Collecting and Handling

Seeds of Forest Trees

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Some 50 million acres in the United States (exclusive of Alaska and Hawaii) need to be planted to trees because they are not restocking naturally with desirable forest trees; because they are eroding, idle, or unprofitably used; because farmers' fields, animals, or buildings need protection from wind; and because the United States is going to need all the timber we can grow.

This tremendous undertaking will require more than 25 thousand tons of seeds of forest trees. To insure that this program gets the best possible start, we must apply the best knowledge we have about collecting, extracting, storing, and using the large quantities of forest tree seeds needed every year.

Although more than 600 species of woody plants are useful for conservation planting in the United States, about 130 species make up the bulk of the seed trade. Furthermore, some 25 species, mostly conifers, account for about 90 percent of the area planted and seeded. Even this smallest group presents a variety of problems in collection, extraction, and handling.

The collecting of forest tree seeds in the United States is largely from wild stands, but increasing quantities are being gathered in plantations.

Beginning in the 1950's, some seed has been collected in seed production areas—high-quality stands specially treated to foster heavy production.

Just being established, primarily in the South, are seed orchards made up of vegetatively propagated material representing selected superior trees. More and more of our seeds of forest trees are expected to come from these special stands and orchards.

Much of the supply in the United States is collected by private individuals, most of whom are independent operators. The greatest users of the seeds in this country, however, are the public forestry agencies, although there is a growing use by forest industries and commercial seed dealers.

Both the public and industrial agencies usually buy unextracted cones or fruits from the small private collectors.

The progressive collector of seeds of forest trees will scout out desirable collection areas in advance. He can get some early estimates at the time of spring flowering, but he should check the crops in the summer after the fruits are well developed, keeping in mind these points:

1. Confine collections wherever possible to trees above average in one or more of these qualities: Growth rate, stem form, crown and branching habit, resistance to damage, and seed production. Stands with a high proportion of superior trees are especially desirable for seed collections. Where areas of seed production or seed orchards are available, collect from them.

2. Obtain written permission of landowners before making any collections on their land.

3. Where available, utilize the regional tree seed-crop reporting services to locate collecting areas. In any event, estimate production from actual counts of fruits on representative trees or small sample plots well distributed over the collecting area.

4. Test for soundness of seeds in each locality and on individual trees before collection.

5. Label each sack, before it leaves the collecting ground, to show species; exact locality of collection (including approximate elevation); day, month, and year of collection; and any special merits of the parent stand (as "seed production area," superior stand, or "seed orchard").
Chances are best for getting seeds high in germinability and keeping qualities if they are collected when they are ripe and before they have suffered deterioration on the tree or on the ground.

Experienced collectors judge the ripeness of fruits by their fullness, size, color, degree of "milkiness" of the seeds, hardness of the seedcoat, their attractiveness to animals, or some combination of these factors. More precise indices are desirable.

For some pines and spruces, ripeness can be determined more accurately by the floatability of freshly picked cones in suitable test liquids, some of which are linseed oil for eastern white pine and blue spruce; SAE 20 motor oil for loblolly, longleaf, and slash pines; turpentine for white spruce; half linseed oil and half kerosene for Jeffrey and ponderosa pines; and kerosene for red and sugar pines.

For many tree species, the best time to collect is when the first seeds begin to fall naturally. Large-scale operations must begin sooner than that, however, to avoid substantial losses of good seed.

The best time for seed gathering varies for each species from season to season and place to place. As a guide, the general season is known for a great many species including some that can be collected in two seasons, as follows:

**Spring:** Aspens, cottonwoods, most elms, red maple, silver maple, poplars, and the willows.

**Summer:** Cherries, chokecherries, Douglas-firs, red maple, mulberries, Siberian pea-tree, and the plums.

**Fall:** Most ashes, beeches, most birches, boxelder, catalpas, cherries, Douglas-firs, firs, hickories, junipers, most larches, black locust, maples (except red and silver), Osage-orange, pecan, most pines, plums, spruces, sweetgum, sycamores, walnuts, white-cedars, and yellow-poplar.

**Winter:** Some ashes, yellow birch, boxelder, catalpas, Osage-orange, black spruce, Norway spruce, sycamores, and walnuts.

Any season: Jack pine (except in the southern part of its range), lodgepole pine (except on the eastern side of the Cascade Mountains), Monterey pine, and sand pine.

Forest tree seeds commonly are gathered from standing trees. Collectors usually climb tall trees and detach the seeds or fruits by picking, cutting, or knocking them off. They handpick or flail off the seeds of small trees onto cloths from the ground or ladders.

