Cone and Seed Maturity and Collection Guidelines for Northern Idaho

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For Northern Idaho

Dedication

These guidelines were developed in 1977 from communications with Mr. Charles Brown founder of Brown Seed Company, Vancouver Washington. The methods described here were developed by Mr. Brown during more than 30 years of working with conifer seed in the western United States. His goal was to produce the best possible conifer seed. To do this, he found that the cones must be fully ripe when collected and then stored under proper conditions. If not, seed viability was reduced. These cone maturity indicators are the result of years spent observing cone ripening. His cone handling procedures were developed to insure that seed germination was not reduced by mold or cone heating. Brown seed has earned the world-wide reputation of being the best available. This is ample testimony that his procedures work.

Mr. Charles Brown, founder of Brown Seed Co.

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Introduction

Cone collection is the important first step in a successful regeneration program. Efficient and cost effective greenhouse operations require high quality seed. Seed germination must be high and uniform if you wish to produce the highest quality seedlings at reasonable cost. Cost effective greenhouse operations require maximizing the number of seedlings per styroblock. Seed germination determines how many seeds are sown in each styroblock cavity. For example, seed with 90% germination is sown two per cavity. If germination drops to 80%, three or more seeds per cavity must be sown. This is to minimize empty cavities and maximize use of greenhouse space. Adding an additional seed per cavity increases seed cost. It also reduces the number of seedlings produced from a seed lot; increasing the amount of seed needed. Increasing the seeds per cavity also increases stratification, sowing and thinning costs. High germination is also important in rare or hard to collect seed lots. You need to produce as many seedlings as possible from these lots. Seed germination must also be uniform. All seed in a lot must germinate within a few days of each other or the early germinants quickly over top later germinants. Late germinants growing in the shade are usually shorter than the rest of the lot, often do not meet size specifications and are culled, reducing seedling production efficiency. Shorter trees are also most susceptible to greenhouse diseases such as botrytis.

Collections must stress seed **quality** as well as quantity. To achieve the desired quality, cones must be harvested only after the seed have fully ripened. Immature seeds are more difficult to extract from the cones, reducing seed yield. Seeds collected before they are fully ripe may also have lower germination and lose viability in storage sooner than mature seeds. The goal is to collect seed when it is as ripe as possible. If in doubt about cone maturity, it is wiser to wait and risk losing some seed when cones begin to open than to waste time and money collecting and processing immature seed.

Cone and seed characteristics provide our most reliable maturity indicators. Year-to-year fluctuations in weather patterns may alter ripening by several days but even hot dry years do not cause cones to ripen weeks early. Elevation, aspect and slope position also affect maturity dates. Therefore, on-site cone inspections provide the most reliable information for scheduling cone harvest. As a general rule, cones are mature and ready to pick the last week of August.

Remember that a sound regeneration system is based on **mature**, **high quality seed** that comes from **mature, high quality cones**.

Planning Cone Harvests

Seed Transfer

Closely matching the seed to the planting site insures that the seedlings are well adapted for survival and optimum growth. Cones should be collected from areas that closely match where the seedlings will be planted. If "local" seed is not available, seed transfer guidelines that define species specific limits to both geographic and elevational seed transfer should be consulted to minimize the risk of planting maladapted seed

Genetic Diversity

To assure adequate genetic diversity within seed lots, each lot should be collected from a minimum of 10 separate trees (20 or 30 are better). The trees should not be adjacent to each other but separated by at least two tree lengths. Further separation is preferred. Adjacent trees are often closely related and may have originated from seed from the same parent tree. To assure genetic diversity, cones collected from adjacent trees should not make up more than ¼ of the total collection. Also, avoid collecting from plantations since some seed lots may have come from relatively few trees that were too close together. When possible, select the best growing trees in the stand and avoid collecting cones from trees with obvious insect and disease problems.

Crop Evaluation

Potential cone crops can be evaluated as early as mid-June. For a crop to be rated as heavy, most of the trees in the stand should have heavy crops. Scattered trees with heavy cone crops don't necessarily indicate a good collection year. Unless seed is badly needed, collections should not be scheduled in light to medium crop years. Seed yield is generally poor in light to medium crop years because of poor pollination and increased insect damage. Seed and cone insects may destroy nearly all seed during light crop years. Insect damage can be especially high if there was a fair to good cone crop the preceding year that allowed insect populations to build up. Since it costs as much to collect wormy cones as good ones, collections should be scheduled when you can get as much seed as you can for your efforts. An important fact to remember is that cone collection and seed extraction costs are based on bushels of cones processed. The amount and quality of seed recovered is the major variable. Unless seed inventories are critically low, only moderate to heavy crops should be collected to avoid higher costs and the possibility of lower germination.

Seed count monitoring should begin in mid-July. By then, seeds have developed far enough to produce accurate counts. Cones may be picked or shot down for inspection. Check cones for insect activity. Mid-season (July) insect attacks show as curled, brown tipped or dead, dry cones. Insect bore holes and frass may also be evident. Insect damage may not be easily noticed, however, so cut tests should be a standard part of crop evaluation procedures. The cut test is made by slicing cones longitudinally down the center with a **sharp** knife, hatchet or cone cutter.

