

HANDLING HARDWOOD SEED

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The long-predicted surge in demand for southern hardwoods is now being felt. Wood-using industries feel it in dwindling supplies of raw material; the forester feels it in increasing hardwood mill quotas; and you nurserymen feel it in increasing demands for hardwood seedling production. The hardwood boom has presented us with many problems, some of which we cannot yet answer. My intent today is to take one problem area, the handling of hardwood seed, and discuss the experience we have had in this area at the Southern Hardwoods Laboratory ^{1/}. I will briefly touch upon collection, extraction and cleaning, storage, and stratification, and tell you where I think our future research effort should best be placed.

COLLECTION

Our collection practices mostly have been adapted for handling small quantities or special lots, but the general principles of collection are the same for large and small quantities. We collect most of our seed on logging jobs, particularly light-seeded species such as sweetgum, ash, or yellow-poplar. This practice requires advance knowledge of where logging is to be done and arrangements for collection with the logger and landowner. It is often easier to collect large seed such as acorns, water tupelo, and black walnut from the ground after they fall than on logging jobs. In some cases, good seed can be swept up from paved streets. Shaking limbs or entire trees is also useful in acorn collections.

Of course, only trees of apparently the best quality from local stands should be used for general collection. We often have to repeat this warning because all seed collectors are not under adequate supervision. Another precaution is to avoid solitary trees which may be self-pollinated. Their seed yield may be heavy, but quality is likely to be low. Stricter contracts with collectors, and State or Federal seed legislation, will improve this situation.

Concerning when to collect, I can give you the benefit of our past experience at Stoneville for several species.

^{1/} The Southern Hardwoods Laboratory is maintained at Stoneville, Mississippi by the Southern Forest Experiment Station, U. S. Forest Service, in cooperation with the Mississippi Agricultural Experiment Station and the Southern Hardwood Forest Research Group.

Sweetgum

We collect the fruits when their spines first turn brown. Locations will vary, but collection time for us is late-September through October. The seed is generally mature before this date, but we stay on the safe side. Wilcox (6) found that, in southern Mississippi, seed was good when collected even in early-September. His collections started before any color change of the fruits, and he found that color change was rare for that locality.

Oaks

We take acorns when their micropylar ends turn brown, which usually starts in October. If the cup won't come off easily, the acorn isn't ready. The first acorns to fall are usually not quite mature; good, mature, acorns are heavy and have a bright color. While collecting, an estimate of next year's crop can readily be made for the red oaks by counting the immature acorns on the branches and comparing totals with mature acorn totals.

Green and white ash

Collection can safely begin when the wings on the seed begin to turn brown and the first few seed fall--usually in October. If you wait until the seeds are entirely dried, collection on the logging job will be hard, as the clusters will shatter when a tree falls.

Water tupelo

Wait until the fruit is deep black-purple; this is usually late-October or November. Large quantities can be picked from the ground or scooped out of the water in brakes.

Baldcypress

We handpick the cones when they darken and begin to crack open, which is usually late-October or November. Cone hooks may make collection more efficient.

Yellow-poplar

Collecting yellow-poplar cones from logging sites has been a necessity for us. We collect when the cone exteriors first turn brown: cones picked when entirely green yield low quality seed. Also, it's easier to collect from trees felled early in the morning because mature cones shatter more often when trees are felled later, when the day is hotter and drier.

Sycamore

We collect the fruits any time after they turn brown. Since the fruits persist on the trees, sycamore can be last on the collection list, but quality decreases in seeds left on trees over winter.

Cottonwood

The seed matures in small capsules from May till August, depending on the tree. When the first few pods pop open, we collect branches of unopened pods and force them open in warm rooms. Forcing takes only about 48 hours if the cut ends of branches are not placed in water.

To conclude the section on collection, I would like to mention the need for better seed weight and size data. Seed weights from collections over the years at Stoneville generally have run a little heavier than those reported in the WOODY PLANT SEED MANUAL (5) (table 1). Seed of several species, in particular, sycamore, yellow-poplar, and willow oak, have been considerably heavier.

Weight data have limited use because of variations in seed moisture content. In large seed, such as acorns, small differences in moisture content can drastically change the number of seeds per pound. The number of seed or fruit per unit volume (table 2) would be much more valuable than weight data.

The WOODY PLANT SEED MANUAL also differs from Stoneville records in other measurements. A prime example is the number of sweetgum seeds per fruit. The Manual lists only 7 or 8 good seed per fruit; our count (table 2) is considerably above this range.

EXTRACTION AND CLEANING

In general, both fruits and seeds must be air-dried immediately after collection. Confined storage of undried seed can be costly, just as with pine cones. Drying is necessary to extract the seed from fruits of sweetgum, yellow-poplar, sycamore, and baldcypress. Air-drying in shallow layers in trays is the common method, but artificial drying can be used. It has been used successfully with sweetgum at Mississippi State University.

In some cases, no drying is needed: fully mature acorns can go directly into storage. Sycamore fruits picked late in the season can often be processed without additional drying. If you don't remove the pulp, water tupelo can go directly from collection to stratification.

There are various macerators and other devices for extracting and separating seed of all species, but I won't cover this. Our experience in this field at the Southern Hardwoods Laboratory has been very limited.

STORAGE

At present, the principal reason for storing seed of southern hardwoods is to hold it from fall collection time until it is planted or placed in stratification for spring planting. For many species, storage can

Table 1.--Seed weight data of some important southern hardwoods

| Species | Source of data | |
|------------------|---------------------------------|---|
| | : Woody Plant Seed : Manual (5) | : Southern Hardwoods : Laboratory records |
| | - - - - Seed per pound - - - - | |
| Sweetgum | 65,000 - 90,000 | 70,000 - 92,000 |
| Sycamore | 151,000 - 228,000 | 66,300 - 160,000 |
| Green ash | 11,000 - 24,600 | 15,900 - 24,000 |
| Yellow-poplar | 10,000 - 24,000 | 4,300 - 7,800 |
| Water tupelo */ | 215 - 250 | 182 - 273 |
| Oaks: Cherrybark | 745 | 200 - 720 |
| Nuttall | 104 | 56 - 100 |
| Shumard | - | 78 - 128 |
| Southern red | 390 - 785 | 320 - 374 |
| Swamp chestnut | 55 - 195 | 34 - 40 |
| Water | 280 - 635 | 232 - 400 |
| Willow | 595 - 695 | 272 - 469 |

*/ Pulp intact.

Table 2.—Seed collection data from Southern Hardwoods Laboratory
(1957 - 1965). Both the range and the average values
(in parentheses) are given

| Species | Seed per fruit | Fruit per gallon | Seed per gallon |
|------------------|--------------------------|---------------------|-----------------------------|
| Sweetgum | 13 - 87 (58) | 88 - 200 (120) | - |
| Sycamore | 1,960 - 2,480 (2,150) | 65 - 90 (78) | - |
| Green ash | - | - | 12,000 - 18,600 (16,160) |
| Yellow-poplar | 52 - 73 (65) | 168 - 175 (171) | * / 7,000 |
| Water tupelo | - | 900 - 1,200 (1,070) | - |
| Oaks: Cherrybark | - | - | 975 - 4,100 (2,320) |
| Nuttall | - | - | 340 - 900 (595) |
| Shumard | - | - | 445 - 800 (625) |
| Southern red | - | - | 2,000 - 2,190 (2,115) |
| Swamp chestnut | - | - | 210 - 285 (245) |
| Water | - | - | 1,420 - 2,200 (1,880) |
| White | - | - | 600 - 685 (640) |
| Willow | - | - | 1,790 - 3,000 (2,280) |

* / Only one lot measured.

be simple: after air-drying, the seed is stored in unsealed containers at approximately 35° to 40°F. For species with deep dormancy, stratification immediately after collection will eliminate the need for storage as a separate procedure; examples are yellow-poplar, water tupelo, and baldcypress. This procedure has also been suggested for red oaks, but it can be risky. Some lots of acorns have shallow dormancy and will germinate in the bags before planting time.