Sometimes felled trees provide a cheap source, but the collector must gather seeds only from desirable trees cut after the fruits have begun to ripen.

The amount of seed produced per tree varies widely between species and from year to year. It is influenced also by the age, size, and health of the seed trees. Within any age or size class the dominant, widely spaced or open-grown trees usually produce the most seed if they receive adequate pollination. In good years a good seed tree may produce the following bushels of cones: Tamarack, 0.75; black spruce and eastern hemlock, 1; jack pine, ponderosa pine, red pine, and slash pine, 1 to 1.5; European larch and white spruce, 2; white pine, 5; and sugar pine, 5 to 7.

Some collectors gather squirrel-cut cones from the ground, but these fruits may not be adequately ripened. Collectors 30 or 40 years ago often obtained conifer cones from squirrel hoards in the Lake States and the West, but this is a rare practice today, except in the Pacific Northwest.

Fleshy fruits should not be crushed or dried more than superficially. Others should be spread out and dried partly before shipment. The fruits should be processed or extracted as soon as possible after collection.

Seeds of many tree species must be separated from the fruits and cleaned of fruit parts or debris to prevent spoilage, conserve space and weight, and facilitate handling and sowing.
They fall into three groups as concerns extraction:

1. Tree seeds readily extracted from dry fruits, such as cones (baldeycypress, cypress, firs, larches, pines, spruces, white-cedars); conelike clusters (yellow-poplar); pods (Kentucky coffee-tree, honeylocust, locust); or capsules (aspen, cottonwoods, poplars, willows).

2. Dry fruits with seeds surrounded by a tightly adhering fruit wall, such as the nuts (chestnuts, oaks), and samaras (ashes, elms, maples, yellow-poplar).

3. Seeds of fleshy fruits, such as drupes (cherries, dogwoods, plums, walnuts), and multiple or collective fruits (mulberries, Osage-orange), and berrylike conelets (junipers).

Seeds of the second group are seldom extracted from the fruits because that is either unnecessary or very difficult. Those of the first and third groups are separated from the fruits by drying, threshing, tumbling, depulping, fanning, or sieving.

The simplest method of drying is to spread the fruits in shallow layers so that there is free circulation of air around each fruit. Where the climate is dry, drying may be done in the open. Where the climate is damp or the amount of fruit is great, it usually is done under a roof.

Protection from rodents and birds often is necessary to prevent serious seed losses during drying.

Some cones do not open readily and must be heated artificially in special kilns. These kilns provide the highest dry heat (usually between 145° and 150° F.) that the seeds can stand without injury, and these predetermined safe limits must not be exceeded.

Two general types of kilns are used for extracting seeds from cones—simple convection and forced-air kilns. The first is the oldest, cheapest, and simplest to operate. The second is more complicated and expensive but more efficient.

Recommended temperatures and schedules in convection kilns for several pines are: Jack pine, 2 to 4 hours at 145° to 150°; loblolly and slash pines, 6 to 48 hours (usually 8 to 10) at 120°; longleaf pine, 12 to 72 hours at 120°; ponderosa pine, 3 hours at 120° or less; red pine, 24 to 72 hours at 130° to 140°; and Scotch pine, 5 to 24 hours at 130°.

In forced-air kilns, comparable schedules are 8 to 16 hours at 115° for longleaf pine, 5 hours at 170° for red pine, and 4 to 8 hours at 130° for Scotch pine.

Seed of the following genera and species usually are extracted by air or kiln drying: Aspens, baldeycypress, chestnuts, cottonwoods, cypresses, Douglas-firs, elms, hemlocks, incense-cedar, larches, the pines, poplars, sequoias, spruces, sweetgum, sycamores, thujas, white-cedars, and yellow-poplar. Normally kilns are necessary for the hard-to-open cones of these pines: Bishop, jack, knobcone, lodgepole, Monterey, pond, and sand.

After drying, the cones are tumbled in revolving screened cages or drums to shake out and separate the seeds.

The separation of seeds of many dry fruits from the bunches, pods, or capsules in which they grow requires flailing, treading under foot, or treatment in agricultural threshing machinery or special apparatus, such as a macerator, hammermill, or mixer.

Threshing or screening commonly is required to extract seeds of the alders, American beech, Kentucky coffee-tree, firs, hickories, honeylocust, black locust, Siberian pea-tree, eastern redbud, and walnut.

Some small fleshy fruits are dried whole, but the seeds of most fleshy or pulpy fruits must be extracted promptly to improve germination and to prevent spoilage. Small lots can be cleaned by hand methods, but larger lots should be processed mechanically.

Seeds of the following genera usually are extracted by depulping the fruits: Cherries, chokecherries, junipers, mulberries, Osage-orange, plums, tupelos, and yews.

