MECHANICAL SEPARATION OF FULL AND EMPTY SYCAMORE SEEDS

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ABSTRACT

Tests over a three-year period at the Forest Tree Seed Laboratory in Starkville, Mississippi, have demonstrated how empty seeds can be mechanically removed from sycamore seed lots. Large lots can be upgraded on gravity separators, doubling or even tripling the percentage of full seeds. Removal of all empty seeds is not practical, but the percentage of full seeds can be substantially increased. Small research samples of approximately ten grams can be upgraded to over 90 percent full with laboratory blowers.

Increased production of American sycamore (Plantanus occidentalis L.) seedlings for planting in the South has aggravated the problem of low percentages of full seeds. Empty seeds increase storage space requirements and make regulation of bed density difficult. This paper describes mechanical methods for removing empty seeds from both commercial and experimental lots of sycamore.

The most common cause of empty seeds in sycamore is poor cross-pollination combined with self-incompatibility in isolated trees.[3] Frequently, seed collections are made from easily accessible, open-grown trees rather than from trees in forest stands. However, lots from these isolated trees can be upgraded, even though only 15 to 25 percent of the seeds may be full.

EXTRACTION AND CLEANING

Briscoe has described methods of breaking up dried fruits and of collecting and cleaning the seeds.[4] Very small lots can be

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[3] Beland, J. W., and L. Jones. Self-incompatibility in sycamore. Ninth South. For. Tree Improv. Conf. Proc. 56-58. 1967.

[4] Briscoe, C. B. Establishment and early care of sycamore plantations. USDA For. Serv. Res. Pap. SO-50. 18 p. South. For. Exp. Stn., New Orleans, La. 1969.

rubbed through hardware cloth; large lots can be tumbled in fertilizer spreaders. Since we frequently work with medium-sized lots of two or three bushels, suited for neither of these methods, we break up the fruits with a Dybvig macerator and then clean the seeds on a small table-top air-screen cleaner. We have used a 7 x 3/4 oblong screen to remove twigs, leaves, and fruit cores; small seeds, dust, and hairs can be removed with a 1/21 round-hole screen. Because of the large quantity of hairs, two runs on the small air-screen cleaner are usually required. The fine hairs are a definite safety hazard, and workers must wear masks or filters.

Measurements of purity, seed size, percentages of fullness, and germination (table 1) illustrate the effectiveness of the method for a small lot. Two runs through the cleaner yielded 99+ percent purity, even removing some of the small, light seeds. Average seed weight increased from 2.7 to 3.0 grams per thousand. The removal of light seeds explains the slight upgrading in fullness from 22 to 31 percent. The light seeds removed weighed an average of 1.7 grams per thousand, with 13.5 percent full. The germination data indicated no seed damage.

SEPARATION

After the seeds have been thoroughly cleaned, empties can be removed on a gravity separator. The final cleaned lot in table 1 (25.5 percent full) was processed over a table-top machine and divided into four fractions. The settings were:

End slope:	9 degrees
Side slope:	4 degrees
Shaking speed:	5 (medium)
Air gate:	4 to 5 (medium)

The vibratory feeder from the bin was adjusted to supply the quantity necessary to cover the deck. A profile of the resulting fractions shows that the percentage of full seeds in the heaviest of the four fractions was almost three times as great as in the original lot (cf. tables 1 and 2). Although this fraction weighed only 10 ounces, it was 68 percent full and comprised 40 percent of the total amount of full seeds.

Since the remaining fractions were too small to be rerun on the separator, a larger lot was tested to demonstrate fully the possibilities of the process. The second lot weighed 23.5 pounds, with 27 percent full seeds before separation. After the initial run, various fractions were combined and processed again (figure 1). We were able to double the full-seed percentage in one separation, and further separations did not significantly improve

Table 1.--Seed lot measurements after extraction in a Dybvig macerator and cleaning on a small air-screen cleaner

Treatment	Weight of 1000 seeds	Purity	Proportion of full seed	Germination[1/]
	Grams	Percent	Percent	Percent
Dybvig macerator	2.7	--	22.2	92.1
Air-screen (one run)	2.9	95.9	30.8	87.8
Air-screen (two runs)	3.0	99+[2/]	25.5	91.2

[1/] Percentage based on filled seeds.

