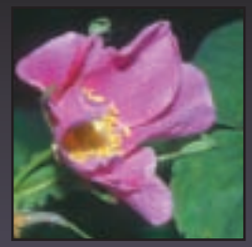
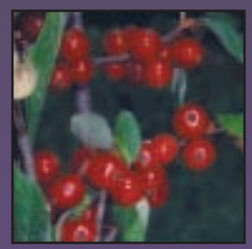
Native Woody Plant Seed Collection Guide *for* BRITISH COLUMBIA





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S. Mishtu Banerjee, Kim Creasey,
and Diane Douglas Gertzen

BRITISH COLUMBIA
Ministry of Forests
Tree Improvement Branch

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This guide, like all field guides, is a labour of love and a community effort. We thank all those who devoted time in finding field sites, editing the text for scientific veracity and practical utility, contributing photos, and accompanying the authors on field trips. While the text conveys basic information on recognizing the plants in various stages, the emphasis is on the pictures, which reflect the changes in a plant through a growing season from flowering stage to fruit maturation. We hope these pictures convey not only useful information, but also a sense of the subtle beauty and intricacy of our familiar native species when examined up close (many of the pictures are shot with a macro lens or through a dissecting microscope). Brian Capon, in his introduction to "Botany for Gardeners," expresses a common sentiment that draws people to the plant world whether as a hobby, as a business, or as a scholarly activity:

> *"Some of us look at plants as a source of livelihood, while others find them intriguing subjects for scientific study. But most enjoy plants for the sheer delight of having them in their every day surroundings, to savor the varied colours, textures, tastes and aromas that they alone can offer. Plants stimulate the senses, give peace to the weary mind and satisfy man's spiritual being in search for answers to the mystery of life."*

Acknowledgements

Numerous individuals contributed to the success of this guide. Penni Adams, David Williams, and Brian Compton provided pictures for the guide, as well as their cheerful company in our hunts for the "perfect" plant photograph. Bobbie Hammersley helped find plants and sites for our trips in the southern interior of British Columbia, reviewed early drafts, and allowed herself to become part of the guide's photo-documentation. Dave Kolotelo reviewed and edited all drafts and assisted with seed dissection photographs. George Douglas, Brian Compton, Douglas Justice, and Tom Wells provided botanical reviews. Shelley Hudson, Don Pigott, and Paulus Vrijmoed kindly reviewed and critiqued the drafts. Satyen Banerjee reviewed drafts, and provided much aid and entertainment during field photography and collection sessions. Wendy Creasey added her unique blend of enthusiasm and support throughout the project. Thanks to Robert Bateman for his words of encouragement. Artur Moeller, Cheryl Calam, Don Summers, Dave Trotter, and Eric van Steenis at Extension Services, Tree Improvement Branch, Ministry of Forests provided much moral support. Thanks to the Nursery and Seed Operations Branch of the Ministry of Forests for their initial support. Thanks also to the staff at TM Communications for their characteristic wonderful job of turning volleys of slides and text into this finished guide. We would like to thank all contributors for their involvement with the creation of this guide.

Table of Contents

Table of Contents

Interest in British Columbia's native plants is flourishing. They are finding increasingly diverse uses in rehabilitation and site remediation of logging roads and log landings, and in the restoration of forest landscape slides, riparian zones, wetlands, and fragile desert areas. In addition, native plants provide beauty and utility in the context of maintaining natural and managed ecosystems. As people continue to utilize native plants, there is a need to develop standard practices for seed collection, vegetative propagation, and nursery culture of these species.

The goal of this guide is to address the issue of native woody plant seed collection by presenting information on collection practices, species descriptions, and photographs that aid the collector in identifying key features of flowers, fruits, and seeds during the stages of flowering, forecasting, and collection. Our major focus is to provide "baseline" collection information and photographs that will be of use to the seed collector, the nursery person, the hobbyist, and anyone with a desire to collect seed and propagate native plants. As a colour field guide to seed collection, this document complements and supplements both local guides to plant species identification and more detailed works on seed biology. We hope users of the guide find both useful information and also inspiration to investigate further the beauty of native plants in their natural environments. While the species contained in this guide are all native to British Columbia, some of the species range as far south as California, and as far east as Ontario.