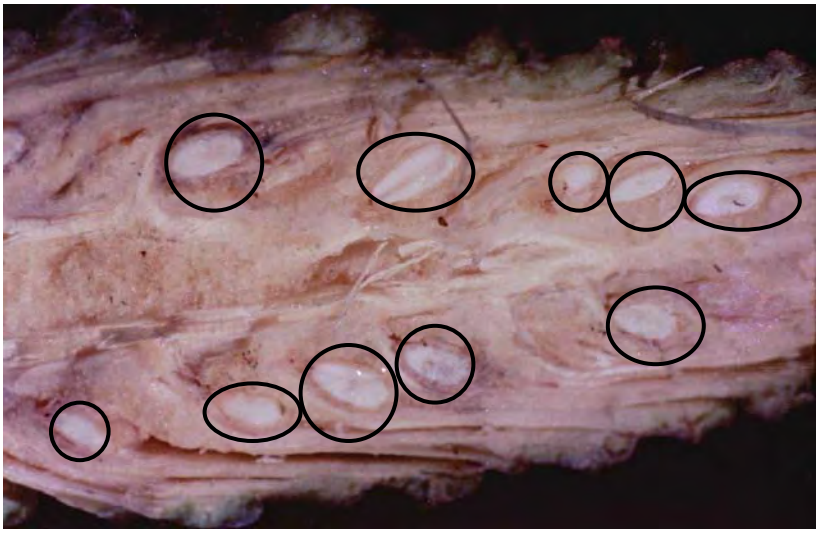
Cut tests are conducted as follows:

- Sample at least 5 cones from each of 4 to 5 trees selected at random throughout the collection area.

- Count all sound filled seed on one face of the cut cone. Filled seed have white centers (endosperm). Aborted seed are darkened or shriveled. Look for insect activity inside the cone and seed (Figure 1).

- If more than half of the cones sampled have insect damage, subtract one sound cut seed from the count on each damaged cone. Insect damaged cones often do not fully open during processing; preventing extraction of all sound seed. Adjusting the seed count compensates for this.

Figure 1. Cut test example. Filled seed that count in the test are circled.



Samples should be collected on at least two-week intervals to monitor maturity and insect damage. Insect damage will increase as the summer progresses. Some crops that appeared good in July have been completely destroyed by harvest time.

Cone Crop Rating and Collection Considerations

Douglas-fir

Light crop – few scattered cones, usually near tree tops and on limb ends.

Medium crop – several cones per limb with cone bearing limbs extending down most of the crown.

Heavy crop – 10 to 20 cones per limb with cone bearing limbs extending down most of the crown.

The number of filled seeds on a cut face (after deductions for insect damage) should average at least 5 for economic harvest. Lower counts can be accepted depending on the need for the particular source. A 6 or better count is considered adequate for a large collection effort.

Ponderosa pine

Light crop – few individual cones scattered over the crown.

Medium crop – cones more numerous and in clusters of 2 or 3 cones.

Heavy crop – cones in clusters of 3 to 5 and several clusters per limb.

The number of filled seeds on a cut face (after deductions for insect damage) should average at least 6 for economic harvest. Lower counts can be accepted depending on the need for the particular source.

Western larch

Larch should be collected any time you can get at least a half bushel of cones per tree and the number of filled seeds on a cut face exceeds 2. Cones from previous years often remain in the tree, making cone crop estimation difficult without binoculars – especially if the tree produces dark red cones.

Western redcedar

Western redcedar frequently self-pollinates. This self-pollination can result in growth losses greater than five percent. To minimize collecting self-pollinated seed, **only collect cones from the upper half of the crown**. Since most of the pollen is produced lower in the crown, cones near the top of the tree stand a better chance of being pollinated by surrounding trees. Cone crop evaluations should focus on the number of cones in the upper half of the crown.

Planning cone collection activities involves determining the type and size of the collection, obtaining needed equipment and preparing storage facilities. The type of cone collection -- climb-and-pick, fall-and-pick, or squirrel cache -- will have an effect on seed quality. See Appendix 3 for information on locating squirrel caches. Unless absolutely necessary, squirrel cache collections are avoided because it is impossible to consistently get 90-plus percent germination from squirrel-cut cones. This is due to three factors:

1. The squirrels do not always wait until seeds are fully mature before cutting cones. Because of this, squirrel cache collections are often characterized by inconsistent maturity levels and a large variation in dormancy, resulting in lower and extended germination. **Always check cached cones for maturity.**

2. Squirrel cache collections have the high probability that cones and resulting seed will be **highly** contaminated with various disease-causing fungi. This is due to the cool, moist environment in the cache. Tests have shown up to 14 times more germinant mortality in Douglas-fir squirrel cache seed lots than in hand-picked seed lots. Ponderosa and lodgepole pine have been successfully collected from squirrel caches. According to Charles Brown, the difference between squirrel-cut cones and hand-picked cones is that squirrel-cut cones have no stem on them. The squirrels clip the stem flush with the base of the cone. Hand-picked cones will have a short stem stub at the base.

3. Old cones – Squirrels often do not use all the cones they cache. Because of this, many of the cones in the cache may be two or more years old. The longer the cones are in the cache, the higher is the probability that they are infected with disease-causing fungi. Some cones collected from caches have had visible mold on them. Fresh ponderosa and lodgepole pine cones have sharp cone scale prickles. Cones that are a year or more old do not. Squeeze them in your bare hands and you will know the difference (Figure 2). When collecting from caches, take care to insure that all the cones are from the current year's crop.

Figure 2. Lodgepole pine cones collected from a squirrel cache. Left cone is from the current year. Middle and right cones are older and should not be collected. Note white mold on center cone and the lack of cone scale prickles on both older cones.

In many of the squirrel cache lots, correlation between germination tests and greenhouse performance is very poor. This makes it very difficult to determine optimum number of seed per cavity. Over sowing to compensate for uncertain germination rates can significantly reduce the number of seedlings produced from these seed lots. Hand-picked cones on the other hand, usually have operational performance similar to that of current germination tests.

In fall-and-pick operations, be sure to have the fallers or pickers limb the trees. There are lots of cones that break off when the trees fall. These can be easily collected if the pickers will pick the limbs then throw them aside. With ponderosa pine you can always find a bushel or two of easy picking on the ground. If the cones are ripe, they can open within a day or two of cutting the trees. Cutting too soon before the pickers can get to them can result in lots of lost seed.

An estimate of the number of seedlings needed from a seed lot will determine the size of the collection. Table 1 is a summary of data from cone collections in northern Idaho. Seedlings per bushel of cones were calculated from seed per bushel data adjusted for the seed/cavity sow rate determined by the germination rate. The range between minimum and maximum seedlings/bu reflect variations in cone size between lots and the number of sound seed/cone. Lots with low cut tests yield less seed per bushel of cones than do lots with higher cut tests.

Table 1. Summary of seedling yields per bushel of cones collected in northern Idaho.

Species	Seedlings / bushel of Cones **Average**	Min	Max	Seed / lb.	Germination Ave %	Seed per Cavity	Seed Lots Sampled
Western Larch	**13,700**	2,365	29,127	115,280	79	3	45
Ponderosa Pine	**4,200**	1,162	12,855	8,538	86	2	136
Lodgepole Pine	**15,900**	5,093	29,772	100,123	87	2	60
Douglas-fir	**10,900**	3,701	20,305	41,453	88	2	79
Grand Fir	**10,432**	1,905	18,231	21,329	67	4	17
Engelmann Spruce	**35,260**	17,955	74,680	191,026	83	3	17
Western Redcedar	**74,000**	12,990	172,593	403,829	77	3	21

Cone Handling and Storage

The following guidelines are designed to preserve seed quality during picking and storage operations.

Require cone pickers to turn in harvested cones daily. Filled sacks should be stored in the shade during the day and not stacked together, especially not in car trunks or covered pickup beds. **Cone heating must be prevented.**

All cones must be cleaned, checked for maturity and insect damage and measured prior to final bagging and payment. This is best accomplished by using a cleaning table with slats or an open mesh screen on the bottom to retain the cones but allow dirt and needles to fall through (Figure 3). Pick out needles, leaves, lichens and other debris prior to bagging. Cleanly bagged cones reduce the possibility of mold and greatly facilitate seed cleaning. Sort out immature and insect damaged cones prior to measurement for payment (Figure 4). Insect damage can be identified by looking for:

- Bore holes in cones
- Pitch and boring dust (frass) on outside of cones
- Unusual red or brown color or dead areas on all or part of cones
- Atypical curling of cones

1 bushel = 32 U.S. dry quarts = 37.35 liquid quarts = 9.34 gallons.

Use only new bags or bags in good condition. Discard bags with holes or loosely woven areas where **seed** can fall out (Figure 5). The maximum of 1/2 bushel of cleaned cones is placed into each 1-bushel burlap bag. The 1.5 and 2 bushel bags can hold up

to 1 bushel of green cones. As a rule of thumb, don't fill bags more than half full. This allows room for air circulation as cones expand and open. If overfilled, bags can burst as cones open resulting in lost seed (Figure 6). If the bag does not burst, the cones may not fully open but dry out and harden. These cones will not fully open later, trapping much of their seed and reducing yield. Turn cone bags inside out so that the frayed edges of the burlap seams are on the outside (Figure 7). Seeds tend to get caught in the frayed burlap, reducing the amount of seed you can get from each bag. Tie the bag closed near the top (Figure 8) – not part way down (Figure 9). One fist down from the top is a good guide for the location of the tie. The cones need room to expand as they open. Avoid using nylon or other synthetic twine to tie bags. Some synthetics are smooth and slick and tend to come untied or slip off with repeated handling. Cotton or other fiber twine works best.

Figure 3. Cleaning cones with a cleaning table.

Figure 4. Discard all insect damaged cones prior to final measurement.

Figure 5. Discard bags with holes large enough for seed to fall through.

Figure 6. Over filled bag without room for cones to open as they dry.

Figure 7. Turn bags inside out so that the frayed burlap edges are on the outside.

Figure 8. Cone bag filled with the proper amount and correctly tied.

Figure 9. Cone bag tie too close to the cones. Not enough space is allowed for cones to expand as they open.

Double tag each bag - one inside the bag and one tied on the closure (Figure 10). The smaller tag goes inside each bag. Use the inner tag in case the outside tag is lost during shipping. Mark tags with seed lot number or collection site, date and collector. Use water proof markers – Sharpies – or pencils (only as a last resort) to mark tags. Regular ink will run and become unreadable if tags become wet during handling or storage (Figure 11).

Figure 10. Cone bag tags. The larger tag is attached to the bag closure. The smaller one goes inside in case the outer tag is damaged or lost.

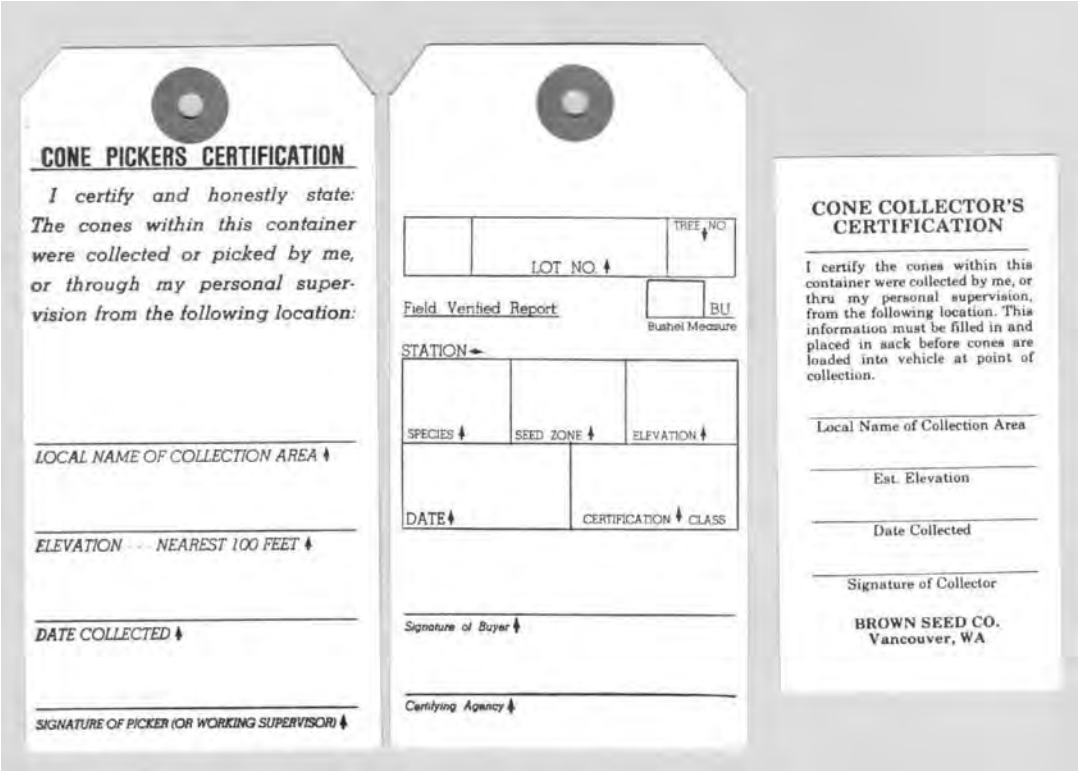


Figure 11. Regular ink will run when wet. Always mark cone tags with waterproof ink or pencil.

