentage of storage moisture content was 245.3 and 75.8 percent, respectively, for the untreated jack pine samples of 1 gram and 30 grams and 70.5 and 13.8 percent, respectively, for the treated jack pine samples of 1 gram and 30 grams at the end of 137 hours. This indicates that moisture absorption is reduced with increased sample size. However, on the basis of number of seeds per unit weight, such variation is still considerable. For example, using the 30 gram untreated jack pine at a count of 319 seeds per gram and a storage moisture of 6.2 percent, an increase in moisture content to 10.9 percent would reduce the count to 304 seeds per gram.

The pattern of moisture absorption by untreated black spruce seed was observed to be similar to that for jack pine (table 3). Since black spruce seed is approximately one third the weight of jack pine seed, a small fluctuation in moisture could have a greater effect proportionally on the number of seeds per gram than for jack pine.

Table 1.—*Moisture content (percent) of jack pine seed after exposure to two relative humidities.*

Seed type	Relative humidity	Test period (hr) 0	4	17	41	65
		Moisture content percent oven-dry weight				
Untreated						
Group A	40	6.4	6.0	5.8	5.4	4.9
Group B	100	7.4	18.3	26.2	32.8	34.9
Treated						
Group C	40	13.1	8.1	6.6	5.7	5.1
Group D	100	13.9	19.1	26.6	31.9	36.0

Table 2.—Changes in moisture content (percent oven-dry weight) of untreated jack pine seed in response to fluctuating external changes in relative humidity.

	Test period (hr) 0	3	17	24	41	48
Moisture content percent oven-dry weight	6.5	10.6	13.2	10.8	10.1	11.3
Relative humidity percent	90	90	90	52	83	87

Table 3.—*Increases in moisture content (percent oven-dry weight basis) of jack pine and black spruce seed in 1 gram and 30 gram samples upon exposure to 100 percent relative humidity*

			Moisture content							
			----- *percent oven-dry weight* -----							
Species	Treatment	Sample Size -- *gram* --	0	4	17	24	41	48	65	137
			time (hr. after establishment)							
Jack	Untreated	1	7.5	10.5	15.7	16.6	19.3	20.0	21.8	25.9
pine		30	6.2	6.5	8.4	7.7	8.4	8.6	9.2	10.9
Jack	Treated	1	17.3	17.6	20.3	22.3	22.8	24.0	25.1	29.5
pine		30	14.5	14.9	15.1	15.2	15.4	15.5	15.7	16.5
Black	Untreated	1	11.2	13.4	17.1	18.5	19.7	20.2	20.9	25.2
spruce		30	9.4	9.7	10.2	10.4	10.8	11.0	11.4	12.5

Discussion and Recommendations

The results indicate that jack pine and black spruce can absorb moisture from the air at high R.H. and lose moisture under conditions of low R.H. This suggests that sowing rates based on the number of seeds per gram can be affected if seed is allowed to remain exposed to the elements for even a few hours (e.g., in garages, hangars, trucks, etc., while pilots wait for suitable flying weather).

Although these changes in seed weight are quite significant, they are not sufficient to account for all of the substantial differences between the calibrated and actual seeding rates observed in the field. Further work is in progress to pinpoint the other sources of error (Riley, L.F., 1977. Canadian Forestry Service, Sault Ste. Marie, Ontario, pers. commun.).

As a result of this study, the following recommendations are made to minimize the error due to changes in seed weight caused by changes in moisture content:

1. Seed should be handled carefully and stored in airtight containers until immediately before use.
2. Prior to sowing, all seedlots should be check-counted for the number of seeds per gram in the field location.
3. Sowing equipment should be check-calibrated with each seedlot shortly before sowing begins.
4. Seed extraction plants should ensure that weights of treated seeds per gram are included in packing slip information.

Literature Cited

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