Fruits that require mashing or soaking before cleaning (such as those of
the cherries, mulberries, Osage-orange, plums, or yews) usually should not be allowed to ferment. An experienced operator, however, can use slight fermentation to make the process easier.

Seeds that require no extraction are produced by the ashes, basswoods, birches, elms, hackberries, oaks, and yellow-poplar. Some of them, however, need to be freed of chaff or trash. In addition, some of the small fleshy fruits, such as those of the common chokecherry and Russian-olive, often are dried without extraction.

**Cleaning is necessary** sometimes to eliminate chaff, trash, adhering fruit parts, or empty seeds and to facilitate seed storage and handling.

Often cleaning is combined with extraction, or a combination of methods may be required. Many seeds can be cleaned satisfactorily by running them through screens, either dry or with running water.

Most conifer seeds have wings that must be removed by hand rubbing, beating or trampling in sacks, moistening and raking, or treatment in dewinging machines or macerators. Treatment must be done carefully to avoid injury to the seeds. Unfortunately no mechanical dewingers yet devised are entirely satisfactory, yet hand methods are too expensive for large-scale use. Dewinging damage therefore is one of the major causes of low-quality seed.

Wings, light chaff, or empty seeds usually are removed by fanning. Most conifer seeds require this treatment in addition to dewinging. Large lots usually are run through standard agricultural or specialized seed fanning or cleaning mills. Some skill is needed to remove the debris but not good seeds.

Flotation in water is the most effective means of cleaning the seeds of most pulpy or fleshy fruits, but is not satisfactory with the junipers, because their seeds float. Sound seeds usually sink, but poor seeds, skins, and pulp either float or sink more slowly. The extracted seeds should be dried promptly after wetting.

The yield of cleaned seeds per 100 pounds of fruit as usually collected is called the extraction factor. It is necessary to know this factor and average viability of the seeds to determine the amount of fruit needed for specific sowing or market requirements.

The average extraction factor varies by species and within species as shown below. Some are so variable that they overlap into two or more groups:

1 to 5: Douglas-firs, hemlocks, incense-cedar, larches, mulberries, Osage-orange, pines, spruces, thujas.

6 to 10: Cottonwoods, firs, sweetgum, American sycamore.

11 to 20: Paper birch, chokecherries, cherries, shellbark hickory, Siberian pea-tree, plums, redwood, Russian-olive, white-cedars.

21 to 40: American beech, yellow birch, boxelder, butternut, catalpas, Kentucky coffee-tree, cherries, shagbark hickory, honeylocust, junipers, black locust, plums, eastern redbud, Russian-olive.

41 to 60: Baldcypress, boxelder, Kentucky coffee-tree, elms, mockernut hickory, Norway maple, sugar maple, oaks, pecan, Russian-olive, black walnut, yellow-poplar.

61 to 80: Ashes, basswoods, boxelder, hackberry, bitternut hickory, mockernut hickory, pignut hickory, sugar maple, oaks, pecan, yellow-poplar.

81 to 100: Bitternut hickory, pignut hickory, black maple, red maple, sugar maple, oaks, pecan.

**Storage of forest tree seeds** usually is necessary for a few months up to several years.

Frequently seeds are extracted in the fall and held over winter, although those of species like longleaf pine and the white pines often are sown soon after extraction and cleaning, and white oak acorns must be sown immediately after gathering.

Seeds of some species often must be held for several years because good seed crops occur infrequently.

Storage methods should be used that will maintain high viability. This is a
simple matter for some species. It is
difficult for others. For many, suitable
storage practices are not yet known.
With proper storage, seeds of many
trees can be kept reasonably viable for
5 to 10 years, and those of a few species
have been kept for several decades.

Seeds of the following forest trees can
be kept satisfactorily by the oldest and
simplest method of storage—in sacks
or sealed containers at air tempera-
tures: Basswoods, Kentucky coffee-tree,
black locust, and Siberian pea-tree.

Seeds of many trees, however, keep
best at low temperatures in sealed con-
tainers. Temperatures between 32°
and 41° have given good results, but
recent research shows that seeds of sev-
eral conifers keep better at 0° to 23°
than at higher temperatures. At 0°,
sealing of the containers appears to be
unnecessary and perhaps undesirable.

Before storage, seeds of most conifers
should be dried to a moisture content
below 8 percent of oven-dry weight.
Seeds best stored cold and dry include
those of the ashes, some aspens,
birches, cypress, Douglas-firs, elms,
gars, hackberries, hemlocks, honey-
locusts, junipers, larches, black locust,
maples (other than silver), Osage-
orange, pines, some poplars, eastern
redbud, sassafras, sequoias, spruces,
sweetgum, sycamore, thujas, white-
cedars, yellow-poplar, and yews.

Several other forest trees also have
seeds that keep best at low tempera-
tures but at a moisture content above
35 percent. Included are: Beeches,
buckeyes, American chestnut, hicko-
ries, silver maple, oaks, and walnuts.
Many of these seeds can be stored for a
few months by mixing them with one
to three times their volume of moist
peat moss, sand, exploded mica prod-
ucts, or chopped sphagnum moss and
placing them in a refrigerator or hold-
ing them over winter in the ground
under a mulch.

Although they can be stored dry and
cold, yellow-poplar seeds have been
kept for 8 years without loss in viability
by placing them in layers alternated
with sand in pits dug in the nursery.

Spring-ripening seeds, such as those
of the red and silver maples, often are
sown soon after collection in the spring
to avoid storage losses. For the same
reason, the seeds of many of the fall-
ripening species are fall sown.

The short-lived seeds of some aspens
and poplars can be kept for several
months in sealed containers either un-
der a partial vacuum or with a relative
humidity of the air of less than 20
percent.

Pretreatment is needed to over-
come the seed dormancy common to
many tree species. Such seeds fail to
sprout even when exposed to favorable
conditions of temperature, moisture,
oxygen, and light unless they are first
given special treatment.

Of some 400 species of woody plants
studied, 33 percent have seeds that are
commonly nondormant, 7 percent have
seeds with impermeable coats, 43 per-
cent have seeds with internal dor-
mancy, and 17 percent have more than
one kind of seed dormancy.

Among the species that require sof-
tening of the seedcoat are most of the
legumes, including Kentucky coffee-
tree, honeylocust, and black locust.

Species that usually require cold,
mist treatment or fall sowing to pro-
mote prompt germination include most
alders, most ashes, baldcypress,
beeches, most birches, most buckeyes,
cherries, American chestnut, Douglas-
fir (coast form), firs, hackberries, hem-
locks, hickories, junipers, most larches,
most maples, mulberries, black oaks,
some pines (especially the white pines),
plums, sassafras, some spruces, sweet-
gum, sycamores, tupelos, walnuts,
white-cedar, and yellow-poplar.

Seeds that often require either a
combination of seedcoat softening and
cold moist treatment or sowing soon
after collection in the late summer or
early fall are those of black ash, bald-
cypresses, basswoods, some junipers,
Osage-orange, Digger pine, whitebark
pine, eastern redbud, and yews.

A tree species may have both dor-
mant and nondormant seeds or those
with more than one kind of dormancy. Unless there is time for tests before sowing, however, dormancy must be assumed and the best treatment given for the suspected condition.

Tests should be made to determine seed quality, a necessary basis for specifying the rate at which seeds should be sown to produce a certain number of usable seedlings. Such tests usually concern genuineness, purity, number of seeds per pound, moisture content, and viability.

The rate of sowing in the nursery and for direct seeding in the field is determined from laboratory tests, as modified by local experience.

Nursery and field germination of forest tree seeds usually is 50 to 80 percent of laboratory germination (in the South it may be 95 percent or higher), but further losses normally occur after germination.

The number of usable seedlings produced per 100 viable seeds sown, therefore, usually ranges from 10 to 60 for conifers and varies even more widely for broadleaf species.

Averages run below 10 for the aspens; 10 to 15 for paper birch, yellow birch, eastern cottonwood, American elm, Russian mulberry, northern white-cedar, and yellow-poplar; 16 to 20 for Japanese larch and redwood; 21 to 30 for American basswood, chokecherries, black locust, Osage-orange, eastern redbud, and Russian-olive; 31 to 40 for boxelder, catalpa, cherries, rock elm, hackberry, eastern hemlock, European larch, Siberian larch, most maples, Siberian pea-tree, plums, most spruces; 41 to 60 for baldcypress, Kentucky coffee-tree, Douglas-fir, honeylocusts, bur oak, pecan, some pines, eastern red- cedar, and tamarack; 61 to 80 for some ashes, American beech, most pines; and 81 to 100 for most oaks and walnuts.

Improvement of seed handling is an activity of a number of agencies.

The Food and Agriculture Organization of the United Nations is urging all collectors of tree seeds to supply information on the origin of their seed and has developed a reporting form for that purpose.

Several Federal, State, and industrial forestry agencies have begun to collect most of their seeds from high-quality stands and selected trees. Some have established seed production areas or seed orchards. These and related activities will help to provide more and better forest tree seeds for the forestation of those 50 million acres in the best and the quickest way.

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For further reading:


