FOREST TREE SEEDS

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The trade in tree seeds is a minor activity when compared with that in agricultural seeds, but its importance is likely to increas. The current trend to more intensive forestry with genetically improved stock will increase the demand for seeds. Genetic gains will force us to intensify efforts to improve methods for seed collecting, cleaning, processing, storing, and testing.

Most work with tree seeds is done by government agencies. The USDA Forest Service, the largest single collector and user in this country, collected or bought more than 212,000 pounds of tree seeds and produced over 113 million seedlings between July 1, 1967, and June 30, 1968.[2/] These figures are higher than average because of the bumper seed crop that year. Combined total for Federal, State, and private concerns are not available.

Although major quantities of seeds from about 130 tree species are collected and processed, 25 species, mostly conifers, account for about 90 percent of the work (5). Private dealers have three types of operation. Many southern companies deal primarily with seeds of the southern pines. Many western companies deal with western conifers, primarily Douglas-fir. Companies throughout the country supply small lots of seeds of many species, primarily to ornamental nurseries. Some States have also been known to sell seeds when they have a surplus. Certain foreign countries sell tree seeds, but not usually in the United States.

Large quantities of conifer seeds are exported. Governments and industrial concerns in South America have been buying large lots of southern pine seeds for several years. European countries are good customers for conifer seeds from the Pacific Northwest, particularly Douglas-fir.

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[2/] Hixon, H. J. Annual reforestation and timber stand improvement report, FY 1969. USDA Forest Serv. Unpublished Rep. 1969.

The greatest domestic use of tree seeds is by State and Federal nurseries in production of seedlings for planting. For example, USDA Forest Service figures show that 1.4 million acres were planted to trees in 1969. More than 814 million seedlings were shipped from Federal, State, and private nurseries to plant these acres (7). Another 220,000 acres were seeded directly. Many large timber and paper companies collect seeds, usually from their own lands. Many of them also run their own nurseries; others contract with State nurseries to obtain seelings.

IMPACT OF GENETIC IMPROVEMENT

Genetic improvement programs will have a big impact on the tree seed business. Development of improved strains is a slower process in forest trees than in agronomic species. Yet research results already show potential gains in volume production alone of 10 to 20 percent; major gains in disease resistance and wood qualities can also be made (8). While a 10-percent gain for wood production does not sound like much when compared to a doubling of corn yield, you must remember that these programs are just getting started.

Within a few years a major part of forest management in the South will be carried out on stands that have been regenerated with selected or genetically improved stock. To furnish the seeds, foresters are establishing seed production areas and seed orchards. Seed production areas are in natural stands of good phenotypes that bear good seed crops; the stands are carefully tended to stimulate seed production. Seed orchards are established with clones selected for production of improved seeds.

The acreage devoted to such efforts is increasing. In 1967, seed production areas covered 10,068 acres nationally, an increase of 500 acres over the previous year; seed orchards covered 5,706 acres, up 1,780 acres (7). A large portion of these area are on State and private lands. The 13 Southern States contain 87 percent of the seed orchards, and 68 percent of the seed production areas in the United States. In the planting season just ending, two out of every three seedlings planted in national forests were grown from seeds harvested from seed production areas. As tree improvement programs progress, seed orchards will replace seed production areas.

Most Southern States now include tree and shrub seeds under their labeling laws. So do New York and some other Northern and Western States. Despite periodic attempts at inclusion, the present Federal Seed Act does not cover tree and shrub seeds.

Voluntary certification programs have been established for forest tree reproductive material--principally seeds--in most Southern States and some Northern ones. The State of Georgia grows seedlings from certified pine seeds and sells the seedlings as certified stock (at increased prices). This program has been well received by landowners. Certain Populus clones are certified as rust resistant in South Dakota. Many States with certification programs have not received requests for certification yet. Certification programs for tree seeds will be increasingly common in the coming years, however. In Mississippi, a committee of professional foresters is currently working on a certification scheme for seeds, seelings, and cuttings of forest tree species. It will soon be ready for submission to the Mississippi Crop Improvement Association.

HARVESTING TREE SEEDS

The size of seed-bearing trees presents collection problems not normally faced with other crops. Large, single-seeded fruits, such as acorns, walnuts, and hickory nuts, and some multiseeded fruits, such as osage-orange, honeylocust, and persimmon, can be gathered from the ground after they fall from the trees. This procedure requires hand labor, and is therefore expensive.

Many valuable species have small seeds, some in multiseeded fruits, and collection from the ground after dispersal is impossible. These fruits must be collected after maturity is reached, but before the seeds are disseminated. Important species in this group are sweetgum, sycamore, yellow-poplar, and most of our conifers. Handpicking from standing trees of these species is difficult. Someone must either climb the trees or collect the fruit from "cherrypickers" or elevated platforms.

Such devices as ballons, climbing nets, and large ladders have been tested here and in Europe, but none have been very successful. Tree shakers may solve harvesting problems for many species in areas where trees cannot be cut down, as in seed orchards and seed production areas. Tree shakers are now being operated in the South to harvest unopened cones of slash and longleaf pines. Cone characteristics of loblolly pine have prevented widespread use with this species so far, but research is underway to solve the problems. Tree shakers will do wonders with some hardwoods, such as the oaks. We are sure to see increased use of this machine in the near future.

Most seeds are still collected by hand from trees downed in logging operations. When only hand labor is available, this method

will get the most seeds per dollar, but there is little or no control over quality of the parent tree. Many State and Federal agencies still buy lots of seeds from private, free-lance collectors. These people almost exclusively collect by hand from downed trees.

