SOUTHERN FOREST EXPERIMENT STATION

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UPGRADING YELLOW-POPLAR SEEDS

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SOUTHERN FOREST EXPERIMENT STATION

Yellow-poplar seed lots can be upgraded considerably by dewinging in a debearder and then cleaning and separating the seeds into four specific-gravity fractions with a fractionating aspirator or a gravity separator. By this process, lots with an original soundness of 6 to 10 percent were upgraded to between 60 and 65 percent full seeds.

Nurserymen have long been plagued by the very low percentage of full seeds in yellow-poplar (*Liriodendron tulipifera* L.) lots. The common results have been expensive handling and stratification procedures, and little or no control over seedling density or distribution in the seedbeds. The inability to obtain uniform lots of high viability, except by X-ray sorting, has also inhibited research with yellow-poplar seeds. This article describes a processing method that has proved highly successful both in small trials and in a larger pilot-scale operation. The method involves removal and separation of the carpel wing and partitioning of the remaining seeds into different weight fractions to isolate the full seeds.

PROCEDURE FOR SMALL LOTS

The seeds' carpel wings were removed in a small debearder designed for seeds of forage grasses or small grains. A rotary horizontal beater inside a steel drum forces the seeds to rub against projecting arms and each other.[3]

The drum of the debearder was filled with intact seeds to about half its capacity, and the discharge gate was blocked for 2 or 3 minutes to insure adequate reduction or removal of the carpels. When visual checks showed that the

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[3]Harmond, J. E., Brandenburg, N. R., and Klein, L. M. *Mechanical seed cleaning and handling.* USDA Agr. Handb. 354, p. 56. 1968.

carpel wings were gone, the discharge gate was partially opened. To maintain a steady flow rate and uniform abrasion, carpels were continually hand-fed into the drum, keeping it about half full. The amount of time necessary for effective dewinging varied by seed lot. Drier carpels were dewinged sooner than moist ones.

The seeds were spearated from the carpel-wing debris with a laboratory model of a fractionating aspirator. The dewinged and cleaned seeds were then rerun through the aspirator and separated into four density fractions. Airflow was adjusted to place the lot's approximate percentage of full seeds, as shown by a prior cutting test, in the heaviest fraction.

The process yielded clean and smooth seeds with flow characteristics entirely different from those of seeds with intact carpels (fig. 1). Processed seeds should flow easily in any cleaning, processing, or planting machinery.

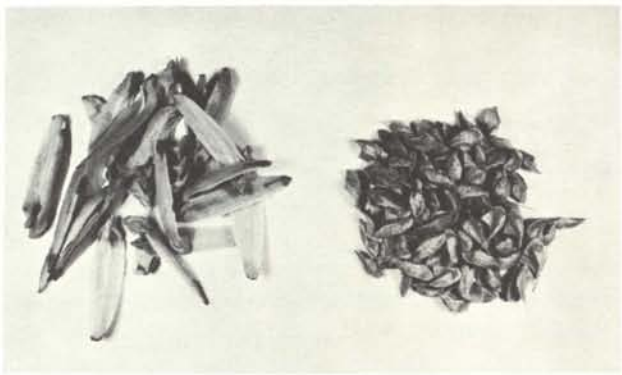

Figure 1. — *Seeds with intact carpels (left), and dewinged and smoothed seeds after processing (right).*

EXPERIMENTAL RESULTS

Two small lots were upgraded by the procedure described:

Lot A—Seeds from a single tree in Warren County, Miss.; cutting tests showed 9 percent full.

Lot B—Seeds from a single tree in Oktibbeha County, Miss.; cutting tests showed 35 percent full.

"Cones" were picked from tree tops in logged areas, air-dried, and broken apart by hand.

Cutting tests after processing showed that the heaviest fractions were 60 and 79 percent full as compared to original lot values of 9 and 35 percent for lots A and B, respectively (table 1).

Table 1. — *Fullness and germinative capacity of two small seed lots*

Aspirator fractions	Proportion of filled seeds	Germinative capacity	
		Total-seed basis	Full-seed basis
	Percent		
Lot A			
1 (heaviest)	60	54	84
2	12	16	100
3	2	4	100
4 (lightest)	2	1	100
Lot B			
1 (heaviest)	79	73	90
2	13	23	100
3	2	2	100
4 (lightest)	1	1	100

As expected, the proportion of full seeds was much lower in the lighter fractions.

Reductions of weight and volume from the original lot were outstanding. Trash and dust removal after dewinging eliminated about one-third of the entire original weight and volume for each lot. Discarding the two lightest fractions (3 and 4) would eliminate an additional 15 percent of the volume in Lot B and about 35 percent in Lot A. Thus, with these lots one-half to two-thirds of the material normally handled could be discarded.

Samples from each fraction were imbibed at room temperature for 48 hours, then stratified in plastic bags at 37° F. for 60 days. Germination was tested on moist Kimpak under an alternating daily regime of 8 hours light at 86° F., and 16 hours dark at 68°. Positive geotropic response of the emerging radicle was the criterion of germination. The test period was 30 days. Germinative capacity values (total seed basis) agreed very well with the cutting tests, with the single exception of fraction 2 in Lot B (table 1). High germinative capacities calculated on full-seed bases show that processing did not harm the seeds.

The number of good seeds in each fraction can be estimated from seed weights (table 2). In Lot B, fraction 1 contained 67 percent of all good seed; fraction 2 contained another 30 percent. With such a lot, the nurseryman could, by discarding all but fraction 1, retain two-thirds of all good seeds in 16 percent of the volume and 21 percent of the weight of the original lot. The seeds put into the beds would run almost 80 percent full, assuming no losses in storage or

Table 2. – *Seed weights and distribution of full seeds by fraction. The 4th fractions of both lots were only 1 percent full and were omitted from table*

Aspirator fractions	Weight of 500 seeds	Total seeds	Total full seeds	Proportion of lot's full seeds
	Gram	*Number*	*Number*	*Percent*[1]
Lot A				
1 (heaviest)	13.25	2,302	1,418	14
2	8.45	55,385	7,532	72
3	7.15	53,986	1,512	14
Total	. . .	111,673	10,462	100
Lot B				
1 (heaviest)	7.75	24,065	19,156	67
2	5.05	50,792	8,533	30
3	3.65	23,151	1,019	3
Total	. . .	98,008	28,708	100

[1] Based on an average of all cutting and germination tests.

stratification. Also, by retaining fraction 2, one could recover practically all of the remaining full seeds in less than half (46 percent) of the volume of the unprocessed lot.

Lot A, with only 9 percent full seeds, is a more typical yellow-poplar lot. By keeping only the heavy fraction of Lot A, the nurseryman would have seeds 60 percent full, but only 14 percent of the total filled seeds would be recovered. Fraction 2, while only 12 percent full, contains 72 percent of the full seeds. The logical step would be to run fraction 2 through the aspirator again, sacrificing a few good seeds to eliminate many empty ones. Fractions 1 and 2 together after a single cleaning contained only about one-third of the original weight and volume.

PILOT TEST

The processing method was tested on a pilot scale with seeds from State nurseries at Winona, Mississippi, and Pinson, Tennessee. These lots, described below, were composed of separated, air-dried carpels:

	Mississippi	*Tennessee*
Approximate volume (bushel)	40	20
Full seeds (percent)	10	6
Carpels per pound	52,700	46,300

Seeds were dewinged in batches in a large Clipper[4] debearder. Approximately 3 bushels of carpels were run at a time; 5 minutes were usually long enough to complete the dewinging. Wing fragments and other trash were removed in a large pneumatic aspirator.

The seeds were separated into five specific-gravity fractions with an Oliver Gravity Separator.[4] Percent fullness was determined by cutting three samples of 50 seeds from each fraction.

Germination was tested in a manner similar to that for the small lots. Germination blotter paper underlain with one layer of moist Kimpak was the medium. The test period was 45 days.

The lots were upgraded and their bulks were reduced considerably (table 3). Dewinging and cleaning removed between 50 and 60 percent of the original weight and volume. The heaviest fractions from both lots were about 64 percent full.

In the Tennessee lot approximately 90 percent of the filled seeds could be recovered in fractions 1, 2, and 3, a combination that contained only 9 percent of the original weight and 8 percent of the original volume. Blending of these three lots would result in a lot approximately 50 percent full.

[4] Mention of a trade name is to identify equipment used and does not constitute endorsement by the U. S. Department of Agriculture or Mississippi State University.

Table 3. — *Characteristics of original lots and separated fractions in pilot scale test*

Lot component	Total weight	Proportion of original weight	Total volume	Proportion of original volume	Proportion of filled seeds	Germinative capacity of full seeds
	Pounds	*Percent*	*Bushels*	*Percent*	*Percent*	*Percent*
			TENNESSEE			
Intact seeds	175	100	20	100	6	26
Dewinged and cleaned	76	43	8	40	6	50
Density fractions						
1 (heaviest)	9	5	½	2	65	55
2	2	1	¼	1	48	52
3	6	3	1	5	28	60
4	10	6	1	5	4	60
5 (lightest)	50	29	5	25	0	-----
			MISSISSIPPI			
Intact seeds	420	100	40	100	10	78
Dewinged and cleaned	168	40	19	48	10	76
Density fractions						
1 (heaviest)	24	6	1¼	3	64	62
2	29	7	3	8	16	87
3	16	4	2¼	6	4	88
4	66	16	7½	19	5	87
5 (lightest)	32	8	4½	11	4	100

In the Mississippi lot the percent of filled seeds dropped sharply in the lighter fractions. An estimate by weight indicated that 75 to 80 percent of all filled seeds were in the two heaviest fractions, which comprised only 13 percent by weight and 11 percent by volume of the original lot. A combination of fractions 1 and 2 would be about 38 percent full.

Results of the germination tests indicated that processing did not damage the seeds (table 3). This conclusion is based mainly on the germinative capacity of seeds with intact carpels vs. dewinged and cleaned seeds. Germination was lower in the Tennessee seeds than in the Mississippi lots. This difference may reflect a greater chilling requirement in stratification for the more northern sources.

The Mississippi seeds were returned to the Mississippi Forestry Commission and planted in drills in the spring of 1970 at the Winona Nursery. Germination and early growth were very uniform.

DISCUSSION AND CONCLUSIONS

The upgrading method described is practical. Modifications could be made in many extractories, but the basic steps of dewinging, cleaning, and separating are essential. Continous-flow processing is more desirable than batch processing, of course, and the dewinged and rounded yellow-poplar seeds have good flow characteristics. Time needed for good dewinging in the debearder varied by lot. Carpel characteristics and moisture content were the main causes of such variation, and the machine operator's judgment must always be relied upon to produce uniformly dewinged seeds.

The large aspirator very efficiently removed all but large trash, such as cone axes and partially intact cones. Air-screen cleaners would probably remove this large trash, as well as light trash and dust.

There is considerable latitude in the proportion of filled seeds that are obtained. Almost all filled seeds can be recovered through repeated separation of medium and heavy fractions. In choosing goals, the seed processor should consider the amount of seed on hand, original fullness, and processing costs.