[2/] Trash fraction too light to register on scales.

Table 2.--Profile of cleaned seed from table 1, separated into four fractions on a small gravity separator

Fraction	Weight of 1000 seeds	Proportion of full seed	Total weight	Estimated number of full seeds	Proportion of total full seed
	Grams	Percent	Ounces		Percent
A (lightest)	2.4	6	8	5,670	4
B	2.6	20	20	43,620	36
C	3.3	28	10	24,050	20
D (heaviest)	3.9	68	10	49,430	40

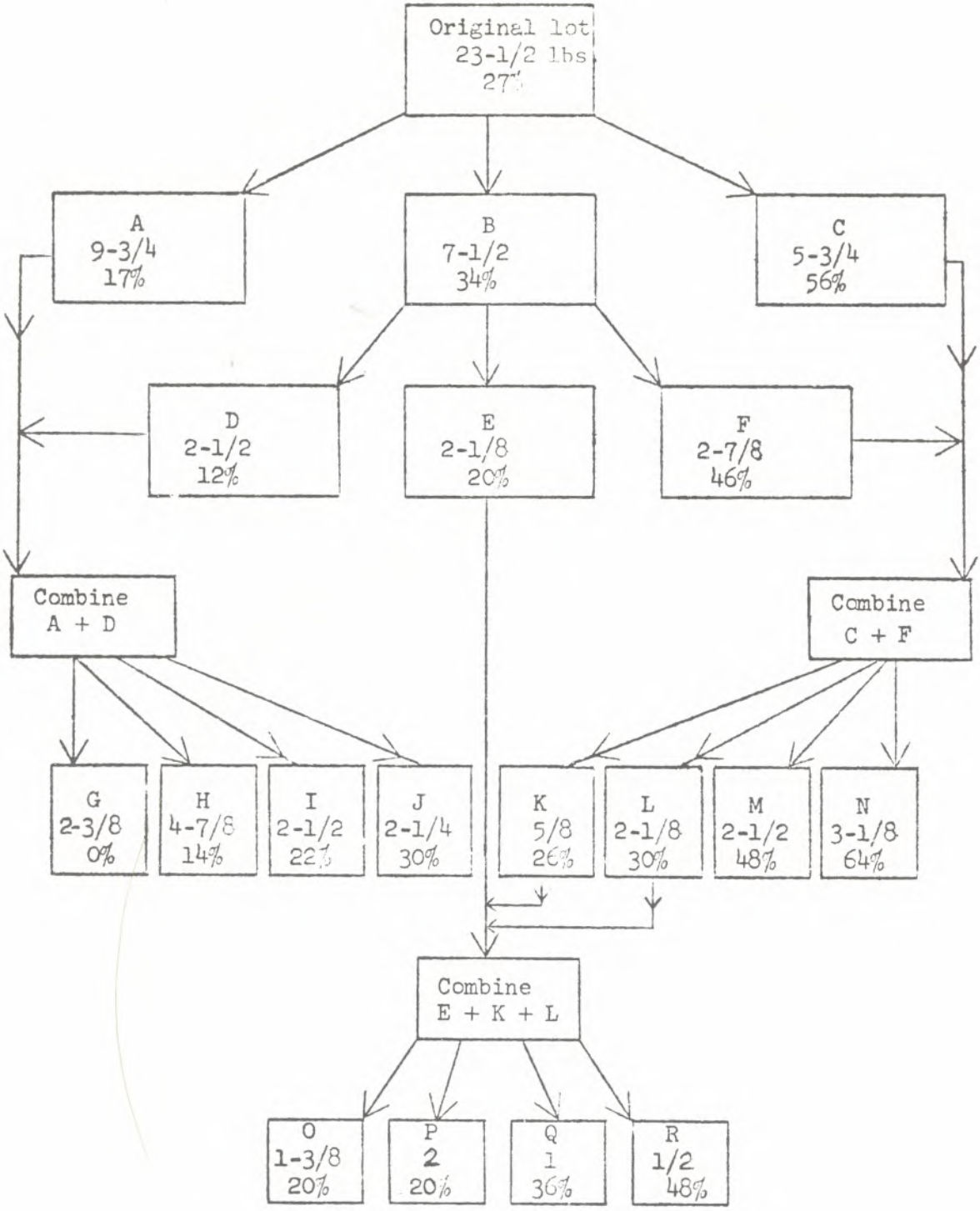

Figure 1.--Separation flow-chart for lot 731010 on the gravity separator. Fractions are designated by letter. Weight in pounds and the percentage of filled seeds are shown for each fraction.

this lot. When the heavy fractions, C and F, were combined and rerun, the heaviest fraction (N) contained only 64 percent full seeds, even though these seeds would logically be the largest of the entire lot. Although repeated separations of the middle fractions (B, E, K, L) gave some high percentages (F and R), most fractions ranged from 20 to 36 percent full (E, O, P, Q). Repeated separations on the light fractions (A and D) gave almost five additional pounds in the 20 to 30 percent range and left 7.25 pounds, almost one-third of the original lot, with very few full seeds (G and H).

The most practical procedure with this lot is to combine C and F, holding them as high-quality seeds, and to combine and reseparate A and D, as in figure 1. Fractions E, I, and J could then be combined and held as a low-quality lot. Fractions G and H would be discarded.

To test the method on a large lot we obtained 190 pounds of seed from the Mississippi Forestry Commission's Winona Nursery. A run through a large aspirator removed 40 pounds of dust and small seeds. The lot then measured 32 percent full, with 95.4 percent purity. At the Mississippi State University Seed Technology Laboratory, the seed was divided into three fractions on a large gravity separator. The light and heavy were set aside, and the medium fraction was rerun two times to isolate two additional heavy fractions. The lot profile (table 3) shows that quality was increased from the original 32 percent to 53 percent in the heavy fraction. The heavy fraction, weighing 44 pounds, had an estimated 3.0 million filled seeds, 53 percent of the total. The medium fraction, which weighed 21 pounds, averaged 20 percent filled and contained 38 percent of the total. The 32 pound light fraction contained only 9 percent of all full seeds and could be discarded without great loss.

Table 3.--Profile of a 1971 Mississippi Forestry Commission seed lot after three separations on a large gravity separator

Fractions	Weight of 1000 seeds	Proportion of full seed	Total weight	Purity	Estimated number of full seeds	Proportion of total full seed
	Grams	Percent	Pounds	Percent	Millions	Percent
Heavy	3.4	53	44	98.7	3.0	53
Medium	2.9	21	66	97.3	2.1	38
Light	2.5	9	32	95.9	.5	9

Germination of the full seeds ranged from 12 to 20 percent. Apparently the seeds had originally been stored wet and had lost viability. The high moisture content may have decreased the effectiveness of the separation process.

For research purposes, small lots can be separated very accurately with laboratory blowers. We used a General ER blower, 2/ which can clean approximately 10 grams at a time. For example, we drew ten samples of ten grams each from a lot only 17 percent full and blew them for five minutes with the aperture set at 25. The resulting heavy fractions averaged 72 percent full, and the light fractions, 13 percent. With samples having a higher original percentage of full seeds, we have used the blower to obtain 90 to 100 percent full samples for research. Obtaining samples of this high quality, however, causes many full seeds to be lost.

DISCUSSION

The procedures described here are useful for upgrading lots of American sycamore seed. An approximate doubling of the percentage of full seed seems possible; and in lots from forest stands normally yielding 50 to 60 percent[6]/ full, mechanical upgrading on the gravity separator should improve this percentage to 75 or 80.

Large gravity separators can quickly fractionate lots weighing hundreds of pounds, and small table-top separators also have a good capacity. Time trials with our small machine have shown a capacity of 32 pounds per hour; allowing for repeat runs, one should be able to separate 150 to 200 pounds per day.

Care should be exercised in several areas: first, the seed must be handled properly during collection and extraction. Next, it must be well-cleaned before separation, since the tiny hairs are a safety hazard and inhibit proper fractionation. Finally, the number of repeat runs on the separator, with combined fractions, will depend on the original condition and value of the lot, and on the number of full seeds needed. Heavy fractions may be rerun repeatedly to improve quality, but at a cost of time and seed. Such decisions always rest with the processor or nurseryman, who can best decide what is practical for his operation.

5/ Mention of equipment is for information only and does not constitute endorsement by the USDA Forest Service.

6/ Personal communication with S. B. Land, School of Forestry, Mississippi State University, Starkville, Mississippi.