THE QUALITY OF UNEXTRACTED PINE SEED

Robert P. Karrfalt[1]/

Abstract.--Three years of Cone Analysis Service data from the Eastern Tree Seed Laboratory were analyzed to determine the quality of pine seed that is not extracted after one drying of the cones. This unextracted seed was, in general, of poorer quality than extracted seed. However, unextracted seed in some cases represented substantial seed losses. Use of the cone analysis procedure to identify cone lots requiring processing is discussed.

Additional keywords: cone analysis, extraction efficiency, reprocessing, Pinus sylvestris, P. taeda, P. elliottii, P. virginiana, P. palustris, P. echinata.

Unopened or partially opened cones are common at a pine seed extraction plant. It is obvious that some seed is lost in unopened cones, but the value of the unextracted seed is not as obvious. Some seed plant operators have considered partially opened cones worth wetting and reprocessing to increase seed yields per bushel. Van Haverbeke (1977) has shown that wetting and redrying could result in increased yields of full seed from Scotch pine (Pinus sylvestris)cones from 18 to 77 percent. In this paper, the quality of unextracted seed is examined in loblolly (Pinus taeda), slash (P. elliottii), Virginia (P. virginiana), longleaf (P. palustris), and shortleaf (P. echinata) pines. Also, a procedure is described for estimating when a reprocessing of cones would be profitable.

METHODS AND MATERIALS

The cone analysis procedure provides a good method for evaluating the quality of unextracted seed. In this procedure seed are extracted from the cones and tested for quality. Any seed remaining in the cone are removed by cutting the cone apart, scale by scale. The seed removed by cutting (the unextracted seed) are also evaluated for quality. The cones are also subjectively classed as: completely open, 3/4 open, 1/2 open, 1/4 open or not opened at all. The reader is referred to Bramlett, et. al. (1978) for a detailed description of the technique.

The Eastern Tree Seed Laboratory has analyzed 3,046, 529, 213, 88, and 272 cones respectively, of loblolly, slash, Virginia, longleaf and shortleaf pines over the three years of 1975, 1976, and 1977. First year ovule abortion, empty seed and potentially sound seed account for 93 to 99 percent of the seed production capacity (table 1). Therefore, this paper will focus primarily on potentially sound seed.

1/ Assistant Laboratory Director, Eastern Tree Seed Laboratory, Macon, Georgia, which is operated cooperatively by the Georgia Forestry Commission; Southern Forest Experiment Station, USDA-Forest Service, and the Southeastern Area, State and Private Forestry, USDA-Forest Service.

Table 1.--Summary of combined cone analysis service data from the years 1975, 1976, and 1977.

SPECIES

Characteristics	Loblolly	Slash	Shortleaf	Virginia	Longleaf
Seed Production Capacity (# of seeds)	143	181	92	90	147
# of samples	3046	529	272	213	88
1st yr. aborted ovules[a]/	33	40	50	50	51
2nd yr. aborted ovules[a]/	2	4	1	3	3
Insect damage[a]/	1	3	0	1	1
Empty[a]/	15	17	30	21	13
Potentially sound[a]/	49	36	19	26	31

a/ Values are a percentage of seed production capacity.

The quality of extracted and unextracted seed was compared in the following manner. Individual cone data were grouped according to opening classes. For example, all cones opening 3/4 of the way were taken as a group. The average percentage of potentially sound seed for all samples in an opening class was computed for both extracted and unextracted seed. The average for the unextracted seed was subtracted from the average for the extracted seed. These differences are given in Table 2. The same comparisons were also made after grouping samples by clone (Table 3).

RESULTS

Seed Quality

In 39 of 47 comparisons of the percent of potentially sound seed made within cone opening class, the extracted seed appeared to be of higher quality (Table 2). This tendency for extracted seed to be better was also clearly shown in comparisons made within clones (Table 3).

However, the tendency towards higher quality in extracted seed does not necessarily mean that the extracted seed is not worth considering. Table 4 shows the number of loblolly clones that had similar numbers of unextracted potentially sound seed. For 35 of 91 samples that were scored open, there was a minimum of five potentially sound seed left in each cone. Using average figures of 17,000 seeds per pound and 35 cones per bushel, it can be computed that when five potentially sound seeds are lost per cone, there would be a loss of 1 pound of seed per 98 bushels of cones. By most economic analyses, this would be a financial loss of several hundred dollars. The loss would become proportionately larger with more seed left in the cones.