Species with small seed such as larch and spruce should be double bagged to prevent seed loss. Small seed can get through even apparently tightly woven burlap bags during handling and shipping.

The bag is placed as quickly as possible on a portable drying rack (Figure 12). Quite often, short distance transport of cones to a more central area is required. Since fresh-picked cones are quite susceptible to heating, arrangements must be made to have the green cones shipped immediately, unloaded, and re-racked before heating damage occurs. Green cones will heat, just like piles of wet hay or grass. Green cones can be stacked together for 1-4 hours; test for heating by putting hands between the piled sacks. Cone heating can reduce germination, produce mold problems and drastically reduce dormancy uniformity that affects stratification time. All these factors reduce the number of seedlings you get from the collection.

Figure 12. Cone bags on drying racks.

In case of rain during picking, keep the bagged cones as dry as possible. Minimize, if possible, the number of muddy cones collected. If possible, bag and label muddy cones separately. Rack wet bags in a dry location daily. Turn wet bags daily and shake cones around to dry cones in the center of the bags. The goal is to quickly surface-dry the cones to prevent molding.

To promote uniform seed maturity, the fresh field-racked cones should be allowed to after-ripen. This simply means the cones should be kept for approximately a two-week period in a dry, shady, well-ventilated, cool area. This allows the cones to **slowly** begin drying. During this period, the seeds in each cone have time to reach uniform dormancy levels. After proper stratification, the result will be quick, uniform seed germination. Turn bags frequently during the drying process. **Open bags and check cones for mold**. If mold appears, immediately move cones to a warmer, drier location to speed cone drying. If mold is detected, note it on the bag tag, notify the nursery and record it on the Seedling Information Sheet.

Following after-ripening, cones may be air-dried before shipment to the processor. If early shipment for long distances is required, precautions are needed to avoid cone heating. In our northern Idaho climate, two months of air-drying will bring the seed moisture levels down to approximately 15-20 percent. At this level, there is no trouble with cone heating if the bags are tightly stacked for 24 hours. Each person responsible for collections will have to determine how best to avoid cone heating.

Fill out a Seedlot Information Sheet (Appendix 1) for each seed lot collected once the collection is completed.

To produce high quality seed, all steps from seed inventory planning through collection and cone storage must be done correctly. Improper methods applied anywhere in the process can substantially reduce both seed yield and germination. Since vigorous, high quality seed is necessary to produce seedlings that meet rigid specifications, both foresters responsible for seed procurement and nursery supervisors must work together to assure that proper seed collection procedures are adhered to.

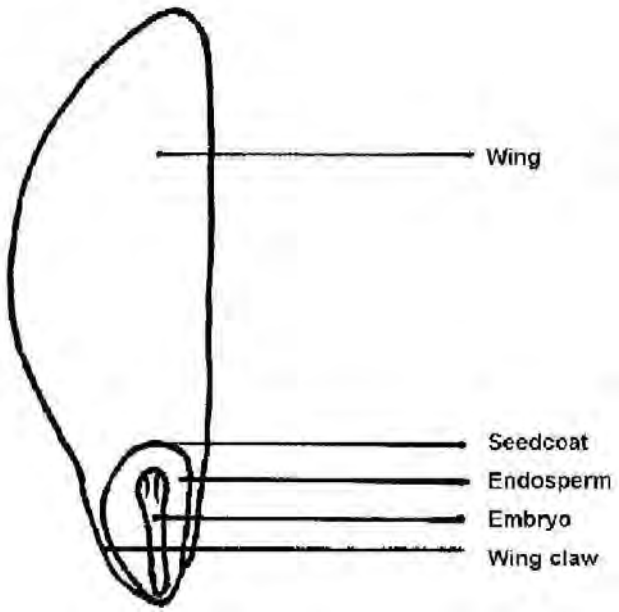
Seed Maturity Guidelines

Seed maturity can only be determined by examining seed. Squirrels cutting cones is **NOT** an indication that the seed is mature – only that it tastes good to the squirrels! Cone color is not the best indicator of maturity. Cut cones open and look at the seed. After cutting, it is easy to bend the cone to separate the scales and observe seed wing seed coat color. Wings of nearly mature seed will easily separate from the cone scales. Cut the seed and mash the contents (endosperm) on your thumbnail with a knife tip. Mature seed is quite firm (like coconut meat) not milky or runny. Sample several trees. Maturity will vary between trees.

Remember, if the seed isn't mature, don't harvest the cones.

Picking early can spread out the work load and make the job easier but usually results in poor seed germination. For example, several lots of ponderosa pine were collected in mid-August. Germination rates ranged from 44% to 65%. Germination of other lots collected in the first week of September exceeded 95%. Seed with 45% germination requires a sowing rate of 6 seed per cavity to efficiently use greenhouse space. Waiting until cones are completely ripe can be a pain, but so can picking lots of cones and not getting many seedlings from them.

Figure 13. Seed anatomy



Appendix 1.