For other species, storage is more difficult. Fresh cottonwood seed will keep only 1 week at room temperature. If stored at 35° to 40°F., cottonwood seed viability remains high for 3 to 5 weeks (2). If longer storage is desired, low moisture content (6 percent), low temperature (about freezing), and partial vacuum will keep seed for 2 to 3 years (3).

Red oak acorns barely over-winter in open containers at 35° to 40°F. More than 5 months under these conditions is apparently too long. Early results of a storage study using cherrybark oak acorns, at the Southern Hardwoods Laboratory, have suggested that high moisture contents (50 percent) and sealed containers may extend storage in the 35° to 40°F. temperature range. All storage for 6 months below freezing failed in this study. Over-winter storage of white oak acorns is even harder, but we've had fair success at 35° to 40°F. in unsealed containers. Fall planting gives even better success.

Another important reason for seed storage is to stockpile against bad seed years. Ironically, the species for which this is most commonly needed, the oaks, are the hardest to store. Sweetgum seems to have poor seed crops about 1 out of 3 years, but stockpile storage is easily managed for this species. We have stored sweetgum, sycamore, and green ash seed without large losses of viability for 2 or 3 years at the Southern Hardwoods Laboratory. Perhaps the best safeguard against seed scarcity now is to arrange for exchanges between States, provided that provenance differences can be minimized. Seed crop failures over the entire South are unlikely.

STRATIFICATION

Stratification to overcome dormancy is a simple practice. The only question we usually hear is not "How?", but "How long?" White oak acorns, and seeds that mature in the spring, such as cottonwood, black willow, and red maple, exhibit no dormancy and need no stratification. Two to 4 weeks is usually long enough for sweetgum, and the usual recommendations are 30 to 60 days for sycamore and 60 to 90 days for the ashes.

We currently use 60 days for the red oaks. This is satisfactory for most species, but 90 days stratification would probably be better for some. Cherrybark oak is not as deeply dormant as other red oaks, and for some lots, 60 days is too long; they germinate during stratification.

Seed of some species need to be placed in stratification immediately after collection and left until planting time. As I mentioned earlier, this has worked well for baldcypress, water tupelo, and yellow-poplar, and even up to 3 years of stratification has been helpful for the latter species (7). A recommendation for yellow-poplar is changing temperatures weekly during stratification from 36° to 54°F. (1). We also have tried changing temperatures with cherrybark oak, but the results were not significantly different from acorns stratified at constant temperatures.

Another suggested innovation for treating tree seed is using light during stratification. This has shown promise for loblolly pine (4), but we found no advantage when using light while stratifying cherrybark oak.

To summarize, we now have generally acceptable stratification methods for all species, but I'm sure that they can be vastly improved. When we know more about the causes of seed dormancy, then we shall be able to overcome it more easily.

FUTURE RESEARCH NEEDS

From my foregoing comments, it is obvious that many questions require more research to furnish answers. The continuing progress achieved by tree improvement workers accentuates the problems. The seed we will collect, clean, store, and stratify in the future will be of much higher value than the seed we handle today. Improved techniques in all phases of tree seed handling will be required.

What are some of the specific areas in which research should prove most fruitful?

1. Time of collection.—We should know the exact stages of seed maturity and how to recognize them.
2. Mechanical aids.—For effectiveness and economy, we should utilize existing agronomic seed equipment or develop our own to clean, sort, treat, and test forest tree seed.
3. Testing methods.—For each species, two types of test are needed: (a) a quick but reliable indicator of viability for use by seed collectors, dealers, and nurserymen; and (b) a standardized laboratory test that will fully indicate the quality of a seed.
4. Storage.—We should learn to store any tree seed for at least 5 years without significant losses in quality.
5. Seed dormancy.—Once we understand this phenomenon, we should be able to custom-treat our seed to cause germination under standard environmental conditions when we want it.

To satisfy these needs sounds like a large order, but our seed handling methods must improve in these areas if they are to keep pace with our rapidly changing forest technology.

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