GUIDELINES FOR
Tree Seed Crop Forecasting and Collecting

Ministry of
Natural
Resources
Ontario

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Tree Seed Crop Forecasting and Collecting

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In Appreciation:

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This paper contains recycled materials.

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Preface

This manual is designed to provide detailed information for all people involved in tree crop forecasting and collecting operations. Most tree and shrub species that currently contribute to Ontario's forest renewal and wildlife management programs have been included in this manual. Information on other species is available on request by contacting any OMNR office location.

Introduction

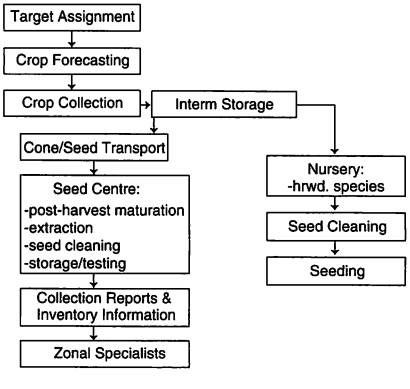
Ontario has a large artificial regeneration program which reflects the commitment to forest management. Successful artificial regeneration through seeding and planting seedling stock requires first and foremost, an adequate supply of high quality seed.

Good supplies of high quality seed can be achieved by

- implementing a sound tree improvement strategy for major regeneration species;
- accurate forecasting and identifying the season's best seed sources;
- proper collection, handling and shipping practices;
- good extraction, cleaning and storage methods.

General information is presented here for an overview and specific, descriptive information for individual species follows.

Figure 1. Seed Collection Flow Chart



Forecasting

Why forecast

Prior to developing a collection program information needs to be gathered about the seed crops. A local district seed register serves as that benefit, not only at the time of forecasting but also for the purpose of collection. The register is also very important in preserving program continuity.

Forecasting provides information to guide collectors to the best stands and help managers plan effective use of manpower, time and funds. This is important because many of our forest species produce good seed crops only periodically, and in good crop years, yields and seed quality are significantly better. When flowering is abundant, the pollen is heterogenous and plentiful; hence higher pollination, fertilization, seed set, germination and seedling vigor are possible. Further, seed collected from bumper crop years tends to maintain its high viability in storage longer. Intervals between good crop years tend to follow a pattern and this is referred to as periodicity. The periodicity for each species is given in the following guidelines.

Field equipment for forecasting

Standard equipment for forecasting includes a pair of high-quality binoculars, an extendible pruning pole, a hand lens, a pocket knife, and a cone cutter (Appendix I).

When to forecast

Generally, cones or fruits can be observed several weeks after flowering. Average periods for each species are given in the manual, but geographic differences will be evident. Note that in pines, it takes two and one half years for a mature cone to develop. Forecasts of fall collection can only be based on second year conelets.

The forecast information is collected by mid July, recorded on the OMNR Crop Forecasting Form and forwarded to the Zonal Specialist. This procedure allows for the comparison of collection targets and expected collections. Shortfalls can then be identified.

The qualitative scoring assessment of the forecast relies on the experience of the forecaster.

Estimating the seed yields

For all species, it is important to sample several fruits or nuts from various parts of the crown to check seed for embryo development and assess potential seed yields.

In pines and spruces, potential seed yields can be determined at this point through a cutting test. The cone is cut in half longitudinally along the axis and then allowed to sit for a few minutes so that the cut surface can darken. The potential yield per cone is estimated by counting the number of filled seed that the knife has cut and multiplying by four (see Appendix I). A range of average yields by species is shown in Appendix II. The cutting test is also valuable for examining seed maturity and detecting insect damage.

For northern white cedar, seeds can be counted simply by pulling apart the cone scales and shaking out the seeds. In maples, ashes and walnuts, it is important to sample several seeds or nuts to check for potential embryo development. This can be done by slicing the seed portion of the samara or the nut. For other hardwood species, a visual count of developing fruit is usually sufficient to estimate the potential crop.

Factors affecting forecasts

The flowering habits, species periodicity and environmental conditions have a direct influence on seed production.

Flower Habits

Generally cones or fruits can be observed several weeks after flowering.

A knowledge of the flower-seed relationship is important to the crop forecaster.

When flowers are unisexual or imperfect, the male and female flowers may both occur on the same tree, which is described as monoecious. It is only the female flowers that develop into seed-bearing cones or fruit.

When the male flowers and the female flowers occur on different trees, the species is termed dioecious.

When the flower has both functional stamens (male) and pistals (female), the species is termed as perfect.

Periodicity

Periodicity is another factor that needs to be considered. Seed bearing of many trees and shrub species is rather irregular from year to year and leads to cyclic effects in crop production. This manual has specified a frequency of seed crop production for species of Ontario.

Environmental Conditions

Environmental factors can be represented in detrimental or beneficial respects. Climate patterns and elements of climate, ie. rainfall, temperature, light and winds can either enhance or hinder the process of seed crop production.

Collecting

Selecting the collection area

Crop collections should come from seed orchards, seed production areas, seed collection areas and gene pool reserves whenever possible.

However, seed may also be collected from healthy natural stands. Ideally, dominant and co-dominant vigorous trees within natural stands should be chosen for seed collections. Avoid isolated trees where self-pollination is very probable. (Ref. Figure 2 & 3)

The collection of seed in a good year affords a number of advantages in that; there can be a high intensity of selection of seed bearers; the cost of collection is lower; due to the concentration of the crop; the seed will usually be of higher germinative energy and capacity and will retain its viability in storage longer than those collected in a poor crop year; in a good seed year damage from insects affects a smaller proportion of the seed; conversely, the impact of insect damage is more devastating in a poor crop year; a heavy seed crop usually reflects a previous heavy production of pollen, to which all or most trees in the stand or area have contributed; collection in a good seed year therefore conserves a higher proportion of the genetic diversity among male parents than collection in a bad year which follows pollination from only a small number of trees. (Willan R.L. 1985)

Field equipment for collecting

Standard equipment for the collection of tree seed crops includes a cone cutter or a sharp cutting knife, picking bags and/or tarpaulins, burlap bags, plastic bags (for use as liners in burlap bags when collecting pulpy fruit), linen tags, permanent ink markers, ladders (standard, extension, and/or tripod), bamboo poles, gloves for certain species, clipboard and record-keeping sheets.

Assessing the crop

It is important that the impending seed crops be monitored after forecasting and prior to commencement of full scale collection activities. Monitoring will determine the level and rate of maturity over the area and establish relative insect or disease conditions that may influence target volumes. Micro climates can also be observed closer in this manner.

Prior to collection, check for aborted cone or fruit development. Insect-damaged cones will feel rubbery and appear underdeveloped when compared to healthy cones. This could be a sign of insect infestation or site stress.

Since insect damage may not be visible on cones or fruit, it is important to do another cutting test. For nut species, a cracking test is recommended. For ash and maple species, the seed may be observed by slicing the seed portion of the samara into two flat halves. Note that in hard maple, it is normal for only one seed in a pair to be filled.

Be aware of warm microclimates that may have brought on early flowering and early seed development.

Figure 2. Form Characteristics

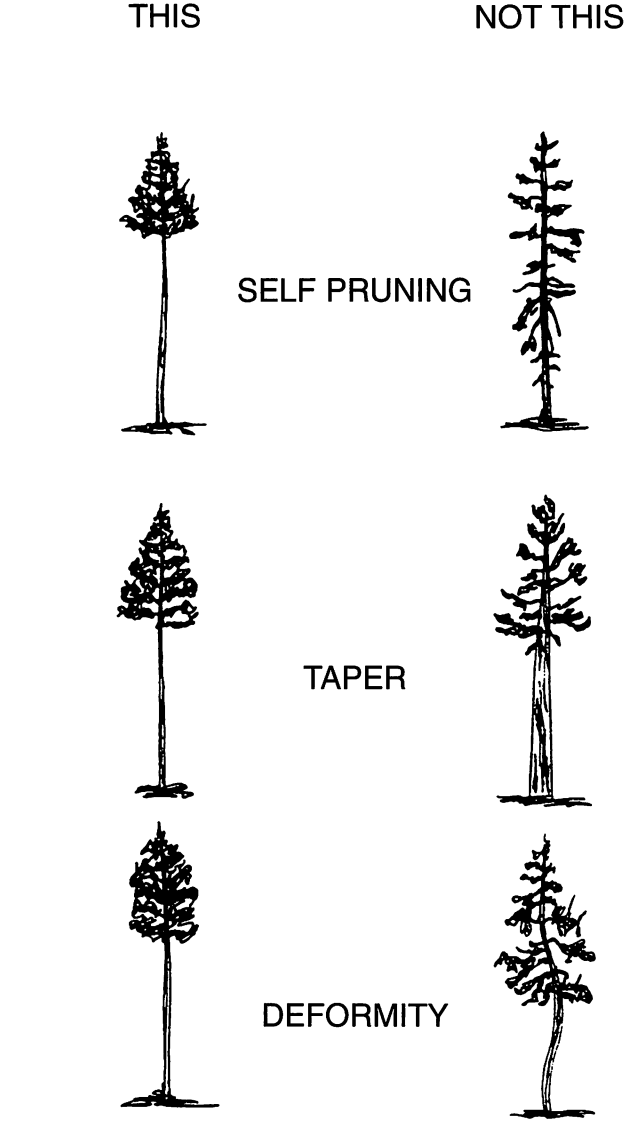
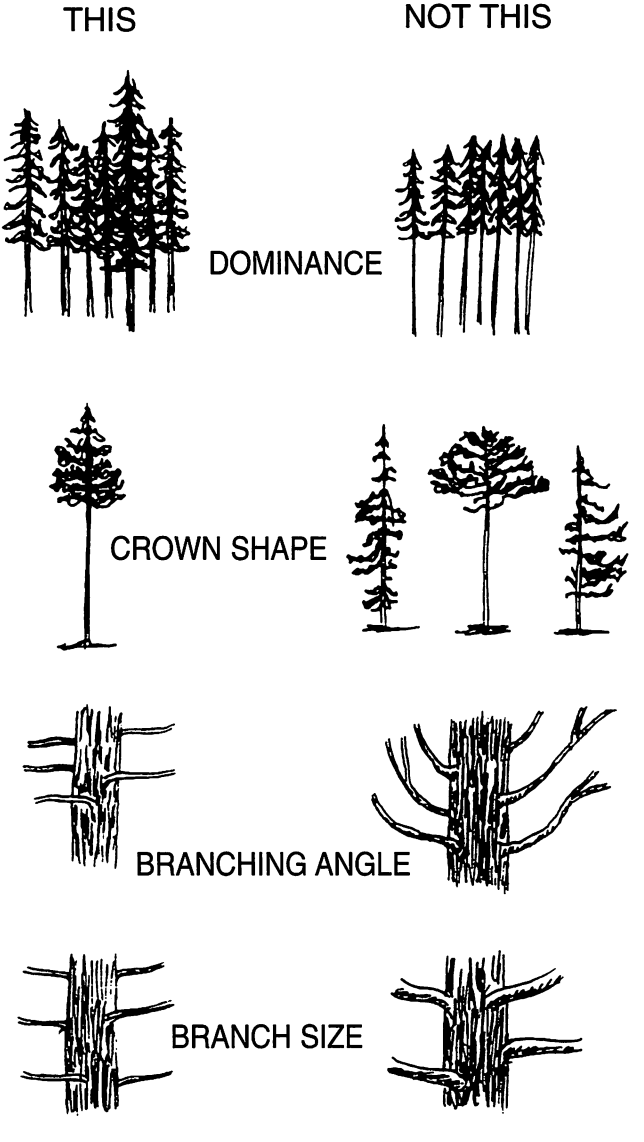


Figure 3. Appearance Guides



Collection methods

Appropriate monitoring is in order as hot and dry weather during late summer and early fall will cause early ripening of conifer cones and will accelerate cone opening and seed dispersal. Cool weather allows ripening to occur slowly and cones can be collected over a long period.

For seed with samaras, choose to collect from areas where ground cover does not make for difficulties when raking, using leaf blowers or ground sheets and bamboo poles.

For species such as Jack Pine and Black Spruce, where cutting operations are frequent, it is possible to collect cones from the cone bearing tops or branches remaining as slash. Tops and branches can be gathered and taken to a convenient central location for cone removal. Modified combines and thrashing units are used to separate the Jack Pine and Black Spruce cones from the branches.

Both species may also be hand-picked but mechanical applications have proven to be more economical.

Hand-picked collections of Jack Pine are made simply by twisting the cones from the branches or by using pruning shears.

Topping of standing trees is an alternative method of collection for trees that do not have an aesthetic value. This should be done only in years of abundant crop production and only in areas where it does not affect the value of the residual tree. This method is most effective in species with fruits that are predominantly clustered at the very top of the tree, such as white pine or white and black spruce.

Tree climbing and hand-picking is a safe and suitable means of collection for many species, as long as proper safety measures are taken.

For many of the hardwood species, or on private land where it is important not to damage the

tree, climbing and hand picking are best. Tree climbing equipment such as pole spurs, tree bicycles, ladders or poles can assist in bringing the picker closer to the cones or fruits. A comprehensive booklet entitled Safe Tree Climbing in Forest Management (see Bibliography) provides detailed information on the various pieces of equipment and tree climbing procedures.

In seed orchards, self propelled hydraulic lifting equipment are useful for getting into the tree crowns.

Squirrels

If squirrels are present in the collection area, they may have nipped off the cones and let them drop to the ground. Often collectors can go directly to their caches to find stores of cones, nuts or acorns. Collections from squirrel caches can be a controversial subject area.

Collection Summary

Some useful guidelines are as follows:

a) Collect seed only from healthy vigorous trees of reasonably good form that indicate average or better than average growth.

b) Collect from mature or nearly mature trees. Overmature trees should be avoided, since seed from them may be low in viability and vigour.

c) Do not collect from isolated trees of naturally cross-pollinating species, since these are likely to be self-pollinated.

d) Do not collect in stands or areas containing numerous poorly formed, off-colour, abnormal or diseased trees.

e) Collect from the dominant and co-dominant trees of average or better than average quality, within the stands or areas.

f) Where a problem of rapid dispersal exists for a species, monitor the crop closely to establish the earliest time for safe collection.

g) Squirrel cache collections introduce more varied problems. Collecting cones from the ground may also exhibit pathogenic problems. It is wise to avoid collecting the early fallen seed, as they are usually underdeveloped or insect damaged.

h) Since seed yield and quality are directly related to cone size and quality, it is important that: aborted, insect and diseased cones not be hand picked. However, such discriminative cone picking does not apply in our mechanized operations for Jack Pine, White Spruce and Black Spruce.

i) Some insects will not show any external signs of their attack. Therefore, cones should be examined routinely by utilizing the cutting test to determine the extent of internal damage. Insects may or may not be present but signs of feeding will be evident, ie. brown tunnelling around the axis, missing seed, or an excavated axis. Other evidence of damage will be seen as shrivelled brown cones.
(photo below)

Field Storage

Freshly harvested cones have a high moisture content and in **cases where bags are being used,** shipments to the Seed Centre should occur in the shortest time as possible via refrigerated transport for large quantities. This applies especially for species such as White Pine and White Spruce. Cones and/or fruits packed for shipping in burlap bags should contain "NO GREATER" than 60 litres measured accurately in each bag. Bags of cones must be palletized for ease of handling.

Self stacking portable cone trays have been adopted by OMNR and are used for all species with the exception of Jack Pine. The cone trays serve as a field storage facility and provide a proper air drying environment that prevents the moist cones from moulding or heating, provided the defined amount of cones, 20 to 40 litres (Table 1), are placed in the trays and that the cones are stirred frequently. Moulds grow on insect damaged or improperly stored cones, and reduce seed yield or in extreme instances, invade the seedcoat and continue growing on the deteriorating megagametophyte or endosperm.

When cone trays are open stacked there is an advantage of natural air movement and the spacing permits sufficient air passage during post harvest maturation.

There are some essential principles when handling freshly collected cones and fruit:

a) Maintain the original identity of seed source location: all cone trays and bags of cones or fruit should be labelled clearly both externally and internally with the correct seed source number, U.T.M. grid, elevation in metres, date collected, number of hl. and crop year.

b) Spread cones on screened trays in thin layers and hold in cool, dry, well-ventilated environments. Care must be exercised when considering the volume per tray.

- drying cones should not be layered more than two cones deep.

- crowded conditions restrict the cone scales' ability to open, and they become set in an unopened or partly open position. These cones may only be fully opened by rewetting to moisten the scales and then drying.

- trays should be twice as deep as the layer of cones to allow for expansion as the cones open.

- the smaller the cone the greater the area needed for a given volume of cones.

- provide suitable and ample ambient air movement either naturally or artificially by fans thus preventing heating, moulding or loss of germination capacity and energy.

c) Ship pulpy fruit immediately in order that the seed can be extracted from the pulp as soon as possible. Pulpy fruits should have a plastic bag inserted inside a burlap bag for shipping and bags should be tied securely. If fruit is not being shipped immediately, hold fruit in tubs of cold water or in open plastic bags inside a walk-in cooler, as it is important to keep pulpy fruit moist.

d) Separate those species requiring processing from those requiring a period of post harvest maturation prior to processing.

- Because collections take place over time, cones should be stored by collection date. In general, the earlier collections are likely to be the least mature and therefore should be stored the longest. The cones from later collections should be processed first, working back to the initial collections.

Note trays, bags, tags and 40 litre measures are available to MNR personnel from the Ontario Tree Seed Plant at Angus (address in Appendix IV).

Transportation

Cones and fruits should be shipped as soon as possible to avoid damage to seed. When this is not possible, store cones and fruits as specified for each species in the manual.

Prior to the shipping of any seed to the Seed Centre at Angus, district/area offices are responsible for scheduling with Quality Control and faxing the completed Cone Shipment Summary, Form CF1 (95/09/27 - Appendix V). This action allows the staff to be informed of incoming shipments and provides for the opportunity to plan activities around the shipments, (93/10).

Cones and seed requiring processing are shipped either by commercial carrier or by OMNR vehicles, to the Seed Centre located at Angus at the expense of the district. The shipping of cones and seed is no longer subsidized by Angus. (93/04)

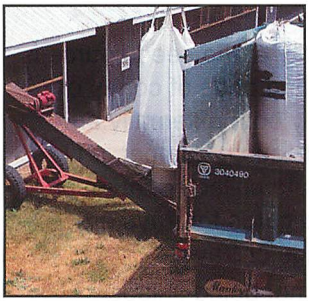
Similarly, seed of Black Walnut, Butternut, Hickories, Maples, Ashes (Fraxinus) and Oaks are transported either by commercial carrier or by OMNR vehicles, directly to a designated nursery.

Shipments whether they are directed to the nursery or the Seed Centre are required to be labelled clearly and correctly with the appropriate information; seed source identification, U.T.M. grid coordinates, elevation in metres, number of hl., crop year and date of collection.

While in transit cones/seed require good air circulation. The air should be cool, free flowing over and around the bags or trays of cones. The cones need to be protected from adverse conditions of rain, snow or hot sun. For fresh cones of high moisture content, refrigerated vans or trailers are recommended. Inside temperature 5° to 10°C.

Due to the serotinous nature of Jack Pine, bulk shipping of this species is a new system Ontario is in the process of integrating as a means to improve the handling efficiencies at the point of shipping and

receiving and to reduce costs for transportation. Time to load and unload is lessened as is the requirement of manpower. Cones are bulked separately by seed source and U.T.M. locations within partitioned areas of the trailer. (photo)



Mega-Bags

Transporting Bulk Cones

Trays

Skids containing bags

Transportation Summary

a) Fax completed Cone Shipment Summary Form, 95/09/27, in advance of shipping cones/seed to Processing Facility or Nursery. (Appendix V)

b) Scheduling for large shipments will be necessary. Contact Quality Control at Angus to discuss arrangements.

c) Ensure the original identity of the seed source is maintained. All cone trays and bags of cones or fruit must be labelled clearly both externally and internally with correct seed source number, u.t.m. grid, elevation in metres, date collected, number of hl. and crop year. Tags and cards for trays are provided when ordering bags or trays.

d) Cones on trays that are not being shipped immediately must be placed in cool, dry, well-ventilated environments. Cones need to be protected from adverse conditions such as rain, snow or hot sun.

e) Care must be exercised when considering the tray volume per tray. Reference Seednote #7. Crowded conditions restrict the cone scales' ability to open and they become set in an unopened or partly open condition.

f) While in transit cones/seed require good air circulation. The air should be cool, free flowing over and around the burlap bags or trays of cones.

g) For fresh cones of high moisture content, refrigerated vans or trailers are recommended. Inside temperature 5° to 10° C.

h) Ship pulpy fruits in plastic lined burlap bags immediately in order that the seed can be extracted as soon as possible. If fruit cannot be shipped immediately, hold fruit in tubs of cold water or in open plastic bags inside a walk-in cooler.

i) All species of cones, excepting Jack Pine and Black Spruce are to be shipped in trays. Burlap bags are acceptable for hardwood species, if seed is shipped or delivered promptly.

j) Jack Pine and Black Spruce cones being shipped in burlap bags must be palletized on skids with 60 li. per bag. Bags of cones on the skid, arranged 4 tiers high and 5 to 6 bags per layer, depending on skid size. Ensure skids are in good repair and that bags when placed on the skid do not impede pallet trucks or forks of lift trucks. Bags need to be stacked securely on skids.

k) Optionally, Jack Pine can be shipped in bulk by transport. Contact Angus or your Client Services Representative for more details.

l) Shipping is at the expense of the originator whether it be via commercial transport or OMNR vehicles.

m) Shipments need to be arranged in an orderly fashion in trailer units. Bags of Jack Pine or Black Spruce placed on skids must be of the same seed source number and same U.T.M., to avoid extensive sorting upon reaching their destination.

n) Black Spruce collected prior to December 1, must be placed and shipped in trays, 30 li. per tray. Black Spruce collected after December 1, can optionally be shipped in burlap bags or trays.

o) When shipping cones by trays, ensure that the bottom tray is complete with orange spacer feet. Extra spacers are available by contacting Quality Control at Angus. Again, refer to Seednote #7 for further information regarding tray procedures.

p) Further handling and shipping information is available by referencing Species Description in these Guidelines.

Table 1. Cone Tray Volume

Species	Volume in Li.
Pw	30
Pr	30
Ps	40
Pa	30
Sw	30
Sb	30
Sr	30
Sn	30
He	20
Ce	20
La	20
Le	40
Lj	40

Conifers

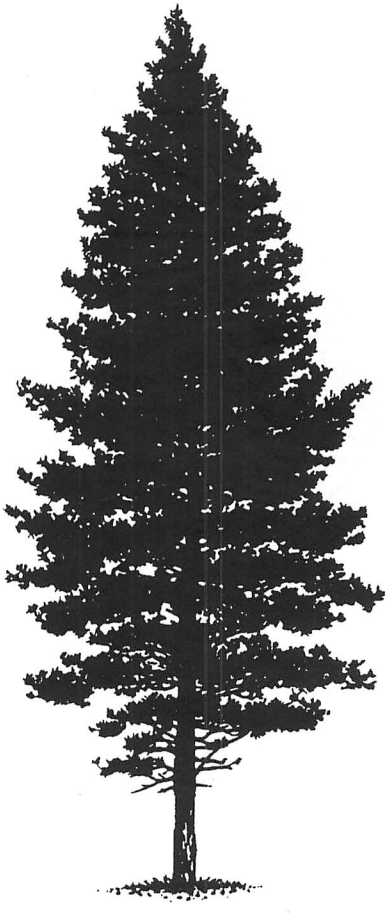


Figure 4. Anatomy of a Cone

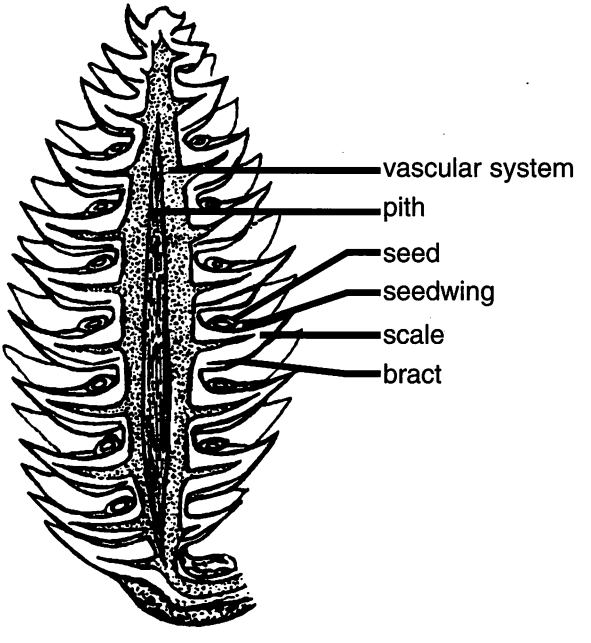
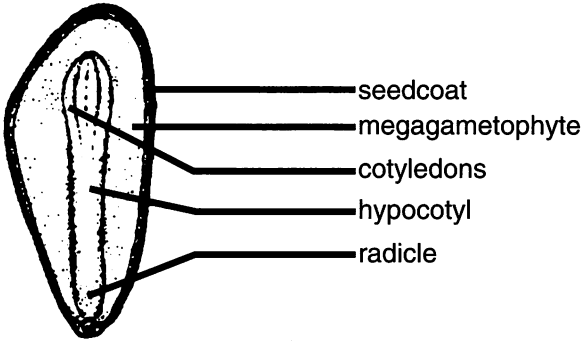


Figure 5. Conifer Seed Anatomy



Common Juniper

Juniperus communis L.

Crop intervals
- irregular

Flowering habit
- usually dioecious, flowering May

Forecasting

When to forecast
- last week of June to first week of July

What to look for
- green berry-like fruits covered with a conspicuous white waxy film

Forecasting notes
- juniper takes up to three years to ripen
- although the fruit is berry-like they are actually modified cones, containing more than one seed

Collecting

When to collect
- late August to late October

Description of ripe fruit and mature seed
- cones or fruit are 10 mm to 15 mm in diameter, globose or broadly ovoid in shape and coated with a thin and resinous waxy coating (bloom), containing 1 to 3 seeds
- ripe fruits bluish black in colour
- seeds are 12 mm to 14 mm in length, elongated ovoid
- seedcoat has two layers, the outer thick and hard, the inner thin and membranous, megagametophyte white to creamy coloured containing embryo with 2 to 6 cotyledons
- mature seed is tri-cornered with depressions, golden brown

Forecasting

Collecting

Collection methods

- collect ripe cones/fruits by hand-picking directly into picking bags or by stripping fruits onto ground tarps

Collection notes

- be sure of species identification
- use a cracking test to determine the percentage of filled seed as it varies widely from tree to tree
- avoid collecting from trees with large numbers of green immature cones/fruit, as they are difficult to separate from mature fruit
- cones/fruit do not open and will remain on the tree throughout the winter, although many are eaten and dispersed by animals

Field storage and transportation procedures

- if possible, cones/fruit should be shipped immediately to the processing centre
- for shipping, cones/fruit should be placed in plastic bags inside burlap bags
- cones/fruit should not be left in bags for long periods of time because they may heat and ferment, causing damage to the seed
- if immediate shipment is not possible, cones/fruit should be spread to reach moisture equilibrium

Eastern Red Cedar

Juniperus virginiana L.

Crop intervals
- two to three years

Flowering habit
- dioecious, flowering mid-May

Forecasting
When to forecast
- last week of June to first week of July

What to look for
- green berry-like fruits covered with a conspicuous white waxy film

Forecasting notes
- although the fruit is berry-like they are actually modified cones, containing more than one seed
- be careful to base forecast only on female trees

Collecting
When to collect
- late September to late November

Description of ripe fruit and mature seed
- cones or fruit are 5 mm to 7 mm in diameter, globular or ovoid in shape and coated with a thin and resinous waxy coating (bloom), containing 1 to 4 seed
- ripe fruits purplish blue in colour
- seeds are 2 mm to 4 mm in length, apex blunt-angular
- seedcoat has two layers, the outer thick and hard, the inner thin and membranous, megagametophyte white to creamy coloured containing embryo with 2 to 6 cotyledons
- mature seed is deeply pitted, shining brown

Forecasting

Collecting

Collection methods

- collect ripe cones/fruits by hand-picking directly into picking bags or by stripping fruits onto ground tarps
- fruits can also be whipped from the crowns onto ground sheets using bamboo poles

Collection notes

- be sure of species identification
- use a cracking test to determine the percentage of filled seed as it varies widely from tree to tree
- avoid collecting from trees with large numbers of green immature cones/fruit, as they are difficult to separate from mature fruit
- cones/fruit do not open and will remain on the tree throughout the winter, although many are eaten and dispersed by animals

Field storage and transportation procedures

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- for shipping, cones/fruit should be placed in plastic bags inside burlap bags
- cones/fruit should not be left in bags for long periods of time because they may heat and ferment, causing damage to the seed

European Larch

Larix decidua Mill.

Crop intervals
- three to ten years

Flowering habit
- monoecious, flowering late April to May

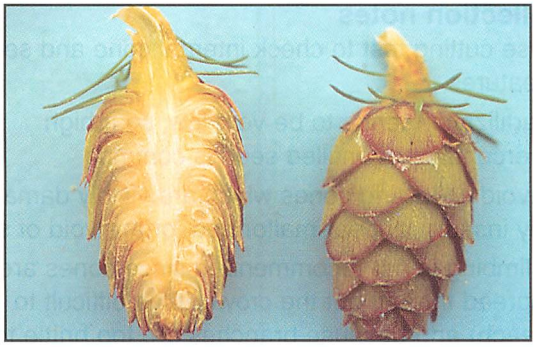
Forecasting
When to forecast
- last week of June to first week of July

What to look for
- green cones that are close to full size

Forecasting notes
- use cutting test at time of forecasting to check embryo development and possible insect damage
- previous years' cones may remain on the tree for a number of years

Collecting
When to collect
- mid-September to October

Description of ripe cones and mature seed
- cones are 3 cm to 4 cm long, cylindrical, with cone scales tightly appressed
- ripe cones are light brown
- cones sit upright on the branch
- seeds are 3 mm to 4 mm long and somewhat triangular
- mature seed has a light brown seed coat, a firm white megagametophyte and a white-to-yellow embryo that extends the length of the embryonic cavity
- seed is generally mature before the cone exhibits fully ripe characteristics



Forecasting

Collecting

Collection methods

- collect cones only when seed is fully mature
- cones can be collected from standing trees, slash, or squirrel caches
- use ladders to access the crown
- collection is somewhat difficult since the cones are firmly attached to branches
- cones can be removed by hand or with pruning shears
- remove cones carefully to avoid damaging branches

Collection notes

- use cutting test to check internal cone and seed features
- fertilization tends to be very low, so a high percentage of unfilled seed is common
- avoid collecting cones which are visibly damaged by insects, appear malformed, or are void of seed
- climbing is not recommended since cones are spread throughout the crown (thus difficult to reach) and because branches are too brittle to permit safe climbing
- since cones remain on branches for several years make sure only the current year's cones are collected

Field storage and transportation procedures

- if possible, ship trays of cones immediately to the processing centre
- if being held prior to shipment, trays of cones should be held in a cool, shaded, dry, well-ventilated area, out of direct sunlight, to prevent heating and/or moulding
- cones should be inspected daily for signs of heating or moulding
- daily stirring or raking of cones should be conducted to ensure even drying and to prevent heating and moulding

Tamarack

Larix laricina (Du Roi) K. Koch

Crop intervals
- three to six years

Flowering habit
- monoecious, flowering late April to May

Forecasting
When to forecast
- end of June to first week of July

What to look for
- cones that are greenish purple and close to full size

Forecasting notes
- use cutting test at forecasting time to check embryo development and possible insect damage
- previous years' cones may remain on the tree for several years

Collecting
When to collect
- mid-August to early September

Description of ripe cones and mature seed
- cones are 1 cm to 2 cm long, oblong, with cone scales tightly appressed
- ripe cones are brown
- cones sit upright on the branch
- seeds are 2 mm to 3 mm long and somewhat triangular
- mature seed has a brown seed coat, a firm white megagametophyte and a white-to-yellow embryo that nearly extends the length of the embryonic cavity
- seed is generally mature before the cone exhibits fully ripe characteristics

Forecasting

Collecting

Collection methods

- collect cones promptly after seed has matured
- cones are best collected from standing trees using ladders
- cones can be removed either by hand-picking or hand-stripping directly into picking bags or onto ground sheets

Collection notes

- check cones often as they near maturity because seed dispersal can occur quickly
- use cutting test to check internal cone and seed features and insect damage
- low filled seed counts for half section evaluation, necessitates cutting tests should be carried out for each individual tree, when collecting, ie. at least 10-20 cones
- avoid collecting cones that are visibly damaged by insects or appear malformed
- climbing is not recommended since cones are spread throughout the entire crown (thus difficult to reach) and because branches are too brittle to permit safe climbing. Tamarack is the weakest limbed of all conifers.
- since cones remain on branches for several years make sure that only the current year's cones are collected

Field storage and transportation procedures

- if possible, ship trays of cones immediately to the processing centre
- if being held prior to shipment, trays of cones should be held in a cool, shaded, dry, well-ventilated area, out of direct sunlight, to prevent heating and/or moulding
- cones should be inspected daily for signs of heating or moulding
- daily stirring or raking of cones should be conducted to ensure even drying and to prevent heating and moulding

Japanese Larch

Laris leptolepis (Sieb. & Zucc.) Gord.

Crop intervals
- three to six years

Flowering habit
- monoecious, flowering April to May

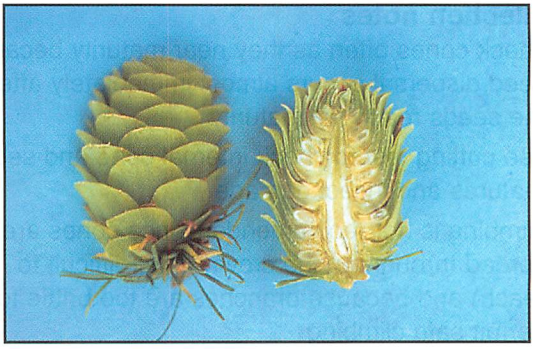
Forecasting
When to forecast
- last week of June to the first week of July

What to look for
- cones that are light green and close to full size

Forecasting notes
- use cutting test at time of forecasting to check on embryo development and possible insect damage
- end of cone looks like a rose

Collecting
When to collect
- mid-September to mid-October

Description of ripe cones and mature seed
- cones are 2 cm to 3 cm long, ovoid, and have scales which bend outwards at their tips giving a rose-like appearance
- ripe cones are brown
- cones sit upright on the branch
- seeds are 3 mm to 4 mm long and somewhat triangular
- mature seed has a light brown coat, a firm white megagametophyte and a white-to-yellow embryo which extends the length of the embryonic cavity
- seed is generally mature before the cone exhibits fully ripe characteristics



Forecasting

Collecting

Collection methods

- collect cones promptly after seed has matured
- cones can be collected from standing trees or squirrel caches
- collections are best made by hand-picking directly into picking bags from standing trees using ladders to access the crown
- cones can also be clipped from branches using pruning shears
- remove cones carefully to avoid damaging branches

Collection notes

- check cones often as they near maturity because seed dispersal occurs almost immediately after the seeds reach full maturity
- use cutting test to check internal cone and seed features and insect damage
- climbing is not recommended since cones are spread throughout the crown (thus difficult to reach) and because branches are too brittle to permit safe climbing
- collection is difficult since cones are firmly attached to branches and are spread throughout the crown
- avoid collecting cones that are visibly damaged by insects, appear malformed, or are void of seed
- since cones remain on branches for several years make sure only the current year's cones are collected

Field storage and transportation procedures

- if possible, ship trays of cones immediately to the processing centre
- if being held prior to shipment, trays of cones should be held in a cool, shaded, dry, well-ventilated area, out of direct sunlight, to prevent heating and/or moulding
- cones should be inspected daily for signs of heating or moulding
- daily stirring or raking of cones should be conducted to ensure even drying and to prevent heating and moulding

Norway Spruce

Picea abies (L.) Karst

Crop intervals
- three to five years

Flowering habit
- monoecious, flowering late April to June

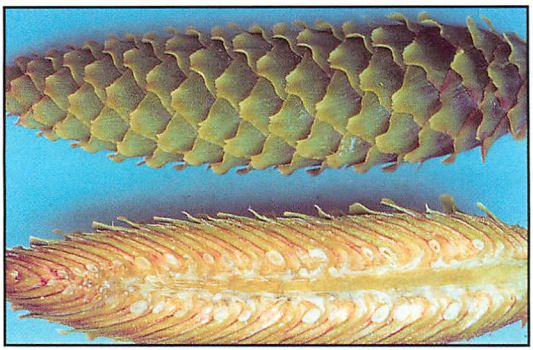
Forecasting
When to forecast
- last week of June to first week of July

What to look for
- cones should be green and about half their full size

Forecasting notes
- use cutting test at time of forecasting to check on embryo development

Collecting
When to collect
- late August to late October

Description of ripe cones and mature seed
- cones are 12 cm to 18 cm long, cylindrical, and composed of many thin, closely overlapping scales
- cone scales can vary in shape from triangular with slightly wavy margins (europa type) to rounded with smooth margins (obovata type)
- ripe cones are greenish brown to light brown
- seeds are 4 mm to 5 mm long, rounded at one end and tapered to a point at the other
- mature seed has a black seed coat, a firm white megagametophyte and a white-to-yellow embryo that nearly extends the length of the embryonic cavity
- seed is generally mature before the cone exhibits fully ripe characteristics



Forecasting

Collecting

Collection methods

- collect cones only when seed is fully mature
- cones can be collected from standing trees or squirrel caches
- collect cones by hand-picking from standing trees using ladders to access the upper crown or by climbing
- extension pruners useful in cutting clusters of cones in bumper crop years

Collection notes

- use cutting test to check internal cone and seed features
- avoid collecting cones that are visibly damaged by insects, appear malformed, or are void of seed
- Norway Spruce is a very strong tree for climbing and climbing is easily accomplished
- if collecting from orn amental trees care should be taken to avoid mechanical damage to the bole or branches

Field storage and transportation procedures

- if possible, ship trays of cones immediately to the processing centre
- if being held prior to shipment, trays of cones should be held in a cool, shaded, dry, well-ventilated area, out of direct sunlight, to prevent heating and/or moulding
- cones should be inspected daily for signs of heating or moulding
- daily stirring or raking of cones should be conducted to ensure even drying and to prevent heating and moulding

White Spruce

Picea glauca (Moench) Voss

Crop intervals
- two to eight years

Flowering habit
- monoecious, flowering in May

Forecasting
When to forecast
- last week of June to first week of July

What to look for
- cones should be green and close to full size

Forecasting notes
- note insect damage (white spruce is quite susceptible to attack)
- cutting test can be used during forecasting to check embryo development
- white resin on cone surface and malformation (such as banana-shape cone) could indicate insect damage

Collecting
When to collect
- August to mid-September

Description of ripe cones and mature seed
- cones 4 cm to 6 cm long, cylindrical and composed of many thin, close overlapping scales; the margins of the cone scales are smooth
- ripe cones are light brown but can vary from green to reddish brown
- seeds are 2 mm to 4 mm long, rounded at one end and tapered to a point at the other end

Forecasting

Collecting

- mature seed has a brown-to-black seed coat, a yellowish and firm megagametophyte (it resembles coconut meat), and a firm white-to-yellow embryo that nearly extends the length of the embryonic cavity
- cones are ready to collect when embryo can be removed with the point of a knife
- these conditions in megagametophyte and embryo development are reached just before the seed coat changes colour
- once seed coats change from light brown to black, collection should be carried out within two weeks
- seed is generally mature before the cone exhibits fully ripe characteristics

Collection methods

- cones can be collected from standing trees, slash, or squirrel caches
- it has been observed that cones located on the south side of the trees and at the top of the crown seem to have less insect infestation than those on the north side and lower in the crown
- cones from high-value trees should be collected by hand-picking or hand-stripping directly into picking bags using ladders, or by climbing to access the crown
- White spruce is a strong tree for climbing
- in mature stands where the appearance of the trees is of minor importance, topping or clipping of branches is a rapid method of collection
- collections from slash can be made by hand-stripping cones at the cutting site
- alternatively, tops can be transported to a central location where cones can be hand-stripped or mechanically removed using top-strippers and combines

Collection notes

- collect cones promptly after seed has matured as cones open soon after ripening, especially during dry weather conditions
- use the cutting test to check internal cone and seed features
- avoid collecting cones that are visibly damaged by insects, appear malformed, or are void of seed
- when using the topping method in areas where damage to the tree is acceptable, tarpaulins should be spread out beneath the tree (space permitting) to catch tops and branches as theydrop; this will reduce losses due to cones dislodging and scattering as branches fall

Field storage and transportation procedures

- if possible, ship trays of cones immediately to the processing centre
- if shipment is over long distances, ship by refrigerated freight
- temperature in refrigerated freight must be above freezing, ideally between 5oC and 10oC
- if being held prior to shipment, trays of cones should be held in a cool, shaded, dry, well-ventilated area, out of direct sunlight, to prevent heating and/or moulding
- cones should be inspected daily for signs of heating or moulding
- daily stirring or raking of cones should be conducted to ensure even drying and to prevent heating and moulding
- when shipping in bags, bags should be filled with no more than 40 litres of cones with each bag tied at the top to allow for cone expansion

Black Spruce

Picea mariana (Mill.) BSP

Crop intervals
- two to eight years

Flowering habit
- monoecious, flowering May to June

Forecasting
When to forecast
- last week of June to first week of July

What to look for
- cones that are purplish green and close to full size

Forecasting notes
- check cone for insect damage (may be indicated by white resin on cone surface or malformed cones)
- cutting test at time of forecasting may not permit determination of embryo development

Collecting
When to collect
- September through to winter months

Description of ripe cones and mature seed
- cones are 1 cm to 3 cm long, ovate, and composed of many thin tightly appressed scales with rounded, notched margins
- ripe cones vary from deep purple to brown
- seeds are very small, 1 mm to 2 mm long, oblong, and gradually taper to a point at one end
- mature seed has a black seed coat, a firm white megagametophyte and a white-to-yellow embryo that nearly extends the length of the embryonic cavity
- seed is generally mature before the cone exhibits fully ripe characteristics

Forecasting

Collecting

Collection methods

- collect cones only when the seed is mature
- cones can be collected from standing trees, slash, or squirrel caches
- collections from short trees (as in young stands, plantations or seed orchards) can be made by hand-picking using ladders to access the crown
- taller trees can be climbed with the aid of a climbing pole, but this method should only be used for special collections (such as from seed production areas)
- collections from slash can be done by hand-stripping cones at the cutting site
- alternatively, tops can be transported to a central location where cones can be hand-stripped or mechanically removed using top-strippers and combines

Collection notes

- use cutting test to check internal cone and seed features
- avoid collecting cones that are visibly damaged by insects, appear malformed, or are void of seed
- since cones are semi-serotinous (i.e. cones may retain their seed for several years following ripening), timing of collections can be flexible
- avoid collecting older cones (i.e. 5 yrs. or older) because of reduced seed yields
- trees on lowland sites will normally retain their seed for longer periods of time, allowing collection to be delayed until late fall or early winter if necessary
- **caution:** if weather conditions are warm and dry in the fall, collections should begin immediately upon seed reaching full maturity to avoid seed loss - especially when collecting from trees on upland sites
- collection from slash must be made soon after the trees are felled since cones close to the ground are frequently subject to temperatures high enough to cause them to open
- cone-bearing branches and tops should not be stored in piles when conditions are warm and damp because heating and moulding will damage seed; cool, dry, well-ventilated storage is necessary when stock-piling fresh material

Field storage and transportation procedures

- if possible, ship trays of cones immediately to the processing centre
- if holding early collections prior to shipment, hold trays of cones out under cool, shaded, well-ventilated conditions, out of direct sunlight, to prevent heating and/or moulding

- Black spruce collected prior to December 1, must be placed and shipped in trays, 30 li. per tray. Black Spruce collected after December 1, can optionally be shipped in burlap bags or trays.
- Black spruce cones being shipped in burlap bags must be palletized on skids with 60 li. per bag. Bags of cones on the skid, arranged 4 tiers high and 5 to 6 bags per layer, depending on skid size. Ensure skids are in good repair and that bags when placed on the skid do not impede pallet trucks or forks of lift trucks. Bags need to be stacked securely on skids.

Colorado Blue Spruce

Picea pugens Engelm.

Crop intervals
- one to three years

Flowering habit
- monoecious, flowering in May to June

Forecasting
When to forecast
- last week of June to first week of July

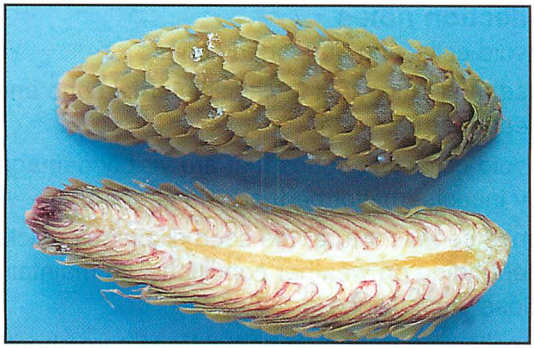
What to look for
- cones will be purplish and half of full size
- embryos will be evident from cutting test

Forecasting notes
- use cutting test at the time of forecasting to check embryo development
- cones are resinous at all times

Rechecking
- monitor seed quality on a regular basis for possible abortion

Collecting
When to collect
- late August to mid-September

Description of ripe fruit and mature seed
- cones are 5 cm to 10 cm long, oblong to cylindrical in shape and composed of many thin, closely overlapping scales
- cone scales are triangular in shape with slightly wavy margins
- ripe cones are golden brown



Forecasting

Collecting

- mature seed are 3 mm to 4 mm long, with a black seed coat, firm white megagametophyte and a white-to-yellow embryo that nearly extends the length of the embryonic cavity
- seed is generally mature before the cone exhibits fully ripe characteristics

Collection methods

- cones can be collected from standing trees or squirrel caches
- cones are hand-picked from standing trees by using ladders or hydraulic lifts to access the upper crown

Collection notes

- avoid collecting unripened cones
- use the cutting test to check internal cone and seed features
- avoid collecting cones that are visibly damaged by insects, malformed, or void of seed
- once cones mature, the seed disperses quickly depending on weather conditions, so maintain close surveillance
- if collecting from ornamental trees care should be taken to avoid mechanical damage to the bole or branches
- cones on tree situated near large bodies of water tend to open later than normal: collections in these areas can be delayed somewhat

Field storage and transportation procedures

- if possible, ship trays of cones immediately to the processing centre
- if being held prior to shipment, trays of cones should be held in a relatively cool, shaded, dry, well ventilated area, out of direct sunlight to prevent heating and/or moulding
- cones should be inspected daily for signs of heating or moulding
- daily stirring or raking of cones should be conducted to ensure even drying and to prevent heating and moulding

Red Spruce

Picea rubens Sarg.

Crop intervals
- three to eight years

Flowering habit
- monoecious, flowering late April to early May

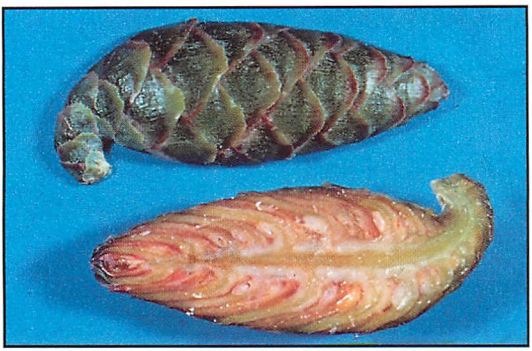
Forecasting
When to forecast
- last week of June to first week of July

What to look for
- cones that are green and close to full size

Forecasting notes
- cones tend to be very resinous
- use cutting test at time of forecasting to check embryo development

Collecting
When to collect
- mid-September to early October

Description of ripe cones and mature seed
- cones are 2 cm to 5 cm long, ovoid to oblong, and composed of many thin closely overlapping scales with rounded slightly wavy margins
- ripe cones are shiny, very resinous, and purplish in colour
- seeds are 3 mm to 4 mm long, rounded at one end and pointed at the other end
- mature seed has a black seed coat, a firm white megagametophyte and a white-to-yellow embryo that extends nearly the length of the embryonic cavity
- seed is generally mature before the cone exhibits fully ripe characteristics



Forecasting

Collecting

Collection methods

- cones can be collected from standing trees, slash, or squirrel caches
- collections are best made by hand-picking from standing trees using ladders or climbing to access the crown

Collection notes

- use the cutting test to check internal cone and seed features
- avoid collecting cones that are visibly damaged by insects, appear malformed, or are void of seed
- be sure of species identification; red spruce trees and cones are easily confused with those of white and black spruce

Field storage and transportation procedures

- if possible, ship trays of cones immediately to the processing centre
- if being held prior to shipment, trays of cones should be held in a cool, dry, well-ventilated area, out of direct sunlight to prevent heating and/or moulding
- cones should be inspected daily for signs of heating or moulding

Jack Pine

Pinus banksiana Lamb.

Crop intervals
- one to three years

Flowering habit
- monoecious, flowering in May to June

Forecasting
When to forecast
- last week of June to first week of July

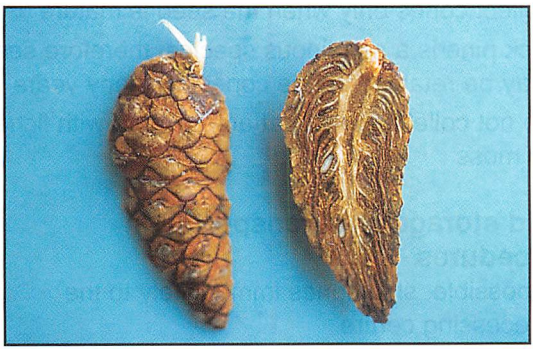
What to look for
- current year's cones that are greenish to greenish brown
- cutting test will reveal embryos

Forecasting notes
- use cutting test at time of forecasting to check embryo development
- note any conelets on current year's growth for indication of next year's crop

Collecting
When to collect
- do not collect the current year's cones until the first week of September
- previous years' cones can be collected at any time since they remain on the tree indefinitely

Description of ripe cones and mature seed
- cones are 4 cm to 7 cm long, vary in shape from straight to strongly curved, and are composed of smooth, tightly closed scales of varying thickness
- current year's cones are ripe when the colour turns to golden brown
- older cones become grayish in colour
- seeds are 3 mm to 4 mm long, elliptical but tapered slightly to a blunt point at one end
- mature seed has a black seed coat

Forecasting



Collecting

Collection methods

- collection normally involves harvesting the current year's crop as well as persistent cones from previous crops
- cones can be collected from standing trees, felled trees in cutover areas, or squirrel caches (in southern Ontario)
- cones near to the ground (as in young stands, felled trees, or slash) are subjected to temperatures capable of opening them; these cones should be collected soon after the seed matures or the trees are felled
- when collecting from standing trees, use ladders or a hydraulic lift to access the upper crown

- since cones are difficult to remove, those collected from standing trees must be carefully clipped off with thin-bladed pruning shears to avoid girdling the branches

Collection notes

- avoid collecting unripened cones, those that are completely gray, or cones that are visibly damaged by insects
- collections should be limited to cones less than six years old because seed loses viability thereafter
- collect cones only when the seed is mature
- jack pine is a serotinous species, therefore seed may be retained in ripe cones for many years
- do not collect cones that are covered with lichen or moss

Field storage and transportation procedures

- if possible, ship cones immediately to the processing centre
- cones require minimal care in handling, storage, and shipping
- if interim storage is required, cones can be stored for many months under cool, dry, well-ventilated conditions
- avoid storing cones in direct sunlight
- cones can be shipped in bulk fashion or in bags stacked on skids
- Jack Pine cones being shipped in burlap bags must be palletized on skids with 60 li. per bag. Bags of cones on the skid, arranged 4 tiers high and 5 to 6 bags per layer, depending on skid size. Ensure skids are in good repair and that bags when placed on the skid do not impede pallet trucks or forks of lift trucks. Bags need to be stacked securely on skids.

Mugho Pine

Pinus mugo Turra

Crop intervals
- annual

Flowering habit
- monoecious, flowering in May to June

Forecasting
When to forecast
- last week of June to first week of July

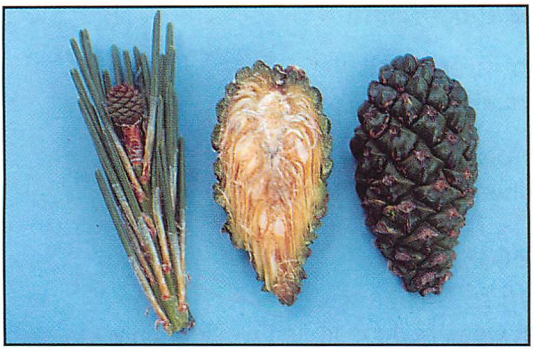
What to look for
- cones should be purplish and half of full size
- embryos should be evident from cutting test

Forecasting notes
- use cutting test at the time of forecasting to check embryo development

Rechecking
- monitor seed quality on a regular basis for possible abortion
- note conelets behind terminal buds for indication of the next years crop

Collecting
When to collect
- late September to late November

Description of ripe fruit and mature seed
- cones are 3 cm to 5 cm long, ovoid to conical in shape and composed of several thick, ridged scales
- ripe cones are purplish brown
- mature seed are 4 mm to 6 mm long, with a black seed coat, firm white megagametophyte and a white-to-yellow embryo that nearly extends the length of the embryonic cavity
- seed is generally mature before the cone exhibits fully ripe characteristics



Forecasting

Collecting

Collection methods

- cones can be collected from standing trees or squirrel caches
- cones are hand-picked from standing trees from the ground or by using ladders or hydraulic lifts to access the upper crown

Collection notes

- avoid collecting immature cones
- use the cutting test to check internal cone and seed features
- avoid collecting cones that are visibly damaged by insects, malformed, or void of seed
- if collecting from ornamental trees care should be taken to avoid mechanical damage to the bole or branches
- cones on tree situated near large bodies of water tend to open later than normal: collections in these areas can be delayed somewhat

Field storage and transportation procedures

- if possible, ship trays of cones immediately to the processing centre
- if being held prior to shipment, trays of cones should be held in a relatively cool, shaded, dry, well ventilated area, out of direct sunlight to prevent heating and/or moulding
- cones should be inspected daily for signs of heating or moulding
- daily stirring or raking of cones should be conducted to ensure even drying and to prevent moulding

Austrian Pine

Pinus nigra Arnold

Crop intervals
- two to five years

Flowering habit
- monoecious, flowering in May to early June

Forecasting
When to forecast
- last week of June to first week of July

What to look for
- cones that are green and close to full size
- cutting test will reveal embryos

Forecasting notes
- use cutting test at time of forecasting to check embryo development

Rechecking
- monitor seed quality on a regular basis for possible abortion
- note any conelets behind terminal buds for indication of next year's crop

Collecting
When to collect
- mid-September to late November

Description of ripe cones and mature seed
- cones are 5 cm to 9 cm long, ovoid to conical, and are composed of several thick, ridged scales
- ripe cones are greenish yellow
- seeds are 5 mm to 7 mm long, elliptical in shape
- mature seed has a yellowish-brown-to-pale-brown seed coat, a firm white megagametophyte and a white-to-yellow embryo that nearly extends the length of the embryonic cavity

Forecasting

Collecting

- seed is generally mature before the cone exhibits fully ripe characteristics

Collection methods

- cones may be collected from standing trees, felled trees, or squirrel caches
- ladders should be used to access the crowns of standing trees

Collection notes

- avoid collecting unripened cones
- collect cones only when seed is fully mature
- use cutting test to check internal cone and seed features
- timing of collection is somewhat flexible as cone opening and seed dispersal do not begin until December
- avoid collecting cones that are visibly damaged by insects, appear malformed, or are void of seed

Field storage and transportation procedures

- if possible, ship trays of cones immediately to the processing centre
- if being held prior to shipment, trays of cones should be held in a cool, shaded, dry, well-ventilated area, out of direct sunlight to prevent heating and/or moulding
- cones should be inspected daily for signs of heating or moulding
- daily stirring or raking of cones should be conducted to ensure even drying and to prevent heating and moulding

Red Pine

Pinus resinosa Ait.

Crop intervals
- three to seven years

Flowering habit
- monoecious, flowering in May to June

Forecasting
When to forecast
- last week of June to first week of July

What to look for
- cones should be purplish and half of full size
- embryos should be evident from cutting test

Forecasting notes
- use cutting test at time of forecasting to check embryo development
- note any conelets behind terminal buds for indication of next year's crop

Rechecking
- check constantly as red pine cones will abort rapidly if attacked by insects (such as coneworms); insect-damaged cones will feel rubbery

Collecting
When to collect
- mid-September to late October

Description of ripe cones and mature seed
- cones are 4 cm to 5 cm long, straight, somewhat tapered, and composed of tightly closed scalesthat are slightly thickened with smooth margins
- ripe cones are reddish brown
- seeds are 4 mm to 6 mm long

Forecasting

Collecting

- mature seed has a light brown seed coat, a firm white megagametophyte, and a white-to-yellow embryo that nearly extends the length of the embryonic cavity
- seed is generally mature before the cone exhibits fully ripe characteristics

Collection methods

- cones can be collected from squirrel caches, recently felled or standing trees, or logging slash provided that the seed is mature
- cones are hand-picked from standing trees by climbing or using ladders or hydraulic lifts to access the crown

Collection notes

- avoid collecting unripened cones
- use the cutting test to check internal cone and seed features
- avoid collecting cones that are visibly damaged by insects, appear malformed, or are void of seed
- look for caching areas, old pulp piles, stone piles and stone fences or slash from thinnings. These provide good cover for squirrels to cache cones

Field storage and transportation procedures

- if possible, ship trays of cones immediately to the processing centre
- if being held prior to shipment, trays of cones should be held in a cool, shaded, dry, well-ventilated area, out of direct sunlight to prevent heating and/or moulding
- cones should be inspected daily for signs of heating or moulding

Eastern White Pine

Pinus strobus L.

Crop intervals
- three to ten years

Flowering habit
- monoecious, flowering in May to early June

Forecasting
When to forecast
- last week of June to first week of July

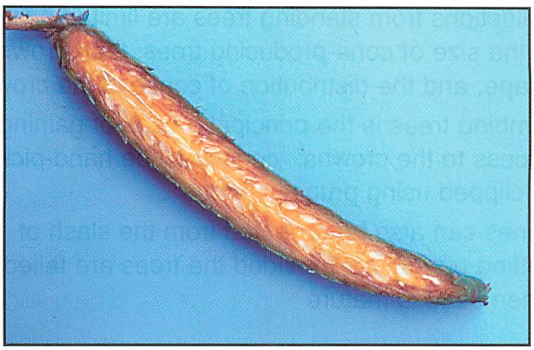
What to look for
- cones should be green and close to full size
- embryos are quite evident from cutting tests

Forecasting notes
- use cutting test at time of forecasting to check embryo development
- note any conelets behind terminal buds for indication of next year's crop
- resin is naturally abundant on white pine cones and is not an indication of insect or disease damage

Rechecking
- check development of cones and watch for aborted cones

Collecting
When to collect
- mid-August to early October

Description of ripe cones and mature seed
- cones are 12 cm to 18 cm long, cylindrical, slightly tapered, and composed of many large, thin, overlapping, tightly appressed scales
- resin drops are commonly found on the cones
- ripe cones are yellowish brown to light brown



Forecasting

Collecting

- seeds are 5 mm to 7 mm long, elliptical in shape
- mature seed has a mottled brown seed coat, a firm white megagametophyte and a white-to-yellow embryo that nearly extends the length of the embryonic cavity
- seed is generally mature before the cone exhibits fully ripe characteristics

Collection methods

- collect cones only when seed is mature
- cones can be collected from squirrel caches, standing or felled trees

- collections from standing trees are limited owing to the size of cone-producing trees, their crown shape, and the distribution of cones in the crown
- climbing trees is the principal means of gaining access to the crowns; cones can be hand-picked or clipped using pruning shears
- cones can also be collected from the slash of cutting operations provided the trees are felled when seed is mature

Collection notes

- use cutting test to check internal cone and seed features
- avoid collecting cones that are visibly damaged by insects, appear malformed, or are void of seed
- a premature change in colour from green to yellowish brown indicates insect damage
- avoid collecting unripened cones
- use of gloves is recommended due to the resinous nature of the cones

Field storage and transportation procedures

- if possible, ship trays of cones immediately to the processing centre
- if being held prior to shipment, tray of cones should be held in a cool, shaded, dry, well-ventilated area, out of direct sunlight, to prevent heating and/or moulding
- cones should be inspected daily for signs of heating or moulding
- daily stirring or raking of cones should be done to promote even drying and to prevent heating and moulding

Scots Pine

Pinus sylvestris L.

Crop intervals
- one to three years

Flowering habit
- monoecious, flowering in May to early June

Forecasting

When to forecast
- last week of June to first week of July

What to look for
- cones that are green and close to full size
- embryos that are quite evident in cutting test

Forecasting notes
- presence of conelets in fall is a clue to next year's crop
- use cutting test during forecasting to check embryo development

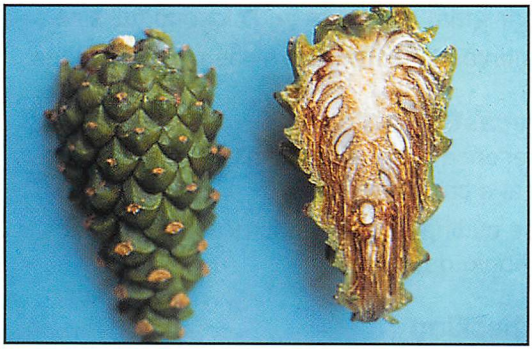
Rechecking
- watch for cone abortion or insect damage

Collecting

When to collect
- late September to mid-November

Description of ripe cones and mature seed
- cones are 4 cm to 5 cm long, straight, conical, and composed of closely appressed scales that are ridged and somewhat diamond-shaped
- ripe cones are dark green
- seed is 3 mm to 5 mm long, elliptical in shape
- mature seed has a light brown to black and/or mottled seed coat, a firm white megagametophyte and a white-to-yellow embryo that nearly extends the length of the embryonic cavity

Forecasting



Collecting

- seed is generally mature before cone exhibits fully ripe characteristics

Collection methods

- collections are best made by hand-picking from standing trees using ladders or climbing to access the crown

Collection notes

- avoid collecting unripened cones
- use cutting test to check internal cone and seed features
- avoid collecting cones that are visibly damaged by insects, appear malformed, or are void of seed
- collect cones only when the seed is mature
- cones can be collected from squirrel caches or standing trees
- timing of collection is quite flexible owing to delayed opening of cone

Field storage and transportation procedures

- if possible, ship trays of cones immediately to the processing centre
- if being held prior to shipment, trays of cones should be spread out in a cool, shaded, dry, well-ventilated area, out of direct sunlight to prevent heating and/or moulding
- cones should be inspected daily for signs of heating or moulding
- daily stirring or raking of cones should be conducted to ensure even drying and to prevent heating and moulding

Northern White Cedar

Thuja occidentalis L.

Crop intervals
- three to five years

Flowering habit
- monoecious, flowering in late April to early May

Forecasting
When to forecast
- last week of June to first week of July

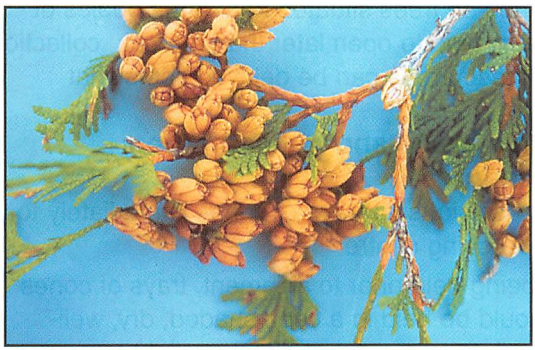
What to look for
- cones that are tiny and green and resemble small scales on the end of new growth

Forecasting notes
- seed development cannot be assessed at the time of forecasting

Collecting
When to collect
- late August to mid-October

Description of ripe cones and mature seed
- cones are 8 mm to 12 mm long, oblong, and composed of eight to ten small scales
- ripe cones are "straw" yellow to golden brown
- seed is 3 mm to 4 mm long
- mature seed has a golden brown seed coat, a firm white megagametophyte and a white-to-yellow embryo that nearly extends the length of the embryonic cavity
- seed is generally mature before cone exhibits fully ripe characteristics

Forecasting



Collecting

Collection methods

- cones are collected by hand-stripping directly into picking bags or onto ground sheets
- collection is easiest from trees whose crowns are accessible from the ground or with ladders
- seeds can be whipped from the ripe cones of standing trees onto ground sheets using bamboo poles - but not on a windy day!

Collection notes

- avoid collecting unripened cones
- ripe cones disperse seed very quickly so monitor cone development and weather conditions closely
- pull cone apart to check internal cone and seed features
- avoid collecting cones that are visibly damaged by insects, appear malformed, or are void of seed
- collect cones only when seed is mature
- cones can be collected from standing trees or squirrel caches
- cones on trees situated near large bodies of water tend to open later than normal; collections in these areas can be delayed somewhat

Field storage and transportation procedures

- if possible, ship trays of cones immediately to the processing centre
- if being held prior to shipment, trays of cones should be held in a cool, shaded, dry, well-ventilated area out of direct sunlight to prevent heating and/or moulding
- cones should be inspected daily for signs of heating or moulding
- daily stirring or raking of cones should be conducted to ensure even drying and to prevent heating and moulding

Eastern Hemlock

Tsuga canadensis (L.) Carr.

Crop intervals
- two to three years

Flowering habit
- monoecious, flowering in May to early June

Forecasting
When to forecast
- last week of June to first week of July

What to look for
- cones that are green and about half their full size

Forecasting notes
- check embryo development at the time of forecasting using cutting test

Collecting
When to collect
- mid-September to late October

Description of ripe cones and mature seed
- cones are 1 cm to 2 cm long
- ripe cones are purple brown
- seed is 3 mm to 4 mm long and irregular in shape
- mature seed has a golden brown seed coat, a firm white megagametophyte and a white-to-yellow embryo that nearly extends the length of the embryonic cavity
- seed is mature before cone exhibits fully ripe characteristics

Forecasting

Collecting

Collection methods

- collect cones from standing trees by hand-picking directly into picking bags or hand-stripping onto ground sheets
- access the crowns using ladders or by climbing
- cones can be whipped from crowns into ground sheets using bamboo poles

Collection notes

- ripe cones disperse seed very quickly so monitor cone development and weather conditions closely. Seed dispersal begins when the cones turn deeper brown
- use cutting test to check internal cone and seed features
- avoid collecting cones that are visibly affected by insects, appear malformed, or are void of seed

Field storage and transportation procedures

- if possible, ship trays of cones as soon as possible to the processing centre
- if being held prior to shipment, trays of cones should be held in a cool, dry, well-ventilated area, out of direct sunlight to prevent heating and/or moulding
- cones should be inspected daily for signs of heating or moulding

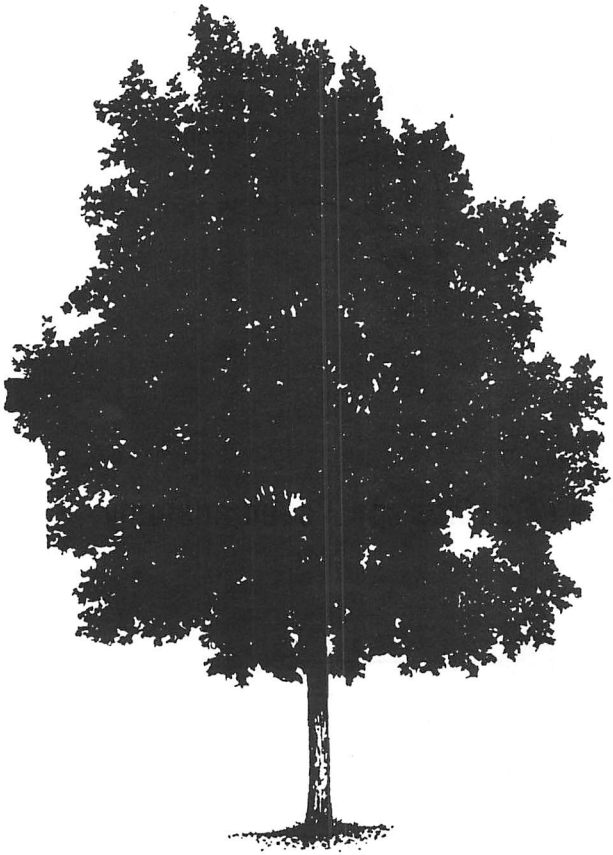


Figure 6.
Maple (*Acer* spp.) seed anatomy

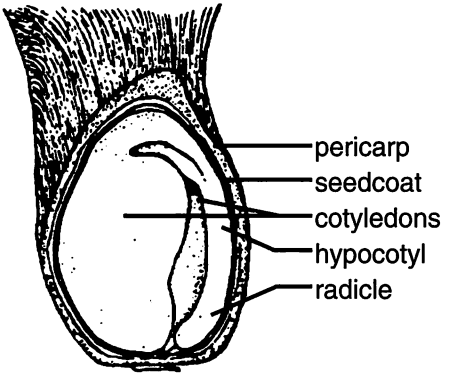


Figure 7.
Ash (*Fraxinus* spp.) seed anatomy

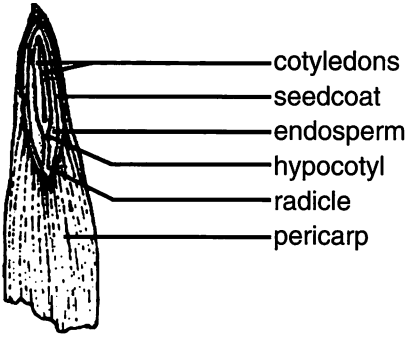


Figure 8.
Oak (*Quercus* spp.) seed anatomy

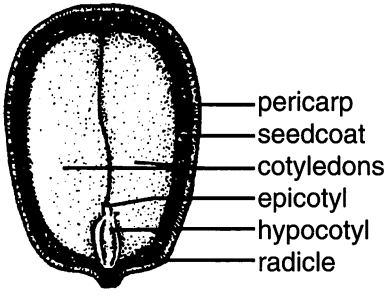


Figure 9.
Cherry (*Prunus* spp.) seed anatomy

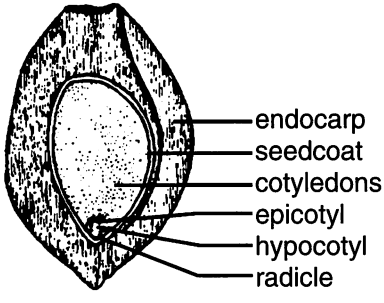
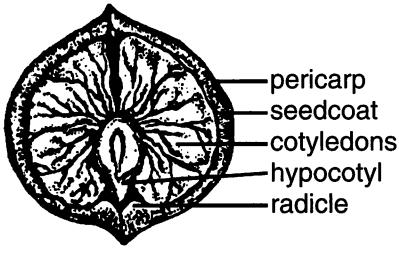


Figure 10.
Walnut (*Julgans* spp.) seed anatomy



Amur Maple

Acer ginnala Maxim.

Crop intervals
- annual

Flowering habit
- polygamous, flowering mid-May to early June
- one of only a few Maples with fragrant flowers

Forecasting
When to forecast
- last week of June to first week of July

What to look for
- samaras are green and mature in size and shape

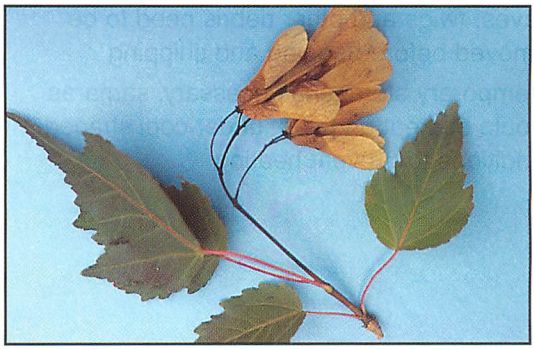
Forecasting notes
- do not look for seeds at this time because embryos appear as tiny specks, if at all

Rechecking
- check seeds during the latter part of July for embryo development

Collecting
When to collect
- late September to early November

Description of ripe fruit and mature seed
- fruits are composed of two winged samaras approximately 10 mm to 15 mm in length, fused together where their seed cavities meet, both cavities are fertile
- ripe samaras are light brown
- the seed consists of a very well-developed, bright green embryo but no megagametophtyte
- mature seed is firm, crisp, green and fully elongated within both seed cavities

Forecasting



Collecting

Collection methods

- collections soon after seed is mature can be made by hand-picking from standing trees
- collect samaras only when seed is mature
- collection after leaves have fallen are easier and can be made by speading Tarpaulins beneath the tree and flailing the branches with a bamboo pole to dislodge samaras
- if collecting from ornamental trees care should be taken to avoid any kind of physical damage to the plant

Collection notes

- use cutting test to determine seed development
- samaras are nearly parallel, forming a very tight U shape
- timing of collection is not critical because samaras persist on the tree throught-out winter months

Field storage and transportation procedures

- samaras should be bagged and shipped immediately to the nursery
- leaves, twigs and other debris need to be removed before bagging and shipping
- if temporary storage is necessary, samaras should be kept on trays, under cool shaded conditions to prevent heating

Norway Maple

Acer platanoides L.

Crop intervals
- annual

Flowering habit
- polygamous, flowering mid-May to early June

Forecasting
When to forecast
- last week of June to first week of July

What to look for
- samaras are in clusters, green and mature in size and shape

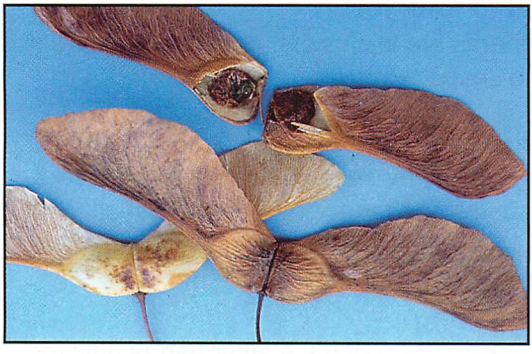
Forecasting notes
- do not look for seeds at this time because embryos appear as tiny specks, if at all
- be sure of species identification

Rechecking
- check seeds during the latter part of July for embryo development

Collecting
When to collect
- late September to mid-October

Description of ripe fruit and mature seed
- fruits are composed of two winged samaras approximately 35 mm to 50 mm in length, fused together where their seed cavities meet, both cavities are fertile
- ripe samaras are light brown
- the seed consists of a very well-developed, bright green embryo but no megagametophyte
- mature seed is firm, crisp, green and fully elongated within both seed cavities

Forecasting



Collecting

Collection methods

- collections soon after seed is mature can be made by hand-picking from standing trees
- collect samaras only when seed is mature
- collection after leaves have fallen are easier and can be made by spreading tarpaulins beneath the tree and flailing the branches with a bamboo pole to dislodge samaras
- if collecting from ornamental trees care should be taken to avoid any kind of physical damage to the plant

Collection notes

- use cutting test to determine seed development
- samaras are wide spreading, virtually horizontal spreading wings

Field storage and transportation procedures

- samaras should be bagged and shipped immediately to the nursery
- leaves, twigs and other debris need to be removed before bagging and shipping
- if temporary storage is necessary, samaras should be kept on trays under cool shaded conditions to prevent heating

Red Maple

Acer rubrum L.

Crop intervals
- annual

Flowering habit
- polygamo-dioecious, flowering early April to early May

Forecasting
When to forecast
- mid-May

What to look for
- samaras that are reddish green

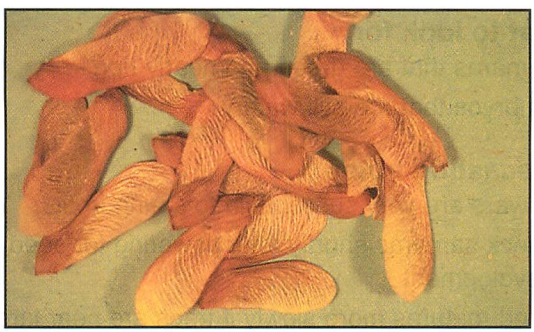
Forecasting notes
- flowers are very susceptible to spring frosts
- check shortly after flowering for seed development

Collecting
When to collect
- late May to mid-June

Description of ripe fruit and mature seed
- fruits are composed of two winged samaras fused together where their seed cavities meet
- ripe samaras are golden brown
- seed consists of a very well-developed embryo but no endosperm
- mature seed is 3 mm to 4 mm long, firm, crisp, green, and fully elongated within the seed cavity

Collection methods
- collections are most often made by spreading tarpaulins beneath the tree and flailing brancheswith a bamboo pole to dislodge samaras
- if seed is being collected from the ground, choose areas where seed can be swept or blown with leaf blowers, as raking from lawns is difficult. Seed collected in this manner is to be in pristine condition and undamaged

Forecasting



Collecting

Collection notes

- collect samaras only when seed is mature
- use cutting test to determine seed development
- seed matures more slowly if trees are near large bodies of water
- collection time is critical because of very quick seed dispersal

Field storage and transportation procedures

- samaras should be bagged and **shipped immediately to the nursery** for sowing on the same day of collection
- twigs, leaves, and other debris need to be removed before bagging and shipment
- if temporary storage is necessary, samaras should be kept on trays under cool shaded conditions to avoid heating

Silver Maple

Acer saccharinum L.

Crop intervals
- annual

Flowering habit
- polygamous, flowering early April to early May

Forecasting
When to forecast
- mid-May

What to look for
- samaras that are green and nearly ripe
- embryos that are still watery

Forecasting notes
- flowers are very susceptible to spring frosts
- check samaras shortly after flowering for seed development
- seed matures more slowly if trees are near large bodies of water

Collecting
When to collect
- late May to mid-June

Description of ripe fruit and mature seed
- fruits are composed of two winged samaras, 4 cm to 6 cm long
- normally only one of the paired samaras will develop a seed while the other side may have aborted; the aborted side is commonly much smaller in size
- ripe samaras are golden brown
- seed consists of a very well-developed embryo but no endosperm
- mature seed is 7 mm to 10 mm long, firm, crips, green, and fully elongated within the seed cavity

Forecasting

Collecting

Collection methods

- collect samaras only when seed is mature
- collections are most often made by spreading tarpaulins beneath the tree and flailing branches with a bamboo pole to dislodge the samaras
- seed can be collected from the ground, by sweeping, raking or by using leaf blowers. Choose areas where the seed has not been degraded by automobile, pedestrian traffic or lawn mowers. Seed collected in this manner is to be in pristine condition

Collection notes

- use cutting test to determine seed development
- monitor seed development often because seed matures quickly after flowering is completed

Field storage and transportation procedures

- samaras should be bagged and **shipped immediately to the nursery** for sowing on the same day of collection
- twigs, leaves, and other debris need to be *removed* before bagging and shipping
- if temporary storage is necessary, samaras should be kept on trays under cool shaded conditions to avoid heating and drying

Hard (Sugar) Maple

Acer saccharum Marsh.

Crop intervals
- three to seven years

Flowering habit
- polygamous, flowering mid-April to May

Forecasting
When to forecast
- last week of June to first week of July

What to look for
- samaras are green and mature in size and shape

Forecasting notes
- do not look for seeds at this time because embryos appear as tiny specks, if at all

Rechecking
- check seeds during the latter part of July for embryo development
- generally, half the seeds are fully developed at rechecking or collecting time

Collecting
When to collect
- late September to mid-October

Description of ripe fruit and mature seed
- fruits are composed of two winged samaras fused together where their seed cavities meet
- ripe samaras are yellowish brown
- the seed consists of a very well-developed, bright green embryo but no endosperm
- mature seed is firm, crisp, green, and fully elongated within the seed cavity
- collect samaras only when seed is mature

Forecasting

Collecting

Collection methods

- collections soon after seed is mature can be made by hand-picking from standing trees
- collections after the leaves have fallen are easier and can be made by spreading tarpaulins beneath the tree and flailing the branches with a bamboo pole to dislodge samaras

Collection notes

- use cutting test to determine seed development
- normally only one of the paired samaras will develop a seed and the other will abort; unlike silver maple, both samaras attain equal size making it impossible to check externally which side is filled
- timing of collection is not critical because samaras persist on the tree for several weeks after reaching full ripeness

Field storage and transportation procedures

- samaras should be bagged and **shipped immediately to the nursery**
- leaves, twigs, and other debris need to be removed before bagging and shipping
- if temporary storage is necessary, samaras should be kept on trays under cool shaded conditions to avoid heating and drying

Juneberry

Amelanchier canadensis (L.) Medic.

Crop intervals
- two to three years

Flowering habit
- perfect, flowering in April

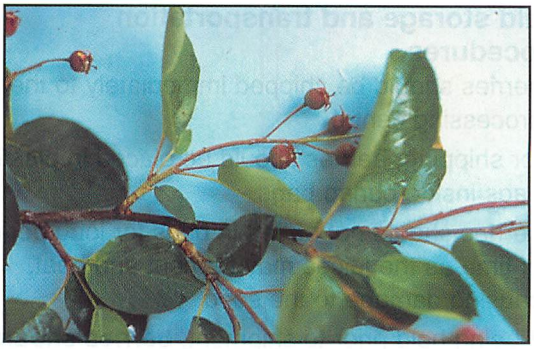
Forecasting
When to forecast
- end of June to first week in July

What to look for
- small green fruit

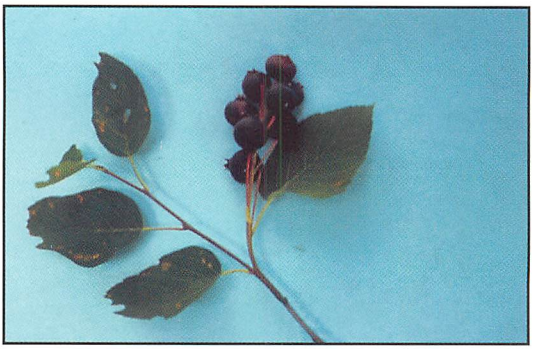
Forecasting notes
- trees are easier to find while in flower
- trees in open areas usually have a heavy flower crop but produce very little mature fruit

Collecting
When to collect
- mid-July

Description of ripe fruit and mature seed
- ripe fruits are small reddish purple berries, 12 mm to 15 mm in diameter, resembling miniature apples
- berries consist of a mass of juicy pulp in which several seeds are embedded
- seeds are 3 mm to 4 mm long, and crescent-shaped
- mature seed is hard and brown
- seed has a large, white, well-developed embryo but no endosperm
- collect berries only when the seed is mature



Forecasting



Collecting

Collection methods

- berries are most easily collected by hand-picking

Collection notes

- collections are often missed due to the very early ripening date of the berries
- berries ripen in stages so plan collections accordingly
- fruit should be collected as soon as it is ripe to reduce losses to birds and animals

Field storage and transportation procedures

- berries should be shipped immediately to the processing centre
- for shipping, berries should be placed in plastic bags inside burlap bags
- berries should not be left in bags for long periods of time as the juices may ferment and heat, causing damage to the seed
- if being held prior to shipment, **berries should be placed in tubs of cold water**
- do not allow berries to dry out

Yellow Birch

Betula alleghaniensis Britt.

Crop intervals
- two years

Flowering habit
- monoecious, flowering late April to May

Forecasting

When to forecast
- last week of June to first week of July

What to look for
- green catkins

Forecasting notes
- be careful to properly distinguish male from female catkins - male catkins generally occur in clusters

Collecting

When to collect
- mid-September to mid-October

Description of ripe fruit and mature seed
- fruits are small catkins, 3 cm to 4 cm long
- catkins are composed of many small, closely overlapping scales
- ripe catkins are brown
- seeds are 3 mm to 4 mm long, oval-to-heart-shaped
- mature seed is golden brown

Collection methods
- catkins are best collected by hand-picking or hand-stripping directly into bags
- ladders should be used to access the crown
- pole pruners or pruning shears are useful for removing branches to permit safer and easier ground collection
- catkins can also be collected from trees felled during cutting operations but timing must be perfect

Forecasting

Collecting

Collection notes

- be sure to collect only the female catkins
- ripe catkins shatter easily, so bag directly when collecting
- collection should be timed so that seed is mature but catkins are still green enough to hold together

Field storage and transportation procedures

- if possible, ship catkins immediately to the processing centre
- twigs, leaves and other debris need to be removed before bagging and shipping
- if being held prior to shipment, catkins should be spread out on trays in a cool, shaded, dry, well-ventilated area to prevent heating and/or moulding
- do not store freshly collected material in bags as heating can occur, causing major losses of seed viability

White Birch

Betula papyrifera Marsh.

Crop intervals
- two years

Flowering habit
- monoecious, flowering late April to May

Forecasting
When to forecast
- last week of June to first week of July

What to look for
- green catkins

Forecasting notes
- be careful to distinguish male from female catkins - male catkins generally occur in clusters

Collecting
When to collect
- mid-August to late November

Description of ripe fruit and mature seed
- fruits are small catkins, 4 cm to 5 cm long
- catkins are composed of many small, closely overlapping scales
- ripe catkins are greenish brown
- seeds are 3 mm to 4 mm long, oval to heart-shaped
- mature seed is golden brown

Forecasting

Collecting

Collection methods

- catkins are best collected by hand-picking or hand-stripping directly into bags
- ladders should be used to access the crown
- pole pruners or pruning shears are useful for removing branches to permit safer and easier ground collection
- catkins can also be collected from trees felled during cutting operations but timing must be perfect

Collection notes

- be sure to collect only the female catkins
- ripe catkins shatter easily, so bag directly when collecting
- collection should be timed so that seed is mature but catkins are still green enough to hold together

Field storage and transportation procedures

- if possible, ship catkins immediately to the processing centre
- twigs, leaves and other debris need to be removed before bagging and shipping
- if being held prior to shipment, catkins should be spread out on trays in a cool, shaded, dry, well ventilated area to prevent heating and moulding
- do not store freshly collected material in bags as heating can occur, causing major losses of seed viability

European White Birch

Betula pendula Roth

Crop intervals
- two years

Flowering habit
- monoecious, flowering late April to May

Forecasting
When to forecast
- last week of June to first week of July

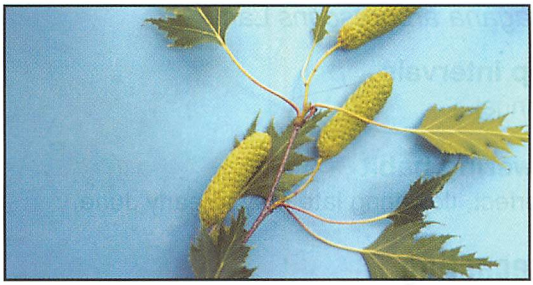
What to look for
- green catkins

Forecasting notes
- be careful to distinguish male from female catkins - male catkins generally occur in clusters

Collecting
When to collect
- mid-August to late September

Description of ripe fruit and mature seed
- fruits are small catkins, 4 cm to 5 cm long
- catkins are composed of many small, closely overlapping scales
- ripe catkins are brown
- seeds are 3 mm to 4 mm long, oval to heart-shaped
- mature seed is golden brown

Collection methods
- catkins are best collected by hand-picking or hand-stripping directly into bags
- ladders should be used to access the crown



Forecasting

Collecting

Collection notes

- be sure to collect only the female catkins
- ripe catkins shatter easily, so bag directly when collecting
- collection should be timed so that seed is mature but catkins are still green enough to hold together
- be careful not to damage this ornamental tree during collection

Field storage & transportation procedures

- if possible, ship catkins immediately to the processing centre
- twigs, leaves and other debris need to be removed before bagging and shipping
- if being held prior to shipment, catkins should be spread out on trays in a cool, shaded, dry, well ventilated area to prevent heating and moulding
- do not store freshly collected material in bags as heating can occur, causing major losses of seed viability

Caragana

Caragana arborescens Lam.

Crop intervals
- annual

Flowering habit
- perfect, flowering late May to early June

Forecasting
When to forecast
- last week of June to first week of July

What to look for
- pods that are green

Collecting
When to collect
- late July to mid-August

Description of ripe fruit and mature seed
- fruits are small pods, 2 cm to 5 cm long
- ripe pods are amber brown
- pods contain four to six small oblong seeds
- mature seeds are shiny, deep reddish brown, and may be mottled in appearance, consisting of hard seed coat surrounding a large, white, well-developed embryo but no endosperm

Collection methods
- pods should be collected by hand-picking directly into picking bags before they begin to open

Collection notes
- timing of collections is important since the pods open when fully ripened to release their seed

Forecasting

Collecting

Field storage and transportation procedures

- if possible, ship pods immediately to the processing centre
- if being held prior to shipment, pods should be spread out on trays in a cool, shaded, dry, well-ventilated area to prevent heating and/or moulding
- after spreading out, cover pods with screening to prevent seed dispersal as pods dry and pop open
- when pods are dry, they can be bagged and shipped to the processing centre

Bitternut Hickory

Carya cordiformis (Wangenh.) K. Koch

Crop intervals
- monoecious, two to three years

Flowering habit
- mid-May to early June

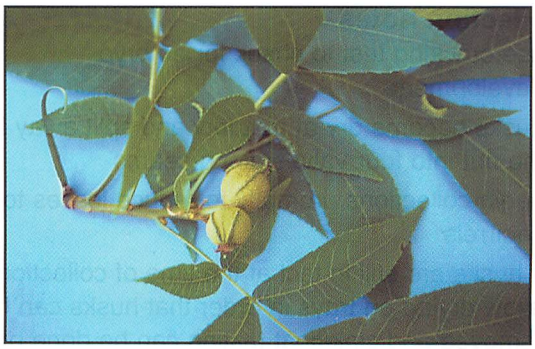
Forecasting
When to forecast
- last week of June to first week of July

What to look for
- small green fruit, half the mature size

Forecasting notes
- be sure of species identification

Collecting
When to collect
- late September to late October depending on fall frosts

Description of ripe fruit and mature seed
- fruits are globose, 25 mm to 40 mm in length, solitary or in clusters of two or three and consist of a dry pulpy husk surrounding a single nut
- the fruits are yellowish green, turning brown to brownish black as they ripen and are exposed to fall frosts
- mature nuts are light brown with hard woody shells enclosing cotyledons and a small, well-developed embryo
- the nuts are thin shelled and abruptly pointed into a conical head



Forecasting

Collecting

Collection methods

- mature fruits fall from the trees after heavy fall frosts, so collection can be timed with natural seed release
- mature fruits can also be removed from the tree by flailing branches with a bamboo pole
- fruits can also be gathered from squirrel caches

Collection notes

- use cracking test to check for embryo development
- husks become dry at maturity and split away from the nut into four valves along seams
- begin collections promptly to reduce losses to squirrels
- if husks are still in tact at the time of collection, allow drying on trays in order that husks can be removed and sink/float testing can be done prior to shipping to the nursery

Field storage and transportation procedures

- nuts should be sink/float tested if separated from husks, surface dried prior to being shipped to the nursery

Shagbark Hickory

Carya ovata (Mill.) K. Koch

Crop intervals
- monoecious, one to three years

Flowering habit
- mid-May to early June

Forecasting
When to forecast
- last week of June to first week of July

What to look for
- small green fruit, half the mature size

Forecasting notes
- be sure of species identification

Collecting
When to collect
- late September to late October depending on fall frosts

Description of ripe fruit and mature seed
- fruits are oval, 3 cm to 6 cm in length, solitary or in clusters of two or three and consist of dry pulpy husk surrounding a single nut
- the fruits are yellowish green, turning brown to brownish black as they ripen and are exposed to fall frosts
- mature nuts are brownish white with hard woody shells enclosing cotyledons and a small, well-developed embryo
- the nuts are thin shelled, oblong, four-angled at the apex and rounded at the base

Forecasting

Collecting

Collection methods

- mature fruits fall from the trees after heavy fall frosts, so collection can be timed with natural seed release
- mature fruits can be removed from the tree by flailing branches with a bamboo pole
- fruits can also be gathered from squirrel caches

Collection notes

- use cracking test to check for embryo development
- husks become dry at maturity and split away from the nut into four valves along seams
- begin collections promptly to reduce losses to squirrels
- if husks are still in tact at the time of collection, allow drying on trays in order that husks can be removed and sink/float testing be done prior to shipping to the nursery

Field storage and transportation procedures

- nuts should be sink/float tested if separated from husks, surface dried prior to being shipped to the nursery

Red-Osier Dogwood

Cornus stolonifera Michx.

Crop intervals
- annual

Flowering habit
- perfect, flowering May to July
- flowering occurs two or three times in one growing season

Forecasting

When to forecast
- last week of June to first week of July

What to look for
- fruit occurs in clusters and varies from green to white

Forecasting notes
- be sure of species identification
- can be mistaken as Swamp Dogwood. The pith of Red-Osier Dogwood is light in colour whilst Swamp Dogwood is dark.

Collecting

When to collect
- mid-July to mid-September

Description of ripe fruit and mature seed
- fruits are small berries, 6 mm to 8 mm in diameter
- ripe berries are snowy white
- each berry contains a single bony stone
- a stone consists of a hard outer shell surrounding two seeds in separate cavities; normally, only one seed develops fully
- mature stones are gray
- a mature stone has a very small, white embryo surrounded by a large amount of endosperm

Collection methods
- hand-picking or hand stripping berries directly into picking bags or onto ground sheets is the best method of collection

Forecasting

Collecting

Collection notes

- be sure of species identification
- berries should be collected when their colour changes from green to white
- berries should be collected as soon as they are ripe to reduce loss to birds
- berries will turn a dark bluish colour when over ripe
- two to three seed crops per season, the first crop is usually the largest and has the most berries. Two crops are the norm, the third is an exception

Field storage and transportation procedures

- if possible, berries should be bagged and shipped immediately to the processing centre
- for shipping, berries should be placed in plastic bags inside burlap bags
- if being held prior to shipment, **berries should be placed in tubs of cold water**
- do not allow berries to dry out

Dotted Hawthorn

Crataegus punctata

Crop intervals
- one to two years

Flowering habit
- perfect, flowering mid May to mid June

Forecasting

When to forecast
- last week of June to first week of July

What to look for
- small green clusters of berries

Forecasting notes
- never forecast based on flowering - wait until fruit is evident
- double check your identification of species

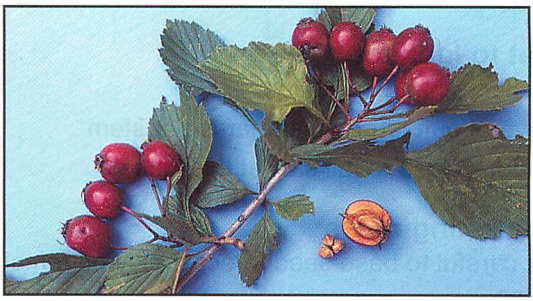
Collecting

When to collect
- mid September to late November

Description of ripe fruit and mature seed
- the fruit, a pome, are small oval shaped berries, 12mm. to 17mm. in length
- ripe fruit is bright red in colour
- each pome consists of a fleshy outer pulp in which are embedded one to three nutlets
- mature seed is 7mm. to 9mm. in length and golden brown to brown in colour
- each nutlet contains a well developed embryo but no megagametophyte although the fleshy cotyledons are often mistaken as such

Collection methods
- collect ripe fruit by hand-picking directly into picking bags
- fruit may drop early and can be gathered from the ground
- collections are best made by flailing the branches with a bamboo pole to dislodge fruit (pomes) onto ground tarps.

Forecasting



Collecting

Collection notes

- be sure of species identification
- if picking fruit by hand, care should be exercised, gloves and other personal equipment should be worn as thorns can cause serious injuries
- only a few birds like the fruits of Crataegus

Field storage and transportation procedures

- if possible, fruit should be shipped immediately to the processing centre
- fruit should not be held in field storage for more than "3" days after collection
- for shipping, fruit should be placed in plastic bags inside burlap bags
- fruit should not be left in bags for long periods of time because the juices may ferment and heat, causing damage to the seed
- if immediate shipment is not possible, "fruit should be placed in tubs of cold water"
- fruit must be kept moist to maintain the viability of the seed and to allow for proper depulping

White Ash

Fraxinus americana L.

Crop intervals
- three to five years

Flowering habit
- dioecious, flowering mid-April to May

Forecasting
When to forecast
- last week of June to first week of July

What to look for
- samaras hang in clusters
- several purple-green samaras per stem
- seed is close to full size at this time

Forecasting notes
- be careful to base seed forecast only on female trees
- seed is almost mature by this time

Rechecking
- check frequently throughout the season because the seed can abort quickly

Collecting
When to collect
- mid-October to mid-November after leaf fall

Description of ripe fruit and mature seed
- fruits are winged, single-seed samaras, 3 cm to 5 cm long
- ripe samara is brown and grows in clusters
- mature seed is firm, crisp, white, and fully elongated within the seed cavity

Forecasting

Collecting

Collection methods

- collections are best made after leaf fall by flailing branches with a bamboo pole to dislodge samaras onto ground tarps
- use ladder to access the crown for collecting by hand or with seed hooks or pruners

Collection notes

- species identification may be difficult: white ash leaves turn purple in autumn, bark is chocolate brown with white spots on new growth
- use cutting test to determine seed development within samara
- timing of collection is flexible since samaras persist on the tree for several weeks after the seed is fully mature
- insect infestation produces discolouration of normal seed. Look for small, dark, round entry holes made by insects

Field storage and transportation procedures

- samaras should be bagged and shipped to the nursery immediately after collection
- remove twigs, leaves and other debris before bagging for shipment
- if temporary storage is necessary samaras should be kept on trays under cool, shaded, dry conditions to prevent heating and moulding

Green Ash

Fraxinus pennsylvanica Marsh.

Crop intervals
- annual

Flowering habit
- dioecious, flowering mid-April to May

Forecasting
When to forecast
- last week of June to first week of July

What to look for
- samaras hang in clusters
- several green samaras per stem
- seed is close to full size at this time

Forecasting notes
- be careful to base forecast only on female trees
- seed is almost mature at this time

Rechecking
- check frequently throughout the season because seed can abort quickly

Collecting
When to collect
- mid-October to mid-November after leaf fall

Description of ripe fruit and mature seed
- fruits are winged, single-seed samaras, 3 cm to 6 cm long
- ripe samara is brown and grows in clusters
- mature seed is firm, crisp, white and fully elongated within the seed cavity

Forecasting

Collecting

Collection methods

- collections are best made after leaf fall by flailing
- branches with a bamboo pole to dislodge samras onto ground tarps
- use a ladder to access the crown for collecting by hand or with seed hooks or pruners

Collection notes

- species identification may be difficult: simply, green ash leaves turn yellow in autumn, twigs are greyish-brown with white spots on new growth
- use cutting test to determine seed development
- timing of collection is flexible since samaras persist on the tree for several weeks after the seed is fully mature
- insect infestation produces discolouration of normal seed. Look for small, dark, round entry holes made by insects

Field storage and transportation procedures

- samaras should be bagged and shipped to the nursery immediately after collection
- remove twigs, leaves and other debris before bagging for shipment
- if temporary storage is necessary samaras should be kept on trays under cool, shaded, dry conditions to prevent heating and moulding

Butternut

Juglans cinerea L.

Crop intervals
- monoecious, two to three years

Flowering habit
- mid-May to early June

Forecasting
When to forecast
- last week of June to first week of July

What to look for
- small, greenish bronze fruit, half the mature size

Forecasting notes
- be sure of species identification as it can be confused with Walnut

Collecting
When to collect
- September to October depending on fall frosts

Description of ripe fruit and mature seed
- fruits are oblong, 50 mm in length and consist of a thick pulpy husk surrounding a single, large nut (versus round fruits, occurring singly or grouped on Walnut)
- the fruits are yellowish green when ripe but turn brown to black after fall frosts
- mature nuts are dark brown with hard woody shells enclosing cotyledons and a small, well-developed embryo
- the nuts are deeply pitted with long, jagged ridges (versus rough nuts with long, rounded ridges for Walnut

Collection methods
- fruits fall from the trees after heavy fall frosts, so wait until then to collect

Forecasting

Collecting

- fruits can be removed from the tree by flailing branches with a bamboo pole
- fruits can also be gathered from squirrel caches

Collection notes

- use cracking test to check for embryo development
- husks have a pungent odour and are sticky to the touch
- the wearing of gloves and old clothing is strongly recommended when handling these fruits
- begin collections promptly to reduce losses to squirrels

Field storage and transportation procedures

- nuts should be shipped immediately to the nursery
- do not store nuts in piles or tubs for extended periods of time
- keep nuts as close to ambient temperature as possible if storing prior to shipping
- as little as two days in big piles can result in heating damage to nuts if temperatures rise above 38.5°C (100°F)
- piling causes lack of oxygen and high carbon dioxide levels
- temperatures ranging from 50°C (120°F) to 61°C (140°F) are lethal to nuts

Black Walnut

Juglans nigra L.

Crop intervals
- monoecious, two to three years

Flowering habit
- mid-May to early June

Forecasting
When to forecast
- last week of June to first week of July

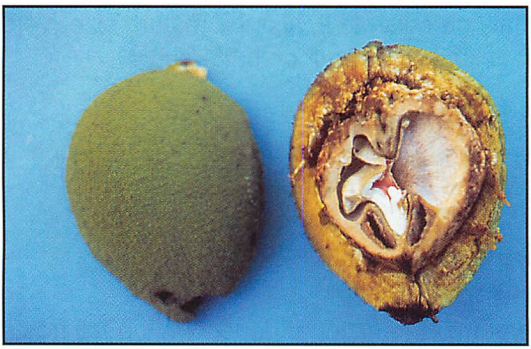
What to look for
- small, greenish fruit, half the mature size (versus greenish bronze fruit on butternut)

Forecasting notes
- be sure of species identification as it can be confused with butternut

Collecting
When to collect
- September to October depending on fall frosts

Description of ripe fruit and mature seed
- fruits are round, 4 cm to 5 cm in diameter, and consist of a thick, pulpy husk surrounding a single, large nut (versus oblong fruits, occurring singly or grouped, on butternut)
- the fruits are yellowish green when ripe but turn brown to black after fall frosts
- mature nuts are dark brown with hard woody shells enclosing a large endosperm and a small, well-developed embryo
- the nuts are rough and marked with long, rounded ridges (versus deeply pitted nuts with long, jagged ridges for butternut)

Forecasting



Collecting

Collection methods

- fruits fall from trees after heavy fall frosts, so wait until then to collect
- fruits can be removed from the tree by flailing branches with a bamboo pole
- fruits can also be gathered from squirrel caches

Collection notes

- use cracking test to check for embryo development
- husks have a pungent odour and contain very strong dyes that can cause permanent stains
- the wearing of gloves and old clothing is strongly recommended when handling these fruits
- begin collections promptly to reduce losses to squirrels
- maggots that appear after collections, only affect the husk and do not damage the coteledons or embryo axis

Field storage and transportation procedures

- nuts should be shipped immediately to the nursery
- do not store nuts in piles or tubs for extended periods of time. If nuts have to be stored prior to shipping, pile no higher than 6" to ensure heating does not occur
- keep nuts as close to ambient temperature as possible if storing prior to shipping
- as little as two days in big piles can result in heating damage to nuts if temperatures rise above 38.5°C (100°F)
- piling causes lack of oxygen and high carbon dioxide levels
- temperatures ranging from 50°C (120°F) to 61°C (140°F) are lethal to nuts

Tulip-Tree

Liriodendron tulipifera L.

Crop intervals
- annual

Flowering habit
- perfect, flowering May to June

Forecasting
When to forecast
- last week of July

What to look for
- elongated green fruit

Collecting
When to collect
- August to October

Description of ripe fruit and mature seed
- fruit is a single-winged samara, 3 cm to 4 cm in length
- samaras occur in aggregate, cone-like structures containing as many as 80 individual samaras
- each samara contains two seeds but one of these usually aborts
- ripe samaras are light brown
- mature seed is firm, crisp, white, and fully elongated within the seed cavity

Collection methods
- collect mature cone-like structures from squirrel caches, newly felled or standing trees
- collections beginning in mid-September are best made by hand-picking directly into picking bags from standing trees using a hydraulic lift or by climbing to access the crown
- fruits can be whipped from the crowns onto ground sheets using bamboo poles when cones are mature and dry

Forecasting

Collecting

Collection notes

- fruit from the upper two-thirds of the crown yields more filled seed than fruit from the lower third
- timing of collections can be critical because seed dispersal can occur quickly on a warm, windy fall day

Field storage and transportation procedures

- if possible, ship trays of fruit immediately to the processing centre
- if being held, early collections should be spread out on trays in a cool, shaded, dry, well-ventilated area to prevent heating and moulding

Cucumber Tree

Magnolia acuminata L.

Crop intervals
- two to three years

Flowering habit
- perfect, mid-May to early June

Forecasting
When to forecast
- last week of June to first week of July

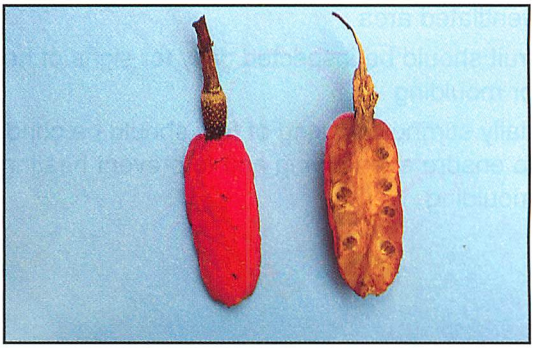
What to look for
- green cucumber shaped-cone

Forecasting notes
- be sure of species identification

Collecting
When to collect
- late September to mid-October depending on fall frosts

Description of ripe fruit and mature seed
- fruit resembles small cucumbers, 5 cm to 8 cm in length and consist of several one to two-seeded fleshy follicles
- fruit is red when ripe but turn rusty brown colour after fall frosts
- mature seeds are 6 mm to 18 mm long, orange in colour
- seedcoat has two layers, the outer is fleshy, oily and soft, the inner is thin and membranous, which encloses a large, fleshy megagametophyte containing a very small embryo

Forecasting



Collecting

Collection methods

- collect ripe fruit by hand-picking directly into picking bags or by stripping fruits onto ground tarps or from trees recently felled
- seed can also be whipped from the crowns onto ground sheets using bamboo poles

Collection notes

- be sure of species identification
- collection may be delayed until follicles have begun to open
- timing the collection is crucial if only the seed and not the fruit is being collected from the tree

Field storage and transportation procedures

- if possible, ship trays of fruit immediately to the processing centre
- for shipping, fruit can be placed in plastic bags inside burlap bags or in plastic cone trays (cone trays preferred)
- fruit should not be left in bags for long periods of time because they may heat, mould or ferment, causing damage to the seed
- if immediate shipment is not possible, fruit should be spread out on trays in a cool, shaded, dry, well ventilated area
- fruit should be inspected daily for signs of heating or moulding
- daily stirring or raking of fruit should be conducted to ensure even drying and to prevent heating and moulding

Ninebark

Physocarpus opulifolius (L.) Maxim

Crop intervals
- annual

Flowering habit
- perfect, flowering mid-June

Forecasting
When to forecast
- last week of June to first week of July

What to look for
- greenish fruit with tinges red, hanging in clusters

Forecasting notes
- be sure of identification

Collecting
When to collect
- late August to mid-September

Description of ripe fruit and mature seed
- ripe fruits are light brown with some reddish tinges
- fruits contain 3 to 5 follicles, with each follicle having 2 to 5 seeds
- mature seed is golden brown and very shiny
- seeds are 2 mm long, somewhat oval in shaped, narrowing towards the radicle area of the seed

Collection methods
- mature fruit clusters are best collected by hand-picking or hand-stripping directly into bags

Collection notes
- if collecting from ornamental trees care should be taken to avoid physical damage to the plant

Forecasting

Collecting

Field storage and transportation procedures

- if possible, ship trays of seed to the processing centre immediately after collection
- remove twigs, leaves and other debris before bagging for shipment
- if temporary storage is necessary, seed should be spread out on trays in a cool, shaded, dry, well ventilated area to prevent heating and moulding
- do not store freshly collected material in bags as heating can occur, causing major losses of seed viability

Sycamore

Platanus occidentalis L.

Crop intervals
- one to two years

Flowering habit
- monoecious, flowering mid-May to early June

Forecasting
When to forecast
- last week of June to first week of July

What to look for
- green globular masses of seeds (about the size of a ping-pong ball)

Forecasting notes
- be sure of identification, can be easily mistaken for London Plane

Collecting
When to collect
- November until spring

Description of ripe fruit and mature seed
- ripe globular fruits are greenish brown
- mature fruits consist of many is elongated, chestnut brown, small, dry, nonsplitting, single seeds with a hairy tuft at their base
- seeds are 7 mm in length, forming the shape of a widened pin

Collection methods
- mature fruit are best collected by hand-picking directly into bags or hand-stripping onto ground tarps
- sometimes fruits may be picked from the ground late in the collection season
- as fruits begin to fall apart in the early spring, they may be stripped onto ground tarps or their seeds may be shaken loose by tapping the branches

Forecasting

Collecting

Collection notes

- be sure of identification
- if collecting from ornamental trees care should be taken to avoid physical damage to the plant
- fruits are persistent, collections can be made into the following spring
- when collecting from this species care should be taken to avoid any physical damage to the plant as it is classified "threatened" to being rare, threatened or endangered

Field storage and transportation procedures

- if possible, ship trays of seed to the processing centre immediately after collection
- remove twigs, leaves and other debris before bagging for shipment
- if temporary storage is necessary, seed should be spread out on tray in a cool, shaded, dry, well ventilated area to prevent heating and moulding
- do not store freshly collected material in bags as heating can occur, causing loss of seed viability

Pin Cherry

Prunus pensylvanica L.

Crop intervals
- annual

Flowering habit
- perfect, flowering in early May to mid-June

Forecasting
When to forecast
- last week of June to first week of July

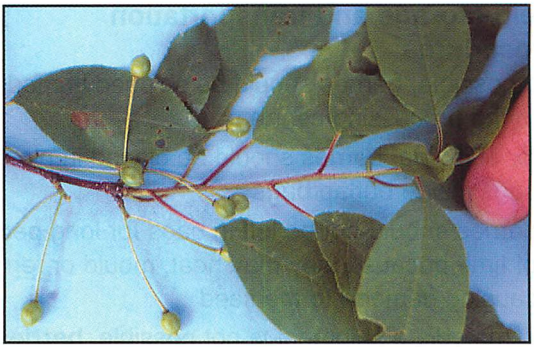
What to look for
- fruit is green, approximately the same size as mature fruit

Forecasting notes
- be sure of species identification

Collecting
When to collect
- mid-July to late July

Description of ripe fruit and mature seed
- fruits are 5 mm to 7 mm in diameter, round in shape and consist of a moist outer pulp surrounding a single seed
- ripe fruits light red in colour
- seeds are 6 mm to 10 mm in length
- mature seed whitish yellow

Collection methods
- collect ripe berries by hand-picking directly into picking bags or by stripping fruits onto ground tarps
- fruits can also be whipped from the crowns onto ground sheets using bamboo poles



Forecasting

Collecting

Collection notes

- be sure of species identification
- wait until berries soften before collecting
- once softened, collect promptly to avoid excessive losses to birds
- timing of collection is important since the fruits persist on the tree for only a few weeks after seed is mature

Field storage and transportation procedures

- if possible, berries should be shipped immediately to the processing centre
- for shipping, berries should be placed in plastic bags inside burlap bags
- berries should not be left in bags for long periods of time because they may heat, mould or ferment, causing damage to the seed
- if immediate shipment is not possible, **berries should be placed in tubs of cold water**
- do not allow berries to dry out

Black Cherry

Prunus serotina Ehrh.

Crop intervals
- one to five years

Flowering habit
- perfect, flowering in June

Forecasting
When to forecast
- last week of June to first week of July

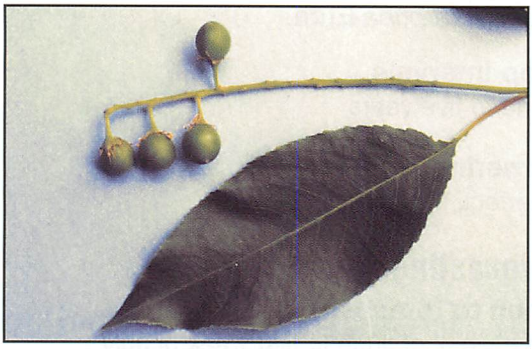
What to look for
- fruit is green and just starting to form

Forecasting notes
- be sure of species identification

Rechecking
- Black Cherry will abort quite rapidly, so final yield may be less than first anticipated

Collecting
When to collect
- late August to mid-September

Description of ripe fruit and mature seed
- fruits are 7 mm to 10 mm in diameter, round in shape and consist of a moist outer pulp surrounding a single seed
- ripe fruits are purplish black in colour
- seeds are about 30 mm in length
- mature seed is reddish to light brown



Forecasting

Collecting

Collection methods

- collect ripe berries by hand-picking directly into picking bags or by stripping fruits onto ground sheets
- fruits can also be whipped from the crowns onto ground tarps using bamboo poles

Collection notes

- be sure of species identification
- wait until berries soften before collecting
- once softened, collect promptly to avoid excessive losses to birds
- timing of collection is important since the fruits can persist on the tree for only a few weeks after seed is mature

Field storage and transportation procedures

- if possible, berries should be shipped immediately to the processing centre
- for shipping, berries should be placed in plastic bags inside burlap bags
- berries should not be left in bags for long periods of time because they may heat, mould or ferment, causing damage to the seed
- if immediate shipment is not possible, **berries should be placed in tubs of cold water**
- do not allow berries to dry out

Choke Cherry

Prunus virginiana L.

Crop intervals
- annual

Flowering habit
- perfect, flowering in late April to mid-May

Forecasting
When to forecast
- last week of June to first week of July

What to look for
- fruit is green
- multiple fruit on a single stem

Forecasting notes
- be sure of species identification

Collecting
When to collect
- early August to early October

Description of ripe fruit and mature seed
- fruits are 8 mm in length, round in shape and consist of a moist outer pulp surrounding a single seed
- ripe fruits are whitish to silvery green in colour
- seeds are about 30 mm in length
- mature seed is brown

Collection methods
- collect ripe berries by hand-picking directly into picking bags or by stripping fruits onto ground tarps
- fruits can also be whipped from the crowns onto ground sheets using bamboo poles

Forecasting

Collecting

Collection notes

- be sure of species identification
- wait until berries soften before collecting
- once softened, collect promptly to avoid excessive losses to birds
- timing of collection is important since the fruits can persist on the tree for only a few weeks after seed is mature

Field storage and transportation procedures

- if possible, berries should be shipped immediately to the processing centre
- for shipping, berries should be placed in plastic bags inside burlap bags
- berries should not be left in bags for long periods of time because they may heat, mould or ferment, causing damage to the seed
- if immediate shipment is not possible, **berries should be placed in tubs of cold water**
- do not allow berries to dry out

Hop Tree

Ptelea trifoliata L.

Crop intervals
- annual

Flowering habit
- polygamous, flowering early May to mid-June

Forecasting
When to forecast
- last week of June to first week of July

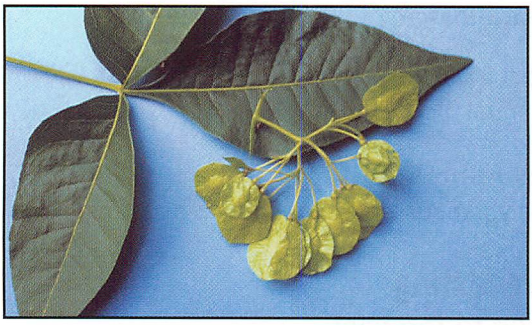
What to look for
- light green, wafer-like samaras

Forecasting notes
- be sure of species identification

Collecting
When to collect
- mid-September through to November, and may persist until the following spring

Description of ripe fruit and mature seed
- fruit, a samara is globose and disc shaped, 33 mm in length and clustered on slender drooping stalks
- ripe samaras are reddish-brown
- mature seed consists of a compressed nutlet surrounded by a membranous wing, well developed embryo, cotyledons and megagametophyte

Collection methods
- collect samaras only when seed is mature, about September
- ripe samaras may be hand picked directly into bags or onto ground sheets spread beneath the tree



Forecasting

Collecting

Collection notes

- use a cutting test to determine seed development
- adverse weather may reduce seed crop, spring frosts can both injure and kill flowers and fruit, as wet spring weather can adversely affect pollination
- samaras on trees situated near large bodies of water tend to mature more slowly after flowering, collections from these areas can be delayed somewhat
- winged samaras are light and disseminated by the wind
- if collecting from ornamental trees care should be taken to avoid any physical damage to the plant as it is classified
- "vulnerable" to being rare, threatened or endangered

Field storage and transportation procedures

- samaras should be bagged and shipped immediately to the nursery for sowing on the same day
- twigs, leaves and other debris need to be removed before bagging and shipping
- if temporary storage is necessary, samaras should be spread out on trays in a cool, shaded, dry, well ventilated area to prevent heating and moulding
- do not store freshly collected material in bags as heating can occur, causing major losses of seed viability

White Oak

Quercus alba L.

Crop intervals
- four to ten years

Flowering habit
- monoecious, flowering in May

Forecasting
When to forecast
- last week of July

What to look for
- acorns that are very small and green

Forecasting notes
- acorns develop in one year

Rechecking
- acorns are yellow when nearly ripe

Collecting
When to collect
- early October

Description of ripe fruit and mature seed
- fully ripened nuts are called acorns
- acorns are 12 mm to 18 mm long, oval, and covered at one end by a small, scaly, chestnut-brown cap
- ripe acorns are brown
- each acorn contains a large, well-developed embryo but no endosperm although two large, fleshy cotyledons are often mistaken as such

Collection methods
- collect ripe acorns by flailing branches with a bamboo pole or by gathering from the ground after frosts

Forecasting

Collecting

Collection notes

- be sure of species identification
- use cutting test to determine internal seed features and possible insect damage
- begin collecting acorns when ripe because they will germinate while still on the tree or soon after falling to the ground
- acorns should be tested prior to collection or purchase; sound acorns will sink when placed in water while hollow, insect-damaged or low moisture content acorns will float

Field storage and transportation procedures

- because acorns germinate very readily, special care is required
- ship immediately to the nursery by the fastest available means

Red Oak

Quercus rubra L.

Crop intervals
- three to five years

Flowering habit
- monoecious, flowering in May

Forecasting
When to forecast
- last week of June to first week of July

What to look for
- acorns that are green and beginning to emerge from cap in second year

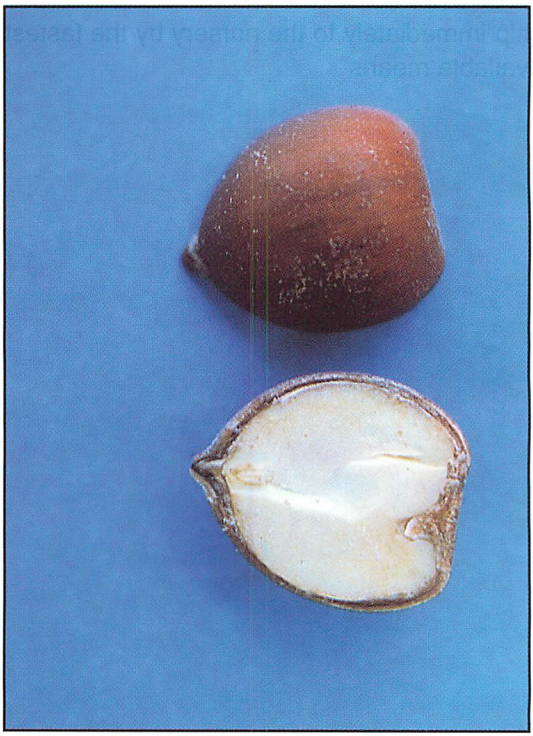
Forecasting notes
- acorns take two years to mature

Collecting
When to collect
- late September to mid-October depending on fall frosts

Description of ripe fruit and mature seed
- fully ripened nuts are called acorns
- acorns are 12 mm to 18 mm long, oval, and covered at one end by a small scaly, brown cap
- ripe acorns are reddish brown
- each acorn contains a large, well-developed embryo but no endosperm although two large, fleshy cotyledons are often mistaken as such

Collection methods
- collect ripe acorns from the ground after frosts or by flailing acorns from the crowns onto ground sheets using bamboo poles

Forecasting



Collecting

Collection notes

- be sure of species identification
- use cutting test to determine internal seed features, checking carefully for insect damage
- timing of collections is very important to reduce losses to squirrels
- acorns should be tested prior to collection or purchase; sound acorns will sink when placed in water while hollow, insect-damaged or low moisture content acorns will float

Field storage and transportation procedures

- ship immediately to the nursery by the fastest available means

Black Locust

Robinia pseudoacacia L.

Crop intervals
- two years

Flowering habit
- perfect, flowering in May

Forecasting
When to forecast
- late August

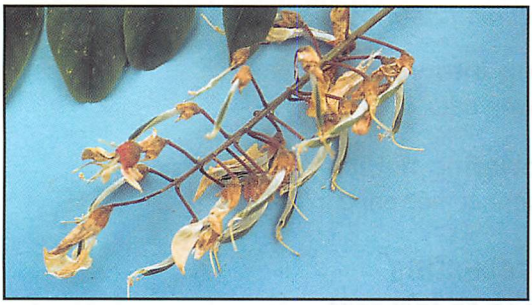
What to look for
- seed pods that are greenish brown

Forecasting notes
- heavy flowering is not always indicative of a heavy seed crop since pollination is sometimes poor
- forecast when pods are evident

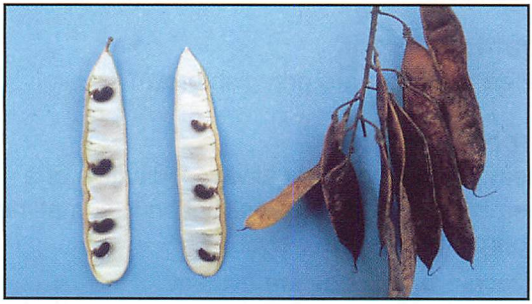
Collecting
When to collect
- late October until spring

Description of ripe fruit and mature seed
- fruits are large pods 5 cm to 7 cm long and similar in appearance to garden peas
- ripe pods are brown
- each pod contains several small, hard seeds 3 mm to 5 mm long
- mature seed has a black seed coat (but sometimes speckled or mottled in appearance) and a single, large well-developed embryo but no endosperm

Collection methods
- collections are best made by flailing pods from the branches onto ground sheets with a bamboo pole



Forecasting



Collecting

Collection notes

- open pods to determine seed development
- timing of collections is not critical because the pods remain closed and may stay on the tree for several months after seeds are fully mature
- collections should be made before pods open to obtain maximum seed yield
- timing of collection is flexible since samaras persist on the tree for several weeks after the seed is fully mature
- extra care should be taken while climbing these trees to avoid injury from thorns located on the branches

Field storage and transportation procedures

- if possible, ship pods immediately to the processing centre
- if being held prior to shipment, pods should be spread out on trays in a cool, shaded, dry, well-ventilated area to prevent moulding

American Mountain Ash

Sorbus americana Marsh.

Crop intervals
- annual

Flowering habit
- perfect, flowering in mid-May to mid-June

Forecasting
When to forecast
- last week of June to first week of July

What to look for
- small green clusters of berries

Forecasting notes
- double check identification of species as other mountain ashes are similar

Collecting
When to collect
- late August to mid-October

Description of ripe fruit and mature seed
- fruits are small round berries, 6 mm to 12 mm in diameter
- ripe berries are bright red in colour and grow in clusters
- each berry consists of a fleshy outer pulp in which are embedded two to five cells, with each cell containing one or two seed small brown seeds
- mature seed is small, 2 mm to 4 mm in length, and golden brown to brown in colour
- each seed contains a well developed, white embryo, cotyledons but no megagametophyte

Forecasting

Collecting

Collection methods

- collect ripe berries by hand-picking directly into picking bags or by stripping fruits onto ground sheets

Collection notes

- be sure of species identification
- wait until berries soften before collecting
- once softened, collect promptly to avoid excessive losses to birds
- timing of collection is important since the fruits persist on the tree for few weeks after seed is mature
- fruits can remain on the trees until late winter, seed is chiefly dispersed by birds
- be careful not to damage this ornamental tree during collection

Field storage and transportation procedures

- if possible, berries should be shipped immediately to the processing centre
- for shipping, berries should be placed in plastic bags inside burlap bags
- berries should not be left in bags for long periods of time because the juices may ferment and heat, causing damage to the seed
- if immediate shipment is not possible, **berries should be placed in tubs of cold water**
- do not allow berries to dry out

White Beam Mountain Ash

Sorbus aria (L.) Crantz

Crop intervals
- annual

Flowering habit
- perfect, flowering in mid-May to mid-June

Forecasting
When to forecast
- last week of June to first week of July

What to look for
- green clusters of berries
- largest berry of all mountain ash species collected

Forecasting notes
- double check identification of species as other mountain ashes are similar

Collecting
When to collect
- late August to mid-October

Description of ripe fruit and mature seed
- fruits are round berries, 15 mm to 20 mm in diameter
- ripe berries are orange-red or scarlet in colour and grow in clusters
- each berry consists of a fleshy outer pulp in which are embedded two to five cells, with each cell containing one or two seed brown seeds
- mature seed is small, 4 mm to 6 mm in length, and golden brown to brown in colour
- each seed contains a well developed, white embryo, cotyledons but no megagametophyte

Forecasting

Collecting

Collection methods

- collect ripe berries by hand-picking directly into picking bags or by stripping fruits onto ground sheets

Collection notes

- be sure of species identification
- wait until berries soften before collecting
- once softened, collect promptly to avoid excessive losses to birds
- timing of collection is important since the fruits persist on the tree for few weeks after seed is mature, seed is chiefly dispersed by birds
- be careful not to damage this ornamental tree during collection

Field storage and transportation procedures

- if possible, berries should be shipped immediately to the processing centre
- for shipping, berries should be placed in plastic bags inside burlap bags
- berries should not be left in bags for long periods of time because the juices may ferment and heat, causing damage to the seed
- if immediate shipment is not possible, **berries should be placed in tubs of cold water**
- do not allow berries to dry out

Showy Mountain Ash

Sorbus decora (Sarg.) Schneid.

Crop intervals
- annual

Flowering habit
- perfect, flowering May to June

Forecasting
When to forecast
- last week of June to first week of July

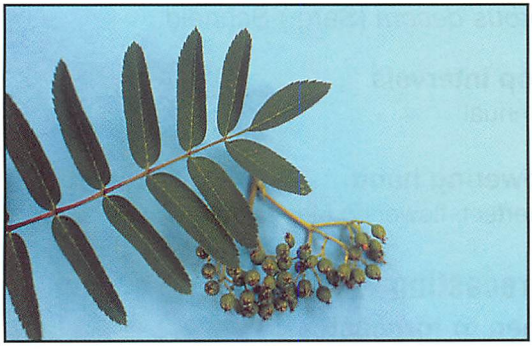
What to look for
- small, green clusters of berries

Forecasting notes
- double check identification of species because other mountain ashes are similar

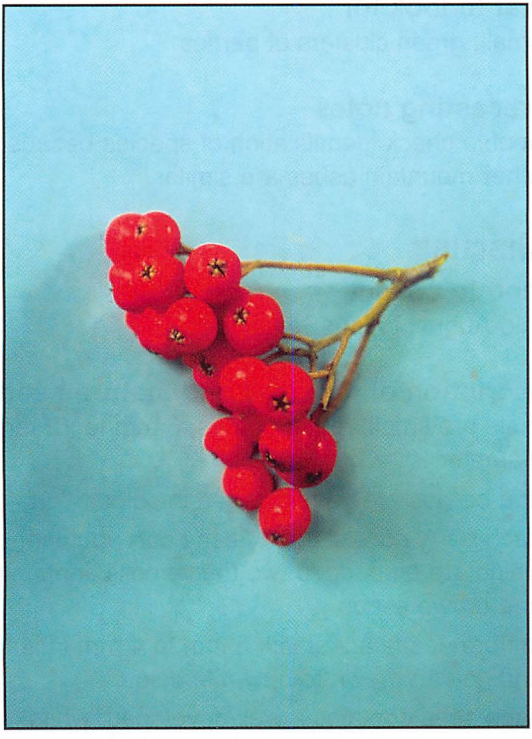
Collecting
When to collect
- mid-August to late September

Description of ripe fruit and mature seed
- fruits are small, round berries, 6 mm to 12 mm in diameter
- ripe berries are vermillion red in colour
- each berry consists of a fleshy outer pulp in which are embedded two to five cells containing one or two seeds
- mature seeds are small, 2 mm to 4 mm in length, and golden brown to brown in colour
- each seed contains a well-developed, white embryo but no endosperm

Collection methods
- collect berries by stripping onto ground sheets or by hand-picking directly into picking bags



Forecasting



Collecting

Collection notes

- collect berries as soon as seed is mature to reduce losses to birds

Field storage and transportation procedures

- if possible, berries should be shipped immediately to the processing centre
- for shipping, berries should be placed in plastic bags inside burlap bags
- berries should not be left in bags for long periods of time because the juices may ferment and heat, causing damage to the seed
- if immediate shipment is not possible, **berries should be placed in tubs of cold water**
- do not allow berries to dry out

Basswood

Tilia americana L.

Crop intervals
- two years

Flowering habit
- perfect, flowering late June to July

Forecasting
When to forecast
- late July

What to look for
- ten to fifteen seeds in drooping clusters
- single wing or bract is green

Forecasting notes
- never scout blossoms at flowering time as forecast could be inaccurate because of poor pollination
- black dot on external surface of the seed could indicate insect damage

Rechecking
- rechecking is important as Basswood will abort quite readily throughout growing season
- check seed development using cutting test

Collecting
When to collect
- late August to mid-September

Forecasting

Collecting

Description of ripe fruit and mature seed

- seeds are 8 mm to 10 mm long, round to egg shaped
- mature seed will be green or just beginning to turn brown and have a crustaceous seedcoat, a fleshy, yellowish megagametophyte and well developed embryo

Collection methods

- mature seed is best collected by hand-picking directly into bags or hand-stripping onto ground tarps
- pole pruners or pruning shears are useful for removing branches to permit safer and easier ground collection
- seed can also be collected from trees felled during cutting operations but timing must be appropriate

Collection notes

- collection should be timed so that seed has just reached maturity
- use cutting test to check internal seed development
- collect as soon as seed is mature for optimum germination results, later collections compromise the ability for seed to germinate

Field storage and transportation procedures

- seed should be bagged and shipped to the nursery immediately after collection
- remove twigs, leaves and other debris before bagging for shipment
- if temporary storage is necessary, seed should be spread out on trays, in a cool, dry, shaded, well ventilated area to prevent heating and moulding
- do not store freshly collected material in bags as heating can occur, causing loss of seed viability

Little-leaf Linden

Tilia cordata Mill.

Crop intervals
- annual

Flowering habit
- perfect, flowering late June to July

Forecasting
When to forecast
- late July

What to look for
- one to seven seeds in drooping clusters
- single wing or bract is green

Forecasting notes
- never scout blossoms at flowering time as forecast could be inaccurate because of poor pollination
- black dot on external surface of the seed could indicate insect damage

Rechecking
- rechecking is important as Linden will abort quite readily throughout growing season
- check seed development using cutting test

Collecting
When to collect
- late August to mid-September

Description of ripe fruit and mature seed
- seeds are 4 mm to 5 mm long, round to egg shaped
- mature seed will be green or just beginning to turn brown and have a crustaceous seedcoat covered with short hairs, a fleshy, yellowish megagametophyte and well developed embryo

Forecasting

Collecting

Collection methods

- mature seed is best collected by hand-picking directly into bags or hand-stripping onto ground tarps
- pole pruners or pruning shears are useful for removing branches to permit safer and easier ground collection
- seed can also be collected from trees felled during cutting operations but timing must be perfect

Collection notes

- collection should be timed so that seed has just reached maturity
- use cutting test to check internal seed development
- collect as soon as seed is mature for optimum germination results, later collections compromise the ability for seed to germinate

Field storage and transportation procedures

- seed should be bagged and shipped to the nursery immediately after collection
- remove twigs, leaves and other debris before bagging for shipment
- if temporary storage is necessary, seed should be spread out on trays in a cool, shaded, dry, well ventilated area to prevent heating and moulding
- do not store freshly collected material in bags as heating can occur, causing loss of seed viability

American Elm

Ulmus americana L.

Crop intervals
- two to three years

Flowering habit
- perfect, flowering late April to early May

Forecasting
When to forecast
- late May

What to look for
- light green, somewhat disc-shaped samaras

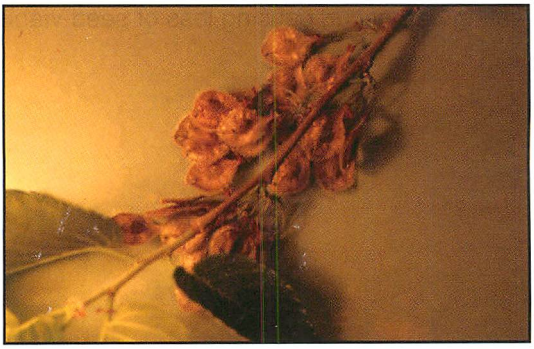
Forecasting notes
- be sure of species identification
- flowers appear prior to leaf flush

Collecting
When to collect
- late May to early June

Description of ripe fruit and mature seed
- fruit, a samara is ovoid, notched and disc shaped, 12 mm to 13 mm in length and clustered on slender drooping stalks
- ripe samaras are greenish brown
- mature seed consists of a compressed nutlet surrounded by a membranous wing, well developed embryo, cotyledons and no megagametophyte

Collection methods
- collect samaras only when seed is mature
- collections are most often made by spreading tarpaulins beneath the tree and failing branches with a bamboo pole to dislodge the samaras

Forecasting



Collecting

Collection notes

- use a cutting test to determine seed development
- monitor seed development often as seed matures quickly after flowering is complete
- adverse weather may reduce seed crop, spring frosts can both injure and kill flowers and fruit, as wet spring weather can adversely affect pollination
- samaras on trees situated near large bodies of water tend to mature more slowly after flowering, collections from these areas can be delayed somewhat
- winged samaras are light and readily disseminated by the wind

Field storage and transportation procedures

- samaras should be bagged and shipped immediately to the nursery for sowing on the same day
- twigs, leaves and other debris need to be removed before bagging and shipping
- if temporary storage is necessary, samaras should be spread out on trays in a cool, shaded, dry, well ventilated area to prevent heating and drying
- do not store freshly collected material in bags as heating can occur, causing loss of seed viability

Nannyberry

Viburnum lentago L.

Crop intervals
- annual

Flowering habit
- perfect, flowering May to June

Forecasting
When to forecast
- last week of June to first week of July

What to look for
- fruit clusters that are green and newly formed

Forecasting notes
- nannyberry occurs naturally in low, wet areas

Collecting
When to collect
- mid-September to mid-October

Description of ripe fruit and mature seed
- fruits are berries that consist of a moist outer pulp surrounding a single seed
- ripe berries are blue-black in colour
- seeds are thin, flat, rounded, and 8 mm to 12 mm in diameter
- mature seed has a yellow seed coat with brown spots

Collection methods
- collect ripe berries by stripping onto ground sheets or by hand-picking directly into picking bags

Forecasting

Collecting

Collection notes

- be sure of species identification
- wait until berries soften before collecting
- once softened, collect promptly to avoid excessive losses to birds

Field storage and transportation procedures

- if possible, berries should be shipped immediately to the processing centre
- for shipping, berries should be placed in plastic bags inside burlap bags
- berries should not be left in bags for long periods of time because the juices may ferment and heat, causing damage to the seed
- if immediate shipment is not possible, **berries should be placed in tubs of cold water**
- do not allow berries to dry out

American High-bush Cranberry

Viburnum trilobum L.

Crop intervals
- annual

Flowering habit
- perfect, flowering May to June

Forecasting

When to forecast
- last week of June to first week of July

What to look for
- fruit clusters that are green and newly formed

Forecasting notes
- this species is easily confused with European high-bush cranberry (viburnum opulus)
- American high-bush cranberry is found naturally in low, wet areas and along riverbanks

Rechecking
- check in late July because seed can abort quickly

Collecting

When to collect
- mid-September to late October

Description of ripe fruit and mature seed
- fruits are berries that consist of a fleshy outer pulp surrounding a single seed
- ripe berries are bright red, juicy, and occur in clusters
- seeds are thin, flat, rounded, and 8 mm to 12 mm in diameter
- mature seed has a pink seed coat

Forecasting

Collecting

Collection methods

- collect ripe berries by stripping onto ground sheets or by hand-picking directly into picking bags

Collection notes

- wait until berries soften before collecting
- once softened, collect promptly to avoid excessive losses to birds

Field Storage and transportation procedures

- if possible, berries should be shipped immediately to the processing centre
- for shipping, berries should be placed in plastic bags inside burlap bags
- berries should not be left in bags for long periods of time because the juices may ferment and heat, causing damage to the seed
- if immediate shipment is not possible, **berries should be placed in tubs of cold water**
- do not allow berries to dry out

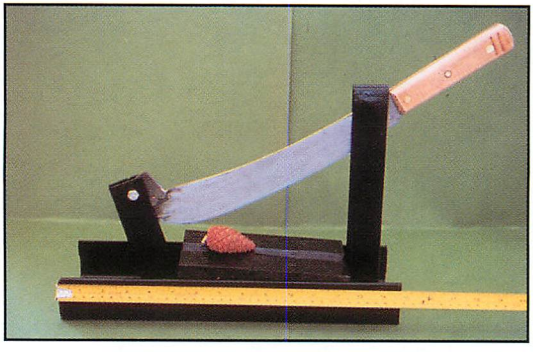
Appendix I:

The Cutting Test

Since insect damage may not be immediately evident, using the cutting test procedure ensures the quality of seed to be collected or purchased.

The cutting test is done by using a cutting knife (as shown below) to cut the cone in half, lengthwise along its axis. Halving the cone or seed allows you to examine seed maturity, presence of internal insect damage and estimate seed yield per cone in the case of conifers. This test should be done before any collections or purchases are made to ensure that cones or other such seed encasements (e.g. nuts or acorns) are not empty and contain viable seed.

Potential yield per cone can be determined by counting the number of seeds visible in one half and multiplying by a factor of four.



Red Pine

Red Oak

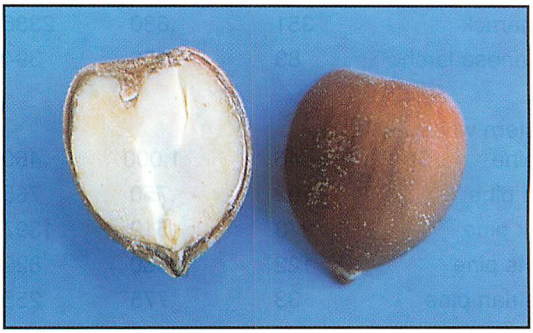


Table 2: Half Section Evaluation

Species	Un-acceptable	Discretionary (purchase/collection)	Acceptable
European larch	0-2	3-5	6+
Tamarack	0-1	—	2+
Japanese larch	0-2	3-5	6+
Norway spruce	0-5	6-10	11+
White spruce	0-3	4-9	10+
Black spruce	0-2	3-5	6+
Jack pine	—	—	—
Austrian pine	0-3	4-9	10+
Red pine	0-2	3-7	8+
White pine	0-3	4-9	10+
Scots pine	0-2	3-7	8+
*White cedar	—	—	5+
Hemlock	0-1	2-3	4+

*Cutting test not practical; for yield evaluation cone should be broken apart completely and number of the full seed counted for entire cone.

Appendix II:

Seed Yield By Species

Table 3: Seed Yield for Some Conifer Species

Species	Average viable Seed per Gram* (across seed sizes)	Yield Per Hec. Kg.	Average viable Seed per Hectolitre
European larch	61	.453	27633
Tamarack	351	.680	238680
Japanese larch	83	.956	39491
Eastern white pine	46	1.000	46000
Red pine	102	.750	76500
Jack pine	273	.512	139776
Scots pine	122	.680	82960
Austrian pine	33	.775	25575
Norway spruce	99	.950	94050
Black spruce	888	.500	444000
Red spruce	287	.826	237062
White spruce	391	.900	351900
Hemlock	188	1.740	327120
Northern white cedar	520	1.230	639600

* Provincial averages calculated using cumulative inventory data from 1955 to 1994 inclusive.

Source: Ontario Tree Seed Plant
Ministry of Natural Resources,
Angus, Ontario

Table 4: Seed Yields for Some Hardwood Species

Species	Average viable Seed per Gram* (across seed sizes)	Yield Per Hec. Kg.	Average viable Seed per Hectolitre
Hard (sugar) maple	566(L)	—	56600
Juneberry	125	1.229	10997
Yellow birch	467	2.000	934000
White birch	1057	2.750	2906750
Caragana	35	—	95494
White ash	1361(L)	—	131600
Tulip tree	1	—	10997
Black locust	43	1.495	46956
Bitternut hickory	106.2(L)	—	10625
Shagbark hickory	113.8(L)	—	11388
Red Osier Dogwood	33	6.450	212850
Multiflora rose	81	—	300090
Showy mountain ash	65	.482	13094
Nannyberry	8	4,715	22878
American high-bush cranberry	17	4.000	68000
Red oak	110.1(L)	—	11011

* Provincial averages calculated using cumulative inventory data from 1955 to 1994 inclusive.

Source: Ontario Tree Seed Plant
Ministry of Natural Resources,
Angus, Ontario

Appendix III:

Standard for Defining a Point Location

(Corporate Explanation)

PURPOSE:

To provide a common means of defining a point location.

APPLICATION:

This standard applies to application development projects that require the sharing of geographic data or the transfer of data between conventional and geographic information systems.

SCOPE:

This standard defines a method of specifying the position of a geographic point, such as a mine entrance or a point within a lake boundary.

It is not intended that the standard be used to define the vertices of a polygon which represents the boundary of a feature as used in a geographic information system. Such vertices will normally have been created by a digitization process and will be stored in a format defined by the GIS.

STANDARD:

The standard is based on the 6 degree UTM reference system, adopted as a Provincial standard in 1974. Staff who are not familiar with the UTM system are referred to "The Ontario Geographic Referencing Grid".

The location information should be stored using the following field (column) definitions:

UTM_ZONE	NUMBER (2)
UTM_EASTING	NUMBER (6)
UTM_NORTHING	NUMBER (7)
UTM_ACCURACY _CODE	CHAR (1)
UTM_DATUM	CHAR (5)

UTM_ZONE

Zone number (6 degrees longitude in width):

15	Between Long. 96 and 90 W
16	Between Long. 90 and 84 W
17	Between Long. 84 and 78 W
18	Between Long. 78 abd 72 W

UTM_EASTING

Vertical lines, or eastings, are measured from a point within each zone. As each zone is 6° of longitude apart (approx. 1,000,000 mtrs wide), the central meridian in each zone is given a value of 500,000. This means that eastings with a value of <500,000 metres are located to left of the meridian and those with a value of >500,000 metres are located to the right of the meridian. Eastings will be recorded using five digits.

UTM_NORTHING

Northings, or the horizontal lines on the grid, represent a distance in metres from the equator. As the southernmost point in Canada is about 4,620,000 metres from the equator, all horizontal lines (northings) have a value greater than that figure. Northings will be recorded using 6 digits.

ACCURACY_CODE

The level of accuracy of the Easting and Northing data:

		Easting	Northing
0	1 m accuracy		
1	10 m accuracy	48157	502759
2	100 m accuracy	48150	502750
3	1 km accuracy	48100	502700
4	over 1 km accuracy	48000	502000

UTM_DATUM

The UTM coordinates of a point are usually determined from a grid printed on the Federal NTS and on the OBM series of maps. The position and numbering of the grid on the map sheet is determined on the basis of the position of the map relative to a geodetic datum. Most maps are based upon a datum known as the North American 1927 Datum (NAD27). There has been a revision to the datum (known as the 1983 datum (NAD83), and this will lead to a revised grid on future maps. This could result in discrepancies of up to 200m between the two versions. For example, if someone was trying to find a mineshaft using coordinates based on the 1927 datum but was using a map based on the 1983 datum, the coordinates could suggest that the shaft was on the wrong side of a lake.

Eventually, all maps will be based upon the NAD83 and all coordinates will be consistent. In the interim, however, it is important that we know the datum on which the coordinates were developed and the datum code is included for this purpose.

The datum on which a map is based is shown on the bottom of the map. All current maps are based on the NAD27 datum. Maps marked NAD83 are based on the 1983 datum.

DATUM CODE

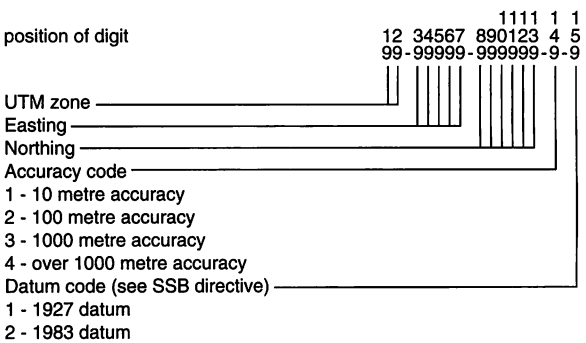
TYPE	*CODE*
NAD 27 (1927 Datum)	1
NAD 83 (1983 Datum)	2

Operational Explanation

Presently the U.T.M. reference is being electronically recorded at the Ontario Tree Seed Plant in a 13 digit characture format ie:

17	58200	490200
Zone	Easting	Northing

The location of a point on the ground is defined by a 15 digit string:



There are 4 UTM zones in Ontario; 15, 16, 17 and 18 and they are 6 degrees of longitude wide (see figure 11).

Easting is the easterly distance from the grid origin on the central meridian of the UTM zone.

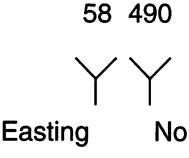
Northing is the northerly distance from the grid origin on the equator.

The grid origin is at the intersection of the central meridian of the UTM zone and the equator. In order to prevent negative numbers for the co-ordinate values, the origin is assigned an easting value of 500 000 metres.

UTM grid co-ordinates are expressed in metres.

For the purposes of forestry the datum code may be ignored and the accuracy code does not have to be shown in most applications if the accuracy convention is used.

The level of accuracy required for collections of seed/cone is established through the program type. For most collections an accuracy level of 10,000 metres is sufficient and can be defined quite easily using the O.M.N.R. Fire Grid Maps, 1:600,000 scale. Each grid on the map sheet will have in it a 5 digit number. This number is the U.T.M. reference for the SW corner of the grid, ie:



For collections that require a greater degree of accuracy, larger scale maps should be referenced, ie:

Topographical Maps	1:50,000
Ont. Base Maps (OBM)	1:10,000

Each zonal associate specialist will identify the U.T.M. reference procedure to the Co-op membership, thereby ensuring the use and understanding of the U.T.M. information. The U.T.M. reference is an important element to the origin of our seed and accurate information is required.

Figure 11. U.T.M. Zones and Central Meridians for Canada

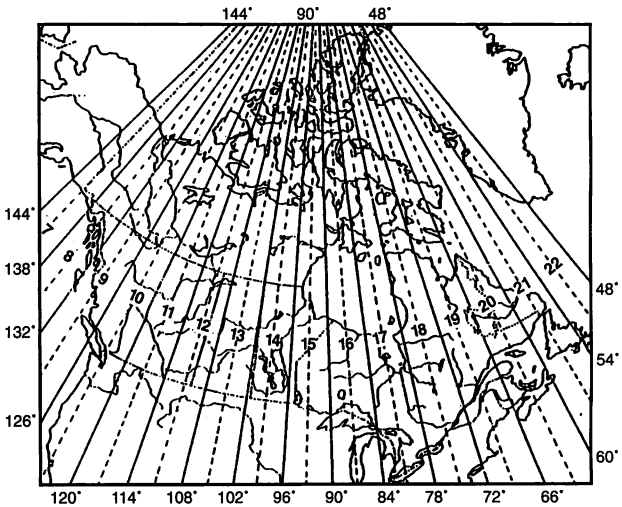


Table 5: Species Codes

Sorted by Number Code

1	Pw	pine, white	Pinus strobus
2	Pr	pine, red	Pinus resinosa
3	Pj	pine, jack	Pinus banksiana
4	Ps	pine, scots	Pinus sylvestria
5	Pp	pine, pitch	Pinus rigida
6	Pa	pine, Austrian	Pinus nigra
11	P	pine, all	Pinus app.
12	Sw	spruce, white	Picea glauca
13	Sb	spruce, black	Picea mariana
14	Sr	spruce, red	Picea rubens
15	Sn	spruce, Norway	Picea abies
18	S	spruce, all	Picea spp.
19	He	hemlock, eastern	Tsuga canadensis
20	Bf	fir, balsam	Abies balsamea
21	—	fir, douglas	Pseudotsuga menziesii
22	Cw	cedar, white	Thuja occidentalis
23	Cr	cedar, eastern red	Juniperus virginiana
24	Ce	cedar, all	Thuja app.
25	La	tamarack	Larix laricina
26	Le	larch, European	Larix decidua
27	Lj	larch, Japanese	Larix leptolepis
28	OC	conifers, other	———
29	Lk	larch, dunkeld	Larix eurolepis*
30	Mh	maple, sugar (hard)	Acer saccharum
31	—	maple, soft	———
32	Mr	maple, red	Acer rubrum
33	Ms	maple, silver	Acer saccharinum
34	Mn	maple, Norway	Acer platanoides
35	Lh	larch, hybrid	Larix X
36	M	maple, all	Acer. spp.
37	By	birch, yellow	Betula alleghaniensis
38	Bw	birch, white	Betula papyrifera
39	Os	oak, shumard	Quercus shumerdii
40	Ow	oak, white	Quercus alba
41	Or	oak, red	Quercus rubra
42	Ob	oak, burr	Quercus macrocarpa
43	O	oak, all	Quercus spp.
44	Be	beech, American	Fagus grandifolia
45	Ab	ash, black	Fraxinus nigra
46	Aw	ash, white	Fraxinus americana
47	Ag	ash, red (or green)	Fraxinus pennsylvanica
48	A	ash, all	Fraxinus spp.
49	Em	elm, all	Ulmus, sp

Table 5: Species Codes (cont'd)

Sorted by Number Code

50	Ea	elm, American	Ulmus americana
51	Bd	basswood	Tilia americana
52	Bg	birch, dwarf white	Betula glanbulosa*
53	Hi	hickory, all	Carya spp.
54	Wb	walnut, black	Juglans nigra
55	Bn	butternut	Juglens cinerea
56	Id	ironwood	Ostrya virginiana
57	Sy	sycamore	Platanus occidentalis
58	Cb	cherry, black	Prunus serotina
59	—	brush	———
60	Tp	tulip tree	Liriodendron tulipifera
61	Lb	locust, black	Robinia pseudoacacia
62	Wi	willow, all	Salix app.
63	Ww	willow, white	Salix alba
64	We	willow, weeping	Salix babylonica
65	Wl	willow, laurel	Salix pentandra
66	OH	hardwoods, other	———
67	Ba	alder, black (or European)	Alnus glutinosa*
68	Hk	hackberry	Celtis occidentalis*
69	Hc	chestnut, horse	Aesculus hippocastanum*
70	Al	aspen, largetooth	Populus grandidentata
71	Pd	cottonwood	Populus deltoides
72	Pc	poplar, carolina	Populus X canadensis
73	Pb	poplar, balsam	Populus balsamifera
74	At	aspen, trembling	Populus tremuloides
75	Po	poplar, all	Populus spp.
76	Pl	poplar, silver	Populus alba
77	—	catalpa	Catalpa speciosa
78	Ss	sassafras	Sassafras albidum
79	Mp	maple, striped	Acer pensylvanicum*
80	Ga	alder, green	Alnus crispa*
81	Sa	alder, speckled	Alnus rugosa*
82	Hz	hazel, beaked	Corylus cornuta*
83	Mt	maple, mountain	Acer spicatum*
84	Ya	yew, American	Taxus canadensis*
85	—	cedar, himmulayan	Cedrus deodora*
86	Obl	oak, black	Quercus nigra
87	Op	oak, pin	Quercus palustris
88	Osw	oak, swamp white	Quercus bicolor
89	Hp	hickory, pignut	Carya glabra
90	Cm	cherry, mazzard	Prunus avium
91	Oc	oak, chinquapin	Quercus muehlenbergii**

Table 5: Species Codes (cont'd)

Sorted by Number Code

92	Hm	hickory, mockernut	Carya tomentosa**
93	Hl	hickory, big shellbark	Carya laciniosa**
94	Mb	maple, black	Acer nigrum**
95	Gb	ginkgo tree	Ginkgo biloba*
96	Gt	locust, honey (see note)	Gleditsia triacanthos*
97	Ph	poplar, hybrid	Populus
98	—	all species	———
99	H	hardwood, all	———
100	Jc	juniper, common	Juniperus communis
101	Ld	larch, dahurian	Larix gmelini
102	Lw	larch, western	Larix occidentalis
103	Ls	larch, siberian	Larix siberica
104	Sk	spruce, koyama	Picea koyamai
105	—	spruce, Serbian	Picea omorika
106	Sc	spruce, Colorado	Picea pungens
107	—	pine, western white	Pinus monticola
108	Pm	pine, mugho	Pinus mugo
109	—	cedar, western red	Thuja plicata
110	Hw	hemlock, western	Tsuga heterophylia
111	Bu	beech, blue	Carpinus caroliniana**
112	Bc	birch, cherry	Betula lenta**
113	Eb	elderberry, black	Sambucus canadensis*
114	Bh	honeysuckle, bush	Lonicera diervilla*
115	Er	elderberry, red	Sambucus pubens*
116	Ma	maple, amur	Acer ginnala
117	Mm	maple, Manitoba	Acer negundo
118	Bj	juneberry	Amelanchier spp.
119	—	pawpaw	Asimina triloba
120	Bp	birch, European white (weeping)	Betula pendula
121	—	birch, hairy	Betula pubescens
122	Ca	Siberian peashrub	Caragana arborescens
123	Hb	hickory, bitternut	Carya cordiformis
124	Hs	hickory, shagbark	Carya ovata
125	—	redbud	Cercis canadensis
126	—	dogwood, flowering	Cornus florida
127	Dr	dogwood, red osier	Cornus stolonifera
128	Ht	hawthorn	Crataegus spp.
129	Ro	olive, Russian	Elaeagnus angustifolia
130	—	silverberry	Elaeagnus commutata
131	Ao	olive, autumn	Elaeagnus umbellata

Table 5: Species Codes (cont'd)

Sorted by Number Code

132	Aq	ash, blue	Fraxinus quadrangulata
133	Kk	Kentucky coffee tree	Gymnociadus dioicus
134	—	sweet gum	Liquidambar styracifula
135	Ho	honeysuckle	Lonicera tatarica
136	—	cucumber tree	Magnolia acuminata
137	—	black gum	Nyssa sylvatica
138	—	ninebark	Physocarpus opulifolius
139	—	cherry, pin	Prunus pensylvanica
140	Pv	cherry, choke	Prunus virginiana
141	—	hop tree	Ptelea trifoliata
142	Rt	sumac, staghorn	Rhus typhina
143	Rm	rose, multiflora	Rosa multiflora
144	Sm	ash, American mountain	Sorbus americana
145	—	white beam tree	Sorbus aria
146	—	ash, European mountain	Sorbus aucuparia
147	—	ash, showy mountain	Sorbus decora
148	—	spirea, false	Sorbaria sorbifolia
149	Lc	lilac, common	Syringa vulgaris
150	Ll	linden, little leaf	Tilia cordata
151	Rw	wild raisin	Viburnum cassinoides
152	Nb	nannyberry	Viburnum lentago
153	Ch	cranberry, American high-bush	Viburnum trilobum
154	—	cranberry, European high-bush	Viburnum opulus
155	Sq	squash berry	Viburnum edule*
156	Bb	bunchberry	Cornus canadensis*
157	Dg	dogwood, grey	Cornus racemosa*
158	Ds	dogwood, silky or swamp	Cornus amomum*
159	Am	chokeberry, black	Aronia melanocarpa*
160	Mc	apple, Siberian crab	Malus baccata*
161	Mf	apple, Japanese flowering crab	Malus floribunda*
162	Be	snowberry	Symphoricarpos alba*
163	Qj	quince, Japanese	Chaenomeles japonica*
164	Sl	lespedeza shrub	Lespedeza bicolor*
165	Te	linden, Crimean	Tilia X euchlora*

Table 5: Species Codes (cont'd)

Sorted by Number Code

166	Bl	linden, big leaf	Tilia platyphllos*
167	Ft	firethorn, scarlet (see note)	Pyracantha coccines*
168	Br	birch, grey	Betula populifolia**
169	Eu	elm, rock	Ulmus rubra**
170	Es	elm, red (slippery)	Ulmus thomasil**
171	Cd	chestnut, american	Castanea dentata**
172	Cs	chestnut, sweet	Castanea satvia**
173	Rf	Glossy Buckthorn	Rhamnus frangula
174	Cc	cherry, sour	Prunus cerasus**
175	Mo	mulberry, red	Morus rubra**
176	Ap	ash, pumpkin	Fraxinus profunda

Sorted by Alpha Code

48	A	ash, all	Fraxinus spp.
45	Ab	ash, black	Fraxinus nigra
47	Ag	ash, red (or green)	Fraxinus pennsylvanica
70	Al	aspen, largetooth	Populus grandidentata
159	Am	chokeberry, black	Aronia melanocarpa*
131	Ao	olive, autumn	Elaeagnus umbellata
176	Ap	ash, pumpkin	Fraxinus profunda
132	Aq	ash, blue	Fraxinus quadrangulata
74	At	aspen, trembling	Populus tremuloides
46	Aw	ash, white	Fraxinus americana
67	Ba	alder, black (or European)	Alnus glutinosa*
156	Bb	bunchberry	Cornus canadensis*
112	Bc	birch, cherry	Betula lenta**
51	Bd	basswood	Tilia americana
44	Be	beech, American	Fagus grandifolia
20	Bf	fir, balsam	Ables balsamea
52	Bg	birch, dwarf white	Betula glanbulosa*
114	Bh	honeysuckle, bush	Lonicera diervilla*
118	Bj	juneberry	Amelanchler spp.
166	Bl	linden, big leaf	Tilia platyphyllos*
55	Bn	butternut	Juglans cinerea
120	Bp	birch, European white (weeping)	Betula pendula
168	Br	birch, grey	Betula populifolia**
162	Be	snowberry	Symphoricarpos alba*
111	Bu	beech, blue	Carpinus caroliniana**
38	Bw	birch, white	Betula papyrifera
37	By	birch, yellow	Betula alleghaniensis
122	Ca	Siberian peashrub	Caragana arborescens
58	Cb	cherry, black	Prunus serotina
174	Cc	cherry, sour	Prunus cerasus**

Table 5: Species Codes (cont'd)

Sorted by Alpha Code

24	Ce	cedar, all	Thuja spp.
153	Ch	cranberry, American high-bush	Viburnum trilobum
90	Cm	cherry, mazzard	Prunus avium
23	Cr	cedar, eastern red	Juniperus virginiana
172	Cs	chestnut, sweet	Castanea satvia**
22	Cw	cedar, white	Thuja occidentalis
157	Dg	dogwood, grey	Cornus racemosa*
127	Dr	dogwood, red osier	Cornus stolonifera
158	Ds	dogwood, silky or swamp	Cornus amomum*
50	Ea	elm, American	Ulmus americana
113	Eb	elderberry, black	Sambucus canadensis*
49	Em	elm, all	Ulmus, spp.
115	Er	elderberry, red	Sambucus pubens*
170	Es	elm, red (slippery)	Ulmus thomasii**
169	Eu	elm, rock	Ulmus rubra**
167	Ft	firethorn, scarlet (see note)	Pyracantha coccines*
80	Ga	alder, green	Alnus crispa*
95	Gb	ginkgo tree	Ginkgo biloba*
96	Gt	locust, honey (see note)	Gleditsia triacanthos*
99	H	hardwood, all	
123	Hb	hickory, bitternut	Carya cordiformis
69	Hc	chestnut, horse	Aesculus hippocastanum*
19	He	hemlock, eastern	Tsuga canadensis
53	Hi	hickory, all	Carya spp.
68	Hk	hackberry	Celtis occidentalis*
93	Hl	hickory, big shellbark	Carya laciniosa**
92	Hm	hickory, mockernut	Carya tomentosa**
135	Ho	honeysuckle	Lonicera tatarica
89	Hp	hickory, pignut	Carya glabra
124	Hs	hickory, shagbark	Carya ovata
128	Ht	hawthorn	Crataegus spp.
110	Hw	hemlock, western	Tsuga heterophylia
82	Hz	hazel, beaked	Corylus cornuta*
56	Id	ironwood	Ostrya virginiana
100	Jc	juniper, common	Juniperus communis
133	Kk	Kentucky coffee tree	Gymnociadus dioicus
25	La	tamarack	Larix laricina
61	Lb	locust, black	Robinia pseudoacacia
149	Lc	lilac, common	Syringa vulgaris
101	Ld	larch, dahurian	Larix gmelini

Table 5: Species Codes (cont'd)

Sorted by Alpha Code

26	Le	larch, European	Larix decidua
35	Lh	larch, hybrid	Larix X
27	Lj	larch, Japanese	Larix leptolepis
29	Lk	larch, dunkeld	Larix eurolepis*
150	Ll	linden, little leaf	Tilia cordata
103	Ls	larch, siberian	Larix siberica
102	Lw	larch, western	Larix occidentalis
36	M	maple, all	Acer spp.
116	Ma	maple, amur	Acer ginnala
94	Mb	maple, black	Acer nigrum**
160	Mc	apple, Siberian crab	Malus baccata*
161	Mf	apple, Japanese flowering crab	Malus floribunda*
30	Mh	maple, sugar (hard)	Acer saccharum
117	Mm	maple, Manitoba	Acer negundo
34	Mn	maple, Norway	Acer platanoides
175	Mo	mulberry, red	Morus rubra**
79	Mp	maple, striped	Acer pensylvanicum*
32	Mr	maple, red	Acer rubrum
33	Ms	maple, silver	Acer saccharinum
83	Mt	maple, mountain	Acer spicatum*
152	Nb	nannyberry	Viburnum lentago
43	O	oak, all	Quercus spp.
42	Ob	oak, burr	Quercus macrocarpa
86	Obl	oak, black	Quercus nigra
91	Oc	oak, chinquapin	Quercus muehlenbergil**
28	OC	conifers, other	———
66	OH	hardwoods, other	———
87	Op	oak, pin	Quercus palustris
41	Or	oak, red	Quercus rubra
39	Os	oak, shumard	Quercus shumardii
88	Osw	oak, swamp white	Quercus bicolor
40	Ow	oak, white	Quercus alba
11	P	pine, all	Pinus spp.
6	Pa	pine, Austrian	Pinus nigra
73	Pb	poplar, balsam	Populus balsamifera
72	Pc	poplar, carolina	Populus X canadensis
71	Pd	cottonwood	Populus deltoides
97	Ph	poplar, hybrid	Populus
3	Pj	pine, jack	Pinus banksiana
76	Pl	poplar, silver	Populus alba
108	Pm	pine, mugho	Pinus mugo
75	Po	poplar, all	Populus spp.
5	Pp	pine, pitch	Pinus rigida
2	Pr	pine, red	Pinus resinosa
4	Ps	pine, scots	Pinus sylvestria

Table 5: Species Codes (cont'd)

Sorted by Alpha Code

140	Pv	cherry, choke	Prunus virginiana
1	Pw	pine, white	Pinus strobus
163	Qj	quince, Japanese	Chaenomeles japonica*
173	Rf	Glossy Buckthorn	Rhamnas frangula
143	Rm	rose, multiflora	Rosa multiflora
129	Ro	olive, Russian	Elaeagnus angustifolia
142	Rt	sumac, staghorn	Rhus typhina
151	Rw	wild raisin	Viburnum cassinoides
18	S	spruce, all	Picea spp.
81	Sa	alder, speckled	Alnus rugosa*
13	Sb	spruce, black	Picea mariana
106	Sc	spruce, Colorado	Picea pungens
104	Sk	spruce, koyama	Picea koyamai
164	Sl	lespedeza shrub	Lespedeza bicolor*
144	Sm	ash, American mountain	Sorbus americana
15	Sn	spruce, Norway	Picea abies
155	Sq	squash berry	Vibernum edule*
14	Sr	spruce, red	Picea rubens
78	Ss	sassafras	Sassafras albidum
12	Sw	spruce, white	Picea glauca
57	Sy	sycamore	Platanus occidentalis
165	Te	linden, Crimean	Tilia X euchlora*
60	Tp	tulip tree	Liriodendron tulipifera
54	Wb	walnut, black	Juglans nigra
64	We	willow, weeping	Salix babylonica
62	Wi	willow, all	Salix, spp.
65	Wl	willow, laurel	Salix pentandra
63	Ww	willow, white	Salix alba
84	Ya	yew, American	Taxus canadensis*
21	—	fir, douglas	Pseudotsuga menziesii
31	—	maple, soft	———
59	—	brush	———
77	—	catalpa	Catalpa speciosa
85	—	cedar, himmulayan	Cedrus deodora*
98	—	all species	———
105	—	spruce, Serbian	Picea omorika
107	—	pine, western white	Pinus monticola
109	—	cedar, western red	Thuja plicata
119	—	pawpaw	Asimina triloba
121	—	birch, hairy	Betula pubescene
125	—	redbud	Cercis canadensis
126	—	dogwood, flowering	Cornus florida
130	—	silverberry	Elaeagnus commutata
134	—	sweet gum	Liquidambar styracifula

Table 5: Species Codes (cont'd)

Sorted by Alpha Code

136	—	cucumber tree	Magnolia acuminata
137	—	black gum	Nyssa sylvatica
138	—	ninebark	Physocarpus opulifolius
139	—	cherry, pin	Prunus pensylvanica
141	—	hop tree	Ptelea trifoliata
145	—	white beam tree	Sorbus aria
146	—	ash, European mountain	Sorbus aucuparia
147	—	ash, showy mountain	Sorbus decora
148	—	spirea, false	Sorbaria sorbifolia
154	—	cranberry, European high-bush	Viburnum opulus

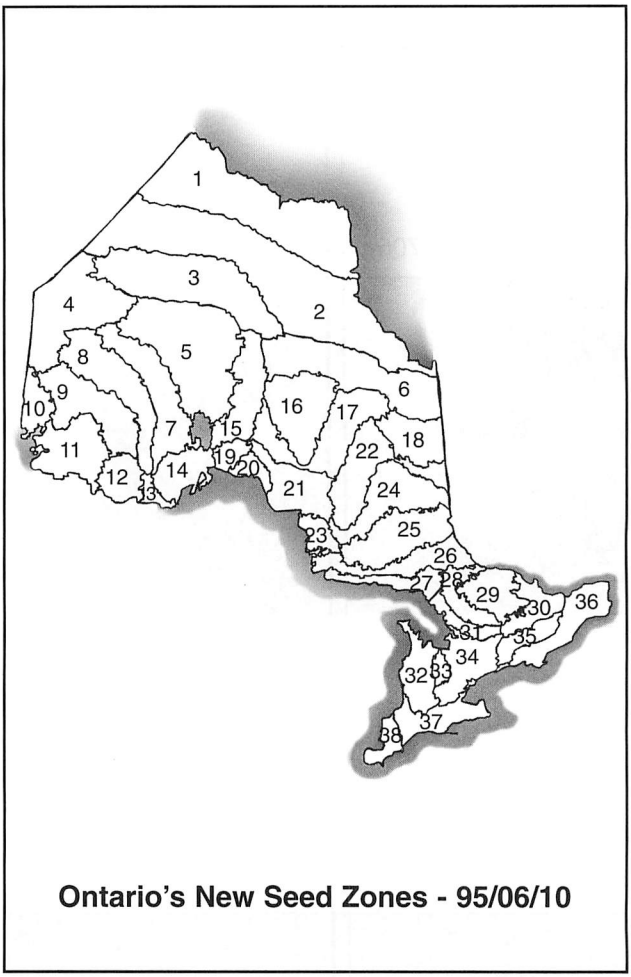
*New species added to list at previous updates

**New species added to list at current update

Note: Full Latin binomials for the following are:

honey locust	Gleditsia triacanthos var. inermis
scarlet firethorn	Pyracantha coccinea "Lalandei"

Figure 12.
Map of Seed Zones in Ontario

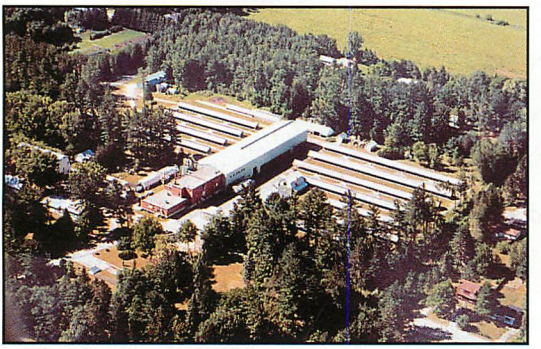


Appendix IV:

Addresses of MNR Seed Processing Facilities

Ontario Tree Seed Plant
King Street
P.O. Box 70
Angus, Ontario
L0M 1B0

Superintendent: (705) 424-5311



Wabigoon Nursery
P.O. Box 90
Wabigoon, Ontario
P0V 2W0

Superintendent: (807) 938-6326

Cone Shipping Summary: *See Reverse for Additional Information*

SHIP TO:
(check one)

___Ontario Seed Plant
King Street Angus, Ontario L0M 1B0
Phone: 705-424-5311
Fax: 705-424-9282

___Dryden Seed Plant
Wabigoon, Ontario P0V 2W0
Phone: 807-968-6326
Fax: 807-938-6430

___Other (please specify)
_____
_____
_____

Field Location Shipped From: _____ **Name of Shipper (contact person):** _____ **Telephone #** _____

Method of Shipment: _____ **Date Shipped:OTIB Zone** (Circle One) **1, 2, 3, 4, 5, 6,** **Crop Year:** _____

Species	Seed Zone	Ownership	Collection Area	UTM	Picking Method (circle choice)	Total Quantity Shipped (hl)	# Of Containers Shipped (circle choice)	Processing Option (circle choice)		
					Machine / Hand		Bags- Trays-	Basic / Standard / Enhanced		
					Machine / Hand		Bags- Trays-	Basic / Standard / Enhanced		
					Machine / Hand		Bags- Trays-	Basic / Standard / Enhanced		
					Machine / Hand		Bags- Trays-	Basic / Standard / Enhanced		
					Machine / Hand		Bags- Trays-	Basic / Standard / Enhanced		
					Machine / Hand		Bags- Trays-	Basic / Standard / Enhanced		
					Machine / Hand		Bags- Trays-	Basic / Standard / Enhanced		
					Machine / Hand		Bags- Trays-	Basic / Standard / Enhanced		

95/09/27

New Seed Source Numbering System: *Explanation and Example*

SPECIES 3-digit code	***SEED ZONE*** 2-digit code (1 to 38)	***OWNERSHIP*** 3-digit code (100 to 999)	***COLLECTION AREA*** 2-digit code (01 to 99)	***UTM*** 13-digit code
003	**25**	**571**	**02**	**17-48600-520400**
Jack Pine		**OTIB Zone 5 E.B. Eddy - 71**	**Gene Pool Reserve**	**Standard UTM Grid Reference Code**
Species code has not changed	Code is used to identify the seed zone in which the seed was collected. Each seed zone represents a homogenous climactic region within the province.	Code is used to identify the seed ownership. Within each Zonal Seed Management Assoc. each agency has been assigned an ownership code.	Collection Area code has not changed. Code continues to follow the numerical codes identified in Procedure FR11.01.10. Examples of collection area include general collections, gene pool reserves, seed production areas, seed orchards and special collection areas.	UTM - "Defined As" the location of a point on the ground, therefore the geographic location of the collection is recorded more precisely.

Shipping Notes: "Please ensure all bags/trays are correctly tagged and labeled"

Bags: Ship all bags on pallets
60 litres max/bag
Mega bags available upon request for Jack Pine - 15.00 hl max/bag

Trays: Volumes/Tray as follows;

Pw 30 li.	Pr 30 li.	Ps 40 li.	Pa 30 li.	Sw 30 li.
Sb 30 li.	Sr 30 li.	Sn 30 li.	He 20 li.	Cw 20 li.
La 20 li.	Le 40 li.	Lj 40 li.		

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Glossary

Achene
a small dry indehiscent fruit

Angiosperm
woody or herbaceous plants: ovules completely enclosed in an ovary which is usually crowned by a style and stigma. Microspores (pollen grains) adhere to stigma; fertilization effected by means of a pollen tube; xylem containing vessels

Anther
the part of the stamen containing pollen grains

Archegonium
the structure in the flower, containing the female sexual cell

Axil
the junction of leaf and stem at the position nearest the tip of the stem

Berry
a fleshy fruit, usually several seeded, without a stoney layer surrounding the seeds

Bract
a modified leaf which extends underneath a scale in female cones

Caseharden
inability of cone scales to reflex, caused by rapid drying of the outer layers while the inner layers remain moist, thereby preventing the further exit of moisture

Cataphyll
early leaf form of a plant, e.g. cotyledon, bud scales

Catkin
see Strobilus

Cone
the reproductive structure of conifers (see also Pollen cone, Seed cone).

Cotyledons
primary leaves of an embryo or seedling which degenerate soon after the plant produces the first true leaves

Cultivar
plant variety, resulting from breeding, and/or selection and/or cultivation; conventionally denoted by species name, followed by "cv" and cultivar name

Dehiscent
opening when dry to shed seed or spores

Dioecious
having sexes on different plants

Dominant (trees)
the tallest, largest-crowned trees in closed canopy woodland

Dormancy
a physiological state in which a seed that is capable of germination does not germinate, even in the presence of favourable environmental conditions

Drupe
a more or less fleshy fruit, with usually one (sometimes more) seeds each surrounded by a stoney layer

Embryo
the product of fusion of a male gamete with an ovule during fertilization. In conifers, the embryo is enclosed by storage tissue and the seedcoat, and under favourable conditions grows into a new plant

Empty seed
a seed that does not contain all tissues essential for germination

Endosperm
a commonly used, but incorrect, term applied to the nutrient storage tissue surrounding the embryo in gymnosperm seeds. This tissue, which is the megametophyte, serves the same function as the endosperm of angiosperm seeds. However, fertilization is not required for this tissue to form in gymnosperm seeds

Fertilization
penetration of a pollen tube into the ovule and union of the male and female nucleii

Filled seed
a seed containing all tissues essential for germination. (Also used in cone evaluation to describe a seed containing storage tissue, but not necessarily an embryo, since the latter is not checked for).

Forest Reproductive Material
seed, cones and parts of plants intended for the production of plants; also young plants raised from seed or from parts of plants.

Genetic qualities
qualities derived from the inherited characteristics of an individual tree

Genetic variability
the presence in a species of different grades of the same characteristic which allows selection and breeding for that characteristic to be carried out

Genetically improved
possessing qualities derived from inherited characteristics, which qualities are superior to the average for a population as a whole

Genotype
an individual organism's hereditary constitution which may or may not be expressed phenotypically

Germination
growth of an embryo resulting in its emergence from the seed

Gymnosperm
wood plants; ovules not enclosed in ovary; xylem without vessels

Hectare
metric unit for measuring land area 1 hectare = 2.47 acres

Hectolitre
metric unit for measuring cone in some European countries; equal to 100 litres or 2.74 bushels

Heritability
the ability of a particular characteristic to be inherited in subsequent progeny

Hybrid vigour
the increased vigour often resulting from the crossing of two closely related but distinct species

Indigenous
of a stand of trees, native to the locality

Integument
the layer of tissue in conifers that encloses the nucleus of an ovule, and which develops into the seedcoat. A protective structure that develops from the base of an ovule and encloses it almost entirely, except for an opening, the micropyle, at the tip of the nucellus

Inter-fertile
the ability of individuals to breed with one another

Internode
the part of a plant stem separating two distinct whorls of branches

Megagametophyte
haploid nutrient storage tissues in coniferous seeds. This tissue is often mistakenly called the "endosperm" in conifers.

Megasporangia
ovules

Micropyle
small channel between the tips of the integument at the apex of the ovule, through which the pollen tube travels, prior to fertilization

Microsporangia
pollen sacs

Microsporophyll
modified leaf, or scale, bearing microsporangia

Monoecious
having both sexes on the same plant

Native
not known to have been introduced by human agency

Normal seed stand
a seed stand in which between 25 and 50% of the dominant trees are healthy and have straight stems and good well shaped crowns. This term was used prior to the introduction of the Forest Reproductive Material Regulations 1973.

Nut
fruit with a bony, woody, leathery or papery pericarp; usually one-seeded and partially or wholly enclosed in a husk (involucre).

Origin
place in which an indigenous stand of trees is growing, or the place from which a non-indigenous stand was originally introduced

Ovule
a female organ surrounded by integument, within which an egg cell is produced, and which matures into a seed following fertilization

Pericarp
outer structure of maturing fruit

Periodicity
the interval (in years) between good cone crops. Some trees in a stand, or area, may bear cones every year, but heavy crops are periodic, usually occuring several years apart

Phenotype
all characteristics - morphological, anatomical, and physiological - of a plant, determined by the interaction between genotype and environment

Phenotypic qualities
qualities resulting from the response of trees to the local site and environment

Phytosanitary Certificate
certificate issued as a result of a test carried out to ascertain that seed or plants are free from general or specific disease organisms not endemic in or desired to be introduced into another country. May only be issued after quarantine or disinfection. Also known as Health Certificate.

Pistil
structure comprising stigma and style

Placenta
the part of an ovary to which the ovules are attached

Plus seed stand
see Almost plus and Normal seed stands. Over 75% dominant trees

Pollen cone
the male reproductive structure of conifers, which produces pollen grains. It consists of an axis bearing spirally arranged scales, each of which supports two pollen sacs containing pollen

Pollination
the transfer of pollen from the pollen cone to the receptive part of the seed cone

Polygamo-Dioecious
applies to species that are functionally dioecious, but having a few bisexual flowers on some of the male-flowering plants as well as on some female-flowering
plants

Polygamo-Monoecious
pertains to species that are functionally monoecious but having a few bisexual flowers on some individual plants that also bear unisexual flowers

Polygamous
having both bisexual and unisexual flowers on the same plant or on different plants of the same species; pertains to species having mostly bisexual flowers

Pome
fruit consisting of an enlarged fleshy receptacle surrounding the pericarp

Primordia
rudimentary structures; structures at their earliest stages of development. The earliest identifiable tissues which subsequently develop into leaf, flower, etc.

Provenance
the place in which any stand of trees, whether indigenous or non-indigenous, is growing

Purity
the amount of pure seed of the specified species in a seed lot expressed as a percentage of the bulk seed

Recalcitrant seed
term used to describe a seed that does not obey the normal seed storage principles that the drier the seed and the cooler it is kept the longer it will maintain its viability. Seeds which conform to the principle are called orthodox seeds

Region of Provenance
for a species, sub-species or variety, the area or group of areas subject to practically uniform ecological conditions, in which are found stands showing similar phenotypic or genetic characteristics; for a seed orchard, the region of provenance of the material used for the establishment of that seed orchard

Resin Duct
a lengthwise or transverse canal carrying resins

Resinous
secreting a viscid exudate

Samara
dry indehiscent fruit, part of the wall of which forms a wing

Seed
a matured ovule containing an embryo and nutritive tissue enclosed by a protective seedcoat, which is capable of developing into a plant under suitable conditions

Seed cone
the female reproductive structure of conifers, which produces seeds. It consists of an axis that supports spirally-arranged bracts, with ovuliferous scales at the base of each bract. Two ovules, which become seeds after fertilization occurs, are attached to the upper surface of each ovuliferous scale

Seed orchard
specially selected collection of trees, planted in an orchard fashion, established to produce seeds, usually of improved genetic quality. Seed orchards may be clonal (ie. propagated from scions and produced from grafts or rooted cuttings) or seedling (i.e. propagated from seeds). An orchard may be described as first generation (from untested "natural stand" parents) or as advanced generation (the offspring of superior parents selected from a genetic test plantation). Some orchards may be established to produce seeds of species that do not produce adequately in natural stands

Seed planning zone
in accordance with seed transfer rules, an area throughout which seeds of a given provenance may be transferred and in which the resulting seedlings can be expected to perform adequately

Seed production stand
a forest stand reserved and managed as a source of seeds

Seed source
the place (latitude, longitude, and elevation) at which seeds are collected. The source of a seed collection may not be identical with its provenance

Seed zone
a geographic area usually delimited by some natural boundary and showing nearly uniform ecological conditions in which trees of a given species are regarded as distinct from those in neighbouring zones. Widely used in North America in natural forest stands

Seedcoat
the protective outer layer of a seed derived from the integument of the ovule

Seedling orchard
an orchard laid down for seed production but produced from seedlings raised from seed and not clonally by vegetative means

Seed lot
a quantity of seeds of the same species, provenance, date of collection and handling history, and which is identified by a single number

Selected seed stands
seed stands derived from seedling orchards

Serotinous
a term applied to cones that remain on the parent tree, without opening, for a year or more after the seeds inside have matured

Source identified
category of seed certification available in the OECD scheme but not in the EEC which seeks to guarantee that the seed was actually collected in the area or seed-zone specified on the certificate

Specific combining ability
the ability of an individual to pass on a specific good characteristic to all of its progeny

Stamen
male reproductive organ of plant

Staminate
of such organs

Sterile
of seed, not capable of germination; of stamens, not capable of producing viable pollen

Stigma
the receptive surface of the gynoecium to which pollen grains adhere

Strobilus
multiple-seeded fruit with catkin or cone-like structure, e.g. Betula, Alnus

Testa
skin or outer coat of a seed

Viability
the presence in a seed of viable tissue which, provided the appropriate dormancy breaking treatment is experienced, will lead to its germination when conditions permit

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