A major problem in collection is how to know when tree seeds are mature. The standard method for southern pines is based on specific gravity of the cone. If the cone floats in SAE-20 motor oil, then specific gravity is below 0.89, and collection should start immediately. At a specific gravity of about 0.70, cones start opening (9). We use fruit and seed color changes to determine maturity on most hardwood species (2,3), but improved methods are needed. In the Pacific Northwest, one large company makes maturity decisions on several conifers on the basis of chemical analyses of sample cones (4). We could do the same here in the South on certain species (3), but widespread use of this principle is not likely with hardwoods.

DRYING, EXTRACTING, AND PROCESSING

Once tree seeds have been collected, they must be treated in ways similar to those for crop seeds. They must be dried, extracted if they are in multiseeded fruits, cleaned, and processed. Seeds are usually spread in shallow layers on sheets, shelves, or racks for initial drying. Seeds are frequently extracted from fruits during drying. A common method is to spread the fruits on screening through which the seeds can pass. The fruits are turned occasionally and seeds are caught as they fall through the screen. In large-scale operations with conifers, such as southern pines, Douglas-fir, or true firs, seeds are extracted in kilns that dry the cones.

Various types of equipment are available for extracting and cleaning small lots of tree seeds. Berry-like fruits, such as mulberry, can be thoroughly macerated in kitchen blenders and the pulp removed by flotation in water, The same procedure can be applied on a large scale and on larger fruits, such as osage-orange, wild plums, and black cherry, with motor-driven macerators (6). One type of macerator can be used with water to clean pulpy fruits or without water to shatter dry, multiseeded ruits, such as yellow-poplar, sycamore, and sweetgum.

Some winged seeds, such as those of certain southern pines and western conifers, are dewinged after extraction to facilitate sowing. The usual dewinger is similar to a debearding machine, but the inside arms are more flexible and the action is softer. Improper

dewinging can badly damage tree seeds. Ashes and maples are good examples of fragile, winged hardwood seeds that cannot normally be dewinged.

The ratio of empty to full seeds is very high in some species; yellow-poplar and sycamore are prime examples. Without a procedure to separate full from empty seeds, the nurseryman has to sow what he gets; this practice usually results in very poor control over seedling density in the nursery bed. We have recently developed a promising technique to solve the problem for yellow-poplar, a species whose seeds are often only 5 to 10 percent full. We simply dewing the yellow-poplar seeds in a debearder, remove the trash with a large aspirator, and then separate by density on a gravity separator. We are still running tests, but the results look very promising.

There are probably many other crop-seed processing machines and methods that could be used on tree seeds, but the size of the operation has not required them. Cleaning and separating by hand is still best for small lots.

STORAGE

Irregularity of tree seed crops has led foresters to depend on seed storage probably more than farmers do. We can find small amounts of seeds of most species almost every year, but regionwide seed crop failures do occur. Furthermore, collection when the crop is small is very expensive. Seedling production for large-scale regeneration efforts, such as those with southern pines, frequently must depend on stored lots to produce the seedlings. When bumper seed crops do occur, as with the southern pines in 1967 and sweetgum in 1969, large collections must be made to stockpile seed against lean years.

Foresters generally aim to store tree seeds longer than farmers do for crop seeds. As a result, the storage environment for tree seeds is more exacting. Standard storage conditions recommended for southern pine seeds are 0°F. and a seed moisture content of no more than 10 percent (1). Under these conditions, there should be no significant loss in viability for at least 10 years.

Seeds of most tree species can be dried to low moisture contents and stored at about 32°F. for several years without significant loss in viability. Certain seeds, such as beechnuts and acorns, cannot be readily dried to low moisture contents without killing them. Acorns usually are killed if dried below 25 percent moisture. At higher moisture contents, temperature below freezing kill the acorns. Consequently, we cannot store acorns longer than 6 or 7 months

without great losses in viability. Our best storage results with acorns have been at 35°F. and a seed moisture content of 40 to 50 percent. Unfortunaltely, these conditions promote sprouting. We are currently searching for treatments that will prevent germination during storage but assure rapid germination after sowing.

DORMANCY

Many seeds that mature in the fall exhibit a delayed germination, or dormancy, and some treatment is required to secure prompt germination. For those that are hardseeded, acid scarification is the answer. This method is commonly used on redbud, black locust, honeylocust, basswood, and the sumacs.

We usually place other dormant seeds in a cold, moist environment for an extended period in a treatment called stratification. The treatment was once carried out by storing seeds over winter in layers with alternating layers of moisture-holding materials, such as peat or sand, in large pits in the ground. As refrigerators became available, we substituted large cans or drums in cold storage for outdoor pits and put the seeds in cheesecloth bags. Now we often place fully imbibed seeds in polyethylene bags not over 4 mils thick, omit the moisture-holding medium, and add a small amount of water. This technique has been give the apt description of "naked stratification."

The common stratification temperature range is 33° to 40°F. Length of treatment varied by species and by geographic source within species. Sweetgum seeds may require only 2 to 4 weeks of stratification, while 4 to 5 months is not too much for green ash or some of the hickories. Seeds from northern sources usually require longer periods than southern seeds.

Many seeds that mature in the spring show no dormancy and require no pretreatment for prompt germination. Examples are cottonwood, willow, red maple, and American elm.

If we can learn enough about dormancy, we may be able to control it with chemical regulators. In the future we may be able to turn dormancy on when we want to hold seeds in storage and turn it off when we are ready to plant--all with chemicals.

I foresee rapid advances in techniques for handling forest tree seeds. We have many problems in common with agricultural seed workers, and we have many problems that are unique to forest tree seeds. Our research is increasing rapidly along with consumption of tree seeds.

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