Seedlot Information Sheet

Species _____ **Year** _____

Seed Lot Number _____ **Elevation** _____

Lot Name _____ **Stand No.** _____

Twp _____ **Rng** _____ **Sec.** _____ **Sub** _____

Habitat Type _____**Snow Depth**_____

Collection Type: Fall & Pick _____ **Climb & Pick** _____ **Squirrel Cache** _____

Other _____

Collector _____ **$/Bu** _____

Collection Date _____ **Bushels Collected** _____

Number of trees collected from _____

Cut Test Averages _____

Cone Condition

Size _____

Color _____

Maturity _____

Insect Damage _____

Field Storage Location _____

Comments _____

_____

_____

_____

_____

Area _____ **District** _____

Collection Supervisor _____

Appendix 2. Cone and Seed Maturity and Collection Guidelines by Species.

Douglas-fir

Cone and Seed Maturity Guide

Seed

Immature seed are white to cream-colored with clear to white wings.

As the seed matures, the seed coat turns tan then dark tan as the wing turns brown.

Mature seed has a golden brown seed coat with completely brown wing.

Cones

Immature cones are green. As they ripen, they acquire a yellow tinge like a ripening banana; not bright yellow but slightly yellowish. As they lose their yellow tinge and begin turning brown, they puff up. Bracts turn brown first.

The seed is ripe when the cones puff.

Cones won't drop seed until they turn brown and open.

Cutting mature cones longitudinally through the center will reveal brown lines (seed wings) running in from the scale tip. If the wing isn't evident the cone isn't mature.

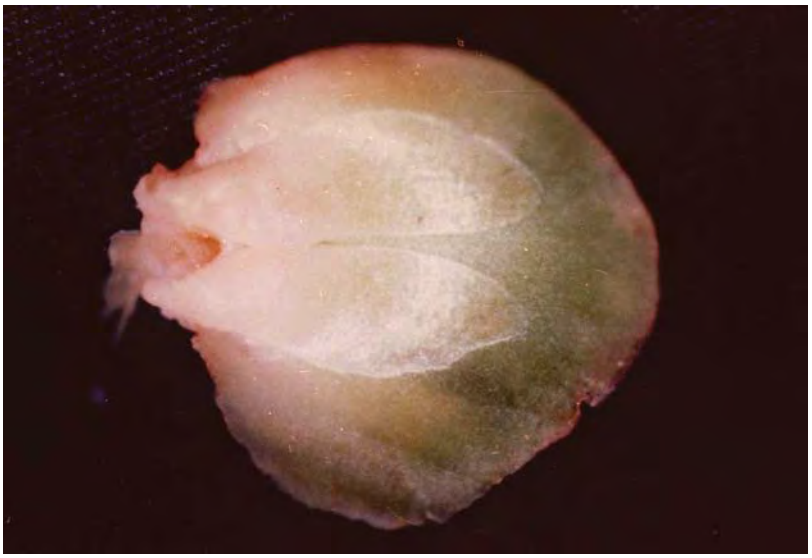
The cut surface of immature cones will turn brown (as will a green apple) within five minutes. Ripe cones will too, but not as rapidly.

Dry sample cones in the sun or oven until they open. If mature, the seed wing will not stick to the scale. If immature, the wing will not easily release.

Bend the cone. If the scales start to separate they are ripe. You only have a few days to collect after the cones start to loosen.

1. Immature cone. Cut surface turning brown, seed wings not evident.

Douglas-fir



2. Immature seed. Seed coat white; wings clear.

3. Immature seed. Seed coat and wing light brown.

Douglas-fir

4. Almost mature cone. Bracts brown. Seed wings evident. Endosperm not firm.

5. Almost mature seed. Seed coat golden brown, wing brown. Check endosperm firmness at this point.

Douglas-fir

6. Mature cone. Bracts brown. Seed wing evident. Cone swelling prior to opening.

7. Mature seed. Seed coat golden brown. Wing completely brown. Endosperm firm.

Engelmann Spruce

Cone and Seed Maturity Guide

Seed

Immature seed is gray with a purple wing.

Mature seed is black with a brown wing.

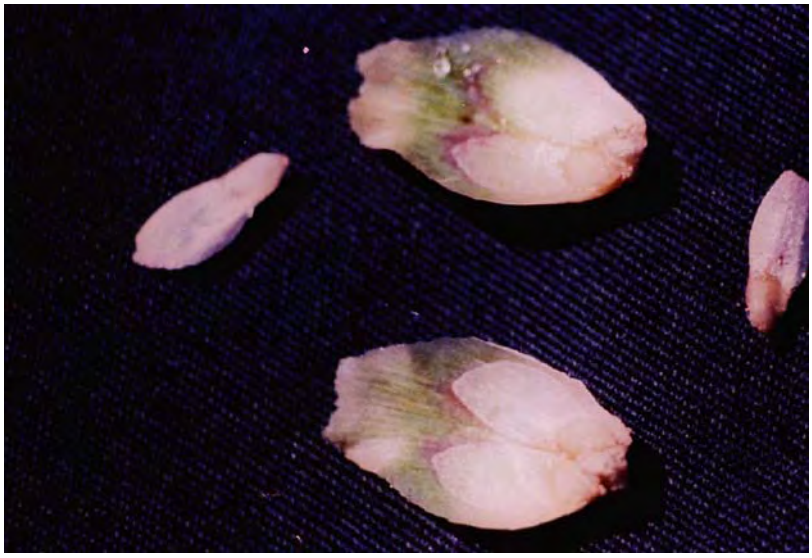
Cones

Immature cones are either green or purple. Green cones turn yellowish and purple cones turn brown as they mature.

Spruce generally matures later than other species.

1. Immature cone. Cones green or purple. Seed wing purple.

Engelmann Spruce



2. Immature seed. Seed is grey with a clear to purple wing.

3. Mature cone. Cone swelling and starting to open. Green cones turn yellow: purple cones turn brown when ripe.

Engelmann Spruce

4. Mature seed. Seed coat black, wing brown.

Grand Fir

Cone and Seed Maturity Guide

Cones are examined by slicing down the cone edge, like cutting corn off the ear, not down the center like other species.

Seed

Immature seed has a green wing and a dirty, washed-out green seed coat.

As the seed matures, the wing turns purple, then brown from the tip in as the seed coat turns tan.

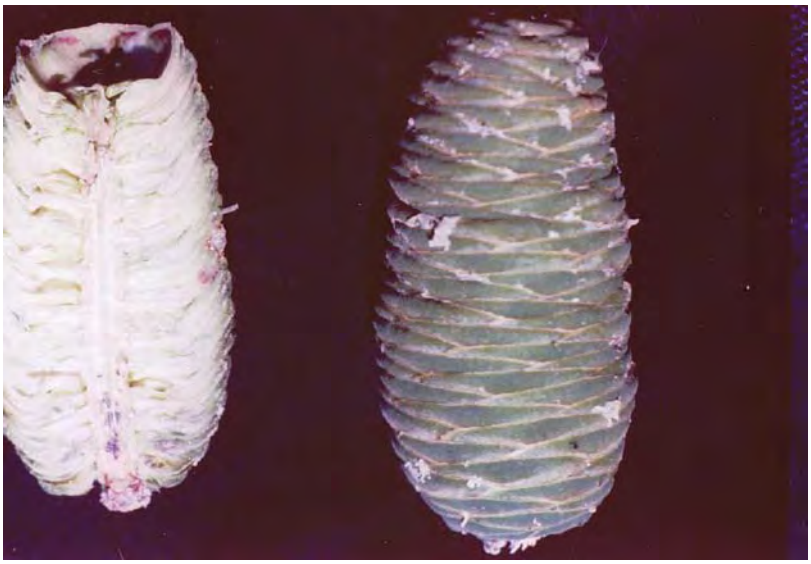
Mature seed is brown and shows no sign of green. Greenish seed is immature.

Cones

As the cone matures, the green cone scale acquires a slight tinge of yellow. This is evident without cutting the cone but you have to look closely.

Scales on fully mature cones are turning brown, the scales are starting to open and the cone feels spongy when squeezed.

There are about 7 to 10 days between when the seed matures and the cone begins to fall apart and release seed.



1. Immature cones. Cone green and hard.

Grand Fir

2. Immature seed. Wing tip purple; seed coat dirty green.

3. Immature seed. Wing purple; seed coat green with brown tinge.

Grand Fir

4. Mature cones. Cone brown, scales opening. Cone is spongy when squeezed. Pick now. Cones may fall apart within a week.

5. Mature seed. Wing tan; seed coat brown.

Lodgepole Pine

Cone and Seed Maturity Guide

Seed

Immature seed is white to cream-colored with clear to white wings.

As the seed matures, seed coats darken and wing tips turn brown. The seed becomes darker and the entire wing turns brown.

Mature seed have black seed coats and brown wings.

Cones

Cones turn chocolate brown to reddish brown after the seed is ripe. Previous year's cones remain on the tree and are weathered and may be light gray on one side or near the base or the entire cone may be buckskin colored. Older cones may be entirely grey. Since the germination rate of seed from older cones is unknown, we should avoid collecting these cones. If older cones are collected, they should be bagged as a separate seed lot.

Most cones in our area open at maturity, so harvest timing is critical. They are not serotinous.

Cutting mature cones longitudinally through the center will reveal brown lines (seed wings) running from the scale tip inward. If the wing isn't evident, the cone isn't mature.

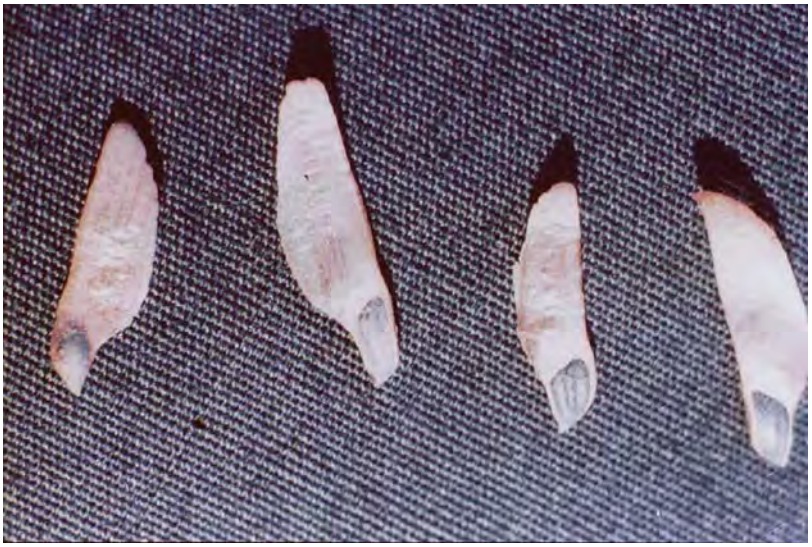
1. Immature seed. Wing clear, seed coat cream-colored.

Lodgepole Pine

2. Mature cones. Cone brown with a yellow or green tinge. Scales beginning to open. Ready to pick! Some cones will open when mature: others remain closed for years.

3. Mature cone. Black seed coats and brown wings visible on cut surface. Cone turning from yellow-green to brown. Ready to pick.

Lodgepole Pine



4. Mature seed. Seed coats black; wings brown.

5. Mature cones. Left to right: mature this year, mature last year, mature 2 years Ago, mature more than 3 years ago. Do not collect old, grey cones that have started to open.

Ponderosa Pine

Cone and Seed Maturity Guide

Seed

Immature seed coats are white and the wings are clear to white.

As the seed matures, the wing turns tan or light brown along the outside edge and occasional brown freckles appear on the seed coat. Gradually the brown on the wing edge moves inward to the seed and more and more freckles appear on the seed coat. The freckles then merge forming a solid brown color and the wings and claws (where wing is attached to seed) turn brown.

Mature seed are coal black, chocolate brown, or dark tan. Some still have large freckles.

Wings **and claws** are all brown on mature seed. White or cream-colored seed are mature if the wing claws are brown.

Light-colored mature seed have a dark spot on the end opposite the wing.

Cones

Ponderosa pine has either green or dark red cones. On some trees the immature cones are green. On other trees they are red. The red cones may look brown and ripe from the ground.

The cut surface of immature cones will turn brown (as will a green apple) within five minutes. Ripe cones will too, but not as rapidly.

After the seed matures, the cones turn brown from the base upward. Cone scales open as they turn brown.

Cutting mature cones longitudinally through the center will reveal brown lines (seed wings) running from the scale tip inward. If the wing isn't evident, the seed isn't mature.

If the bottom ¼ of the cone has opened, little seed has been lost.

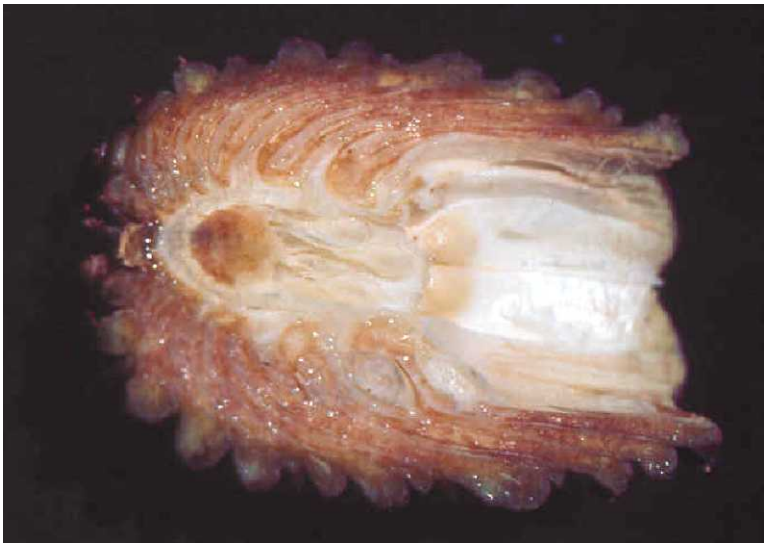
Dry sample cones in the sun or oven until they open. If mature, the seed wing will not stick to the scale. If immature, the wing will not easily release.

Ponderosa Pine

1. Immature cones can be green or red-colored.

2. Immature cone.
   Left: Cut surface rapidly turns brown.
   Right: Seed wings not obvious as brown lines.

Ponderosa Pine



3. Immature seed. Seed wing is clear to white. Seed coat is light tan.

4. Immature cone. Endosperm is firming up. Seed wing still not evident on cut surface.

Ponderosa Pine

5. Immature seed. Wing edge turning brown: seed coat buff colored.

6. Immature seed. Seed coat buff colored. Wing tip turning brown.

Ponderosa Pine

7. Mature cone. Cone brown, opening from base upward. Seed wing brown. Pick now!

8. Mature seed. Wing and claws brown. Seed coat dark brown with some small spots. Endosperm firm.

Western Hemlock

Cone and Seed Maturity Guide

Seed of most conifer species in our area is fully ripe by the last week of August or the first week of September. Hemlock appears to ripen one to two weeks later.

Seed

Immature seed has a clear to light green seed coat and a clear seed wing. As the seed ripens, the seed wing gradually turns light tan along the outer edge. Then the wing turns all tan as the seed coat turns grey-green.

Mature seed has a dark brown seed coat. The wing is tan with dark brown edges.

Cones

Immature cones are green with a red to brown tinge on the tip of the scales. As they ripen, they slowly turn yellow like a banana and the cone scale edges turn brown and begin to dry.

Ripe cones turn from yellow to light brown and the scales loosen as the cones puff.

1. Immature cone. Cone light to dark green.

Western Hemlock

2. Immature seed. Wing clear, seed coat clear to light green.

3. Almost mature cones. Cones turning yellow.

Western Hemlock

4. Mature cone. Scales light brown.

5. Mature seed. Seed coat dark brown with light brown wing.

Western Larch

Cone and Seed Maturity Guide

Seed

Immature seed has a white to cream colored seed coat and a clear wing.

As the seed matures, the wing develops red or purple streaks and then turns light brown.

Mature seed has a brown seed coat on the side away from the cone scale. The underside of the seed next to the cone scale may remain cream colored or light brown. The wing is brown and dark brown where it is attached to the seed.

Cones

Larch trees have either green or dark red cones. Immature cones are either light green or dark red to maroon. The red cones may appear brown and ripe from the ground.

As the cones ripen, the bracts will turn brown and bend back away from the scales.

The cones will puff up and the scale tips will bend back and the cone will feel loose and ready to open. This can happen several weeks before the seed is mature. Cones of other species are ready to open at this stage. **Larch cones are not**.

As green cones near maturity, scales at the base of the cone begin to turn purple to brown. Scales near the top may also turn brown but this may be caused by insect damage. Scales continue to turn brown until the entire cone is brown. When all scales are brown, the cone is mature – pick immediately.

Dark red cones turn brown as they mature just like the green cones. The color change is more difficult to see, however.

Western Larch

1. Western larch cones are either red or green when immature. Immature red cones appear ripe from the ground.

2. Immature cone. Cone green; scales appear open.

Western Larch

3. Left: Immature green-colored cone.
   Center: Almost ripe. Bracts brown, scales turning brown.
   Right: Mature cone. Scales brown and bent back at tips.

4. Fully ripe green-colored cone. Scales brown.

Western Larch

5. Left: Almost mature red-colored cone.
   Right: Mature red-colored cone. Scales brown and bent back at tips.

6. Immature seed. Note red streaks on wing.

Western Larch

7. Almost mature seed.
   Right: Seed coat green, wing turning dark.
   Left: Seed coat is white where it touches the cone scale.

8. Mature seed. Seed coat dark brown. Wing brown.

Western Larch

9. Left: Upper side of mature seed with dark brown seed coat. Center and Right: Underside of mature seed (scale side). Note light colored seed coat.

Western Redcedar

Cone and Seed Maturity Guide

Cones

Immature cones are green.

As they ripen, they turn banana yellow.

Fully ripe cones are brown.

1. Immature cones. Cones green

2. Almost mature cones. Cones turning yellow.

Western Redcedar

3. Mature Cones. Cones turning brown and opening.

4. Mature seed. Wing clear to light brown. Seed coat light brown.

Western White Pine

Cone and Seed Maturity Guide

Seed

Immature seed is white to cream-colored. The wing is clear to white. As the seed ripens, the wing edge turns brown and the seed coat turns light brown. The seed coat darkens uniformly as the wing turns brown.

Mature seed is dark tan to light brown with tan wings.

Cones

Immature cones are green or purple. As the green cones ripen, they mellow. Like a ripening banana they begin to acquire a yellow tinge; not a bright yellow, but slightly yellowish. They then begin to turn brown.

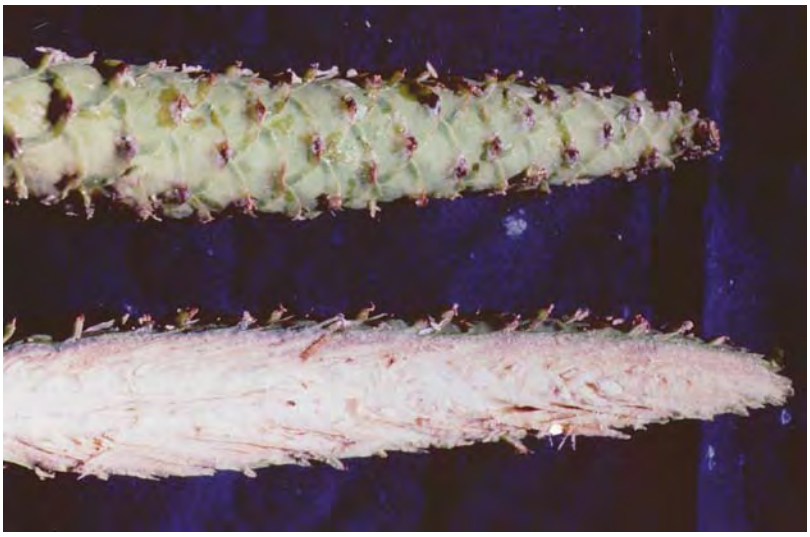
Dry sample cones in the sun or oven until they open. If mature, the seed wing will not stick to the scale. If immature, the wing will not easily release.

Bend the cone. If the scales start to separate they are ripe. You only have a few days to collect after the cones start to loosen.

1. White pine has both green and red cones – on different trees. Red cones may appear to ripen earlier.

White Pine

2. Immature seed (green cone). Wing clear with brown edge. Seed coat light brown.



3. Immature cone. Cone green (or red); turning brown on cut surface.

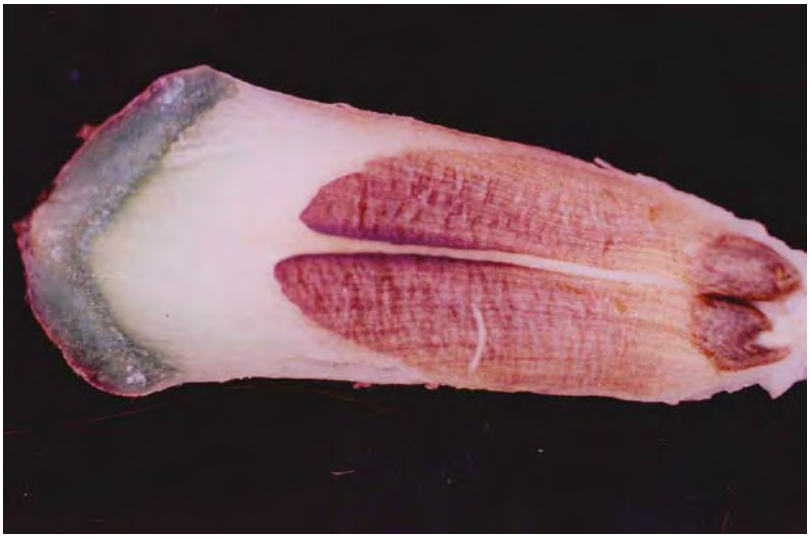
White Pine

4. Almost mature seed (red cone). Wing golden brown; seed coat light brown.

5. Almost mature cone. Cone still green. Seed coat and wing visible on cut surface. Endosperm not yet firm enough for picking.

White Pine

6. Mature cone. Cone brown; scales opening. Pick now.



7. Mature seed. Seed coat dark golden brown. Seed wings brown. Endosperm firm.

Appendix 3. Locating Squirrel Caches

Locating Squirrel Caches

Squirrel caches can be found anywhere but are often located in draw bottoms and low spots where surfacing ground water keeps the ground from freezing in winter. These are good sites to begin a search for cached cones. When searching for cache sites, look for signs of freshly clipped cones on stumps and logs. Clipped pine branch tips and freshly clipped cones scattered on the ground are also evidence that squirrels may be caching cones nearby.

Squirrels chew off the cone scales to get the seed. Once a cache is established, the squirrels will use the site year after year. This results in mounds of old and fresh cone scales. The new cones are usually buried in old cone scales under logs, around and under stumps and in old root holes. Sometimes you have to do a lot of digging to find the freshly cut cones. Squirrels will often gather lodgepole pine cones into little nests of a dozen or more cones scattered throughout the stand.

Early September is the best time to collect cones from caches. Try to get them before ground-soaking rains occur. Heavy rains can wet the cones and may increase fungal contamination of the seed coats.

Look for freshly cut cone scales on stumps

and logs in late August and early September.

Squirrels use the same caches for years often resulting in large mound of old cone scales.

Squirrels often cache cones in low spots where the ground doesn't freeze in the winter.

Squirrel caches are often found around and under old stumps

and logs.

Lodgepole pine cones are sometimes cached in small nests scattered throughout the stand like these Douglas-fir cones were.