Table 2.--Difference in potentially sound seed percentage between extracted and unextracted seed in loblolly pine within cone opening class.

Species	Cone Opening Score	Extracted-Unextracted (%) 1975	1976	1977
Loblolly	Fully open	+ 1	+ 9**	+ 7**
	3/4 open	+ 7**	+ 8**	+ 8**
	1/2 open	+ 6	+ 7**	+ 4*
	1/4 open	+ 4	+ 6	+21**
Longleaf	Fully open	-----	+11	+11
	3/4 open	-----	+20**	+17*
	1/2 open	-----	-11	+ 1
Slash	Fully open	- 3	+10**	+13**
	3/4 open	+ 2	+ 3	+16**
	1/2 open	- 3	-12*	+14
	1/4 open	- 7	-----	+10
Shortleaf	Fully open	-15*	+ 5	+ 9
	3/4 open	- 8	+ 3	+ 5
	1/2 open	-----	- 1	+ 7
	1/4 open	+21	-----	+ 9
Virginia	Fully open	-----	+11	+33**
	3/4 open	-----	+ 6	+ 6
	1/2 open	-----	+18	+ 4
	1/4 open	-----	+14*	+15

**Statistically significant at .01 level by Student's T-Test.
*Statistically significant at .05 level by Student's T-Test.

Measuring Losses

Table 4 also shows that 13 of 91 cone samples, estimated 3/4 open, are less than one potentially sound seed per cone. Using the same average figures above, it can be determined that over 486 bushels would be discarded before a pound of seed was lost. Clearly, a subjective evaluation of cone opening cannot show the seed plant operator how much seed might still remain in his processed cones. However, the extraction efficiency determination in the cone analysis procedure (Karrfalt and Belcher, 1977) offers a simple, objective method for evaluating how complete an extraction has been.

To apply the technique, select at random, 10 to 20 cones from the lot before opening commences. Place them in a container that will allow them to dry, but remain isolated from other cones and seed, and place in kiln with the rest of the lot of cones. Before tumbling cones, remove the sample and process according to the cone analysis procedure.

Table 3.--The percentage of clonal comparisons in which the percentage of potentially sound seed was greater in extracted seed than it was in unextracted seed.

Year	Species	No. of Comparisons	Percentage of Comparisons
1977	Shortleaf	23	78
1976		3	66
1975		1	100
1977	Virginia	9	89
1976		9	100
1977	Slash	4	75
1976		6	100
1975		50	58
1977	Loblolly	76	82
1976		79	86
1975		126	67

Table 4.--Numbers of loblolly pine cone samples with similar numbers of unextracted potentially sound seed (1976 and 1977 combined).

Number of Potentially Sound Seed Per Cone	1	1-2	2-5	5-10	10+
Cone Opening Score					
Fully opened	0	3	0	1	1
3/4 open	13	22	21	15	20
1/2 open	2	7	14	16	30

Use the following procedure to determine the amount of potentially sound seed:

1. Divide the amount of extracted seed, after cleaning, by the extraction efficiency to determine the original weight of seed in the cone lot.

2. Subtract, the weight extracted, from the original weight to determine the weight of potentially sound seed remaining.

As an example, consider a cone lot which yielded 100 pounds of cleaned seed following extraction and had an extraction efficiency of 95 percent. The original weight of potentially sound seed would be 105 pounds (100÷.95). Subtracting the 100 pounds of cleaned seed shows that 5 pounds of potentially sound seed would still remain in the lot of cones.

We can carry our example one step farther and assume a value of $60 per pound for this seed. This would mean that the total value of the unextracted seed is $300. With a cone lot containing 100 bushels we would be able to spend up to $3.00 per bushel to reprocess the cones and recover the extra 5 pounds of seed. In reality, extraction and processing costs would need to be somewhat less than $3.00 per bushel because a complete extraction of the seed would probably not be realized.

Extraction Efficiency

Bramlett et al. (1978) described two methods of estimating extraction efficiency, procedure A&B. The B procedure followed by the Eastern Tree Seed Laboratory is favored because procedure A tends to underestimate the percentage of the potentially sound seed actually extracted. Procedure A would, therefore, tend to indicate reprocessing more often than procedure B, but to no benefit. In 96 percent of all clonal comparisons, over all species in the three years considered, procedure A did not measure the true percentage of potentially sound seed extracted. Procedure A was found at times to be inaccurate by as much as 10 to 20 percent.

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