This guide includes species that are woody in nature. With the exception of common juniper, the plants in this guide are angiosperms (seeds borne within covered fruit) and dicotyledons (two seed leaves). The species are mainly broadleaved and deciduous, although a few are broadleaved evergreens.

The common juniper (*Juniperus communis*) is the only coniferous species (gymnosperm) in this publication. Although juniper has evergreen needles and is cone-bearing, the appearance of the fruit is "berry-like," thus the fruit is handled in a manner similar to hardwood species.

For conifer cone collection, refer to *A Field Guide to Collecting Cones of British Columbia Conifers* (Portlock 1996).

What is a Fruit? What is a Seed?

A vexing question: what am I looking at? What is the "fruit"? What is the "seed"? What is a "berry"? What is a "drupe"? Do I need to know any of this terminology while collecting?

Yes! A basic understanding of fruit and seed anatomy is necessary to both evaluate crop condition and to make sure you are collecting "the right thing." Knowledge of fruit types is important during collection and in terms of identifying appropriate post-collection handling methods. Also, depending on the species, you will often need to separate the seeds from the fruits during seed processing. This "Basics" section explains some of the terminology required, and then presents annotated diagrams of fruit and seed types from several native species. All anatomical terms used in the guide are defined in the Glossary (p. 142). You may wish to jump ahead to the pictures, then re-visit the terminology!

Seed Basics

A seed develops after an ovule has been fertilized in the ovary.

A seed is the basic sexual reproductive unit of the plant. It is composed of:

1. a seed coat (testa) — the outer protective layer;
2. nutritive tissue; and
3. the embryo, which grows into the new plant.

The seed coat has a number of functions. Its primary function is to protect internal contents. Additionally, seed coats mediate the permeability of the seed and may contain germination inhibitors, or may physically inhibit germination until the seed coat is broken down. In these roles, the seed coat ensures "appropriate" germination

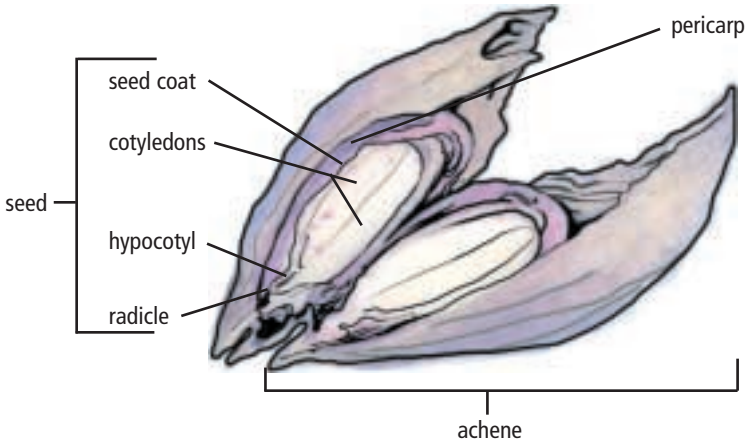


Figure 1. Example of fruit and seed anatomy. (*Purshia tridentata* "antelope-brush" achene and seed [× 6].)

conditions. The seed coat may also function in various dispersal mechanisms.

In angiosperms (flowering plants), the nutritive tissue of the seed is called the endosperm.

The embryo is the rudimentory plant, and is composed of four parts:

1. The radicle, which develops into the primary root.
2. The hypocotyl, which is the part of stem between the radicle and cotyledons.
3. The cotyledons, also called "seed leaves," which are the first leaves the plant produces and may be similar in appearance to true leaves. In many species, the cotyledons may take over the nutritive role in the seed from the endosperm.
4. The epicotyl, the "stem tip" right above the cotyledons, which gives rise to the main stem of the plant once it has germinated.

Fruit Basics

A fruit is essentially a mature, ripened ovary. The ovary itself is enclosed within a structure called the carpel, which is a modified leaf. Fruit develops from the wall of the ovary. It protects the seed, provides it with nutrition, and often helps in the dispersal of the seed once it has matured.

Fruit types can often be confusing. They come in a multitude of sizes and shapes. Specific types of fruit you are likely to encounter include fleshy fruits like berries (huckleberries) and drupes (cherries), and dry fruit such as winged fruit (maples), nuts (hazelnuts), follicles (hardhack), capsules (mock-orange), and achenes (bitterbrush). To add to the confusion, what is commonly called "seed" for a number of species is actually the "fruit" containing the seed.

The fruit wall that develops from the ovary is called the pericarp, and variations in pericarp development provide the basis of botanical classifications of fruit. In some cases, the pericarp may be dry; in other cases, it might be thick and fleshy. For many species the pericarp can be further divided into three distinct layers — exocarp (outer layer), mesocarp (middle layer), and endocarp (inner layer). The cherry fruit is a good example. The "skin" is the exocarp. The "flesh" is the mesocarp. And the "stone" of the cherry is the endocarp, which contains the seed.

If at maturity the pericarp splits open to release the seed, the fruit is called dehiscent. If the fruit does not split open, it is called indehiscent.

In addition to the features of the fruit wall or pericarp, we also classify fruit in terms of the number of ovaries they contain.

A "simple" fruit originates from a flower with a single ovary (which may contain one or many seeds).

An "aggregate" fruit originates from a single flower with many ovaries. Many of the fruits we call "berries," such as salmonberries and thimbleberries, are actually not berries at all, but examples of aggregate drupes. A true berry, in the technical sense is a simple fruit.

To further complicate matters, there are even "false fruits" called "pseudocarps" or accessory fruit. In this case, what you see as the "fruit" is actually modified flower parts within which the true fruit is enclosed. Two very common examples are pomes (crab apples and hawthorns) and hips (roses).

The classification presented below is simplified from more detailed botanical classifications, and refers to fruits of species either covered by this guide, or those you are likely to encounter in the collection of seeds from woody plants in British Columbia. For each general fruit type, we have listed one to several specific examples, based on fruits you are likely to encounter.

Fruit: The structure that develops from the ovary as seed matures

Dry Fruit: Fruit with a dry pericarp		**Fleshy Fruit:** Fruit with a fleshy pericarp	**Accessory fruit:**
Dehiscent Fruit: Fruit that "splits" open to release seed **Examples:** Legume Follicle Capsule	**Indehiscent Fruit:** Fruit that does not "split" open to release seed **Examples:** Achene Nut Samara	**Examples:** Drupe Berry	**Examples:** Pome Hip

Fruit and Seed Examples

Below are annotated cross-sections of some of the fruits and seeds included in this guide. Looking over the line drawings, one should learn to recognize the various fruit and seed parts discussed here and how they can vary between species.

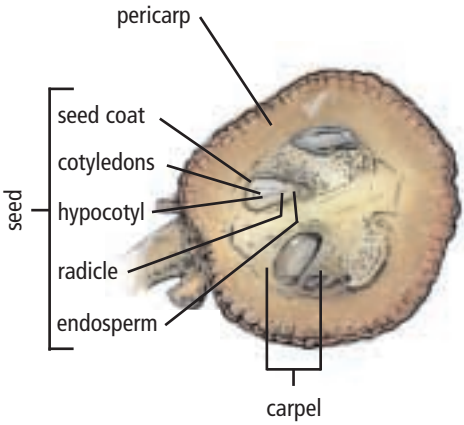


Figure 2. *Arbutus menziesii* (madrone) berry and seed (× 5).

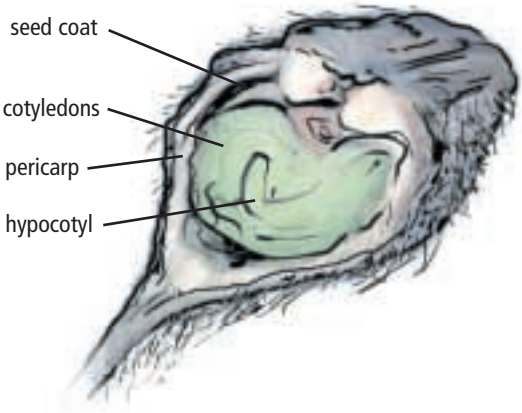


Figure 3. *Acer macrophyllum* (bigleaf maple) one-half of a double samara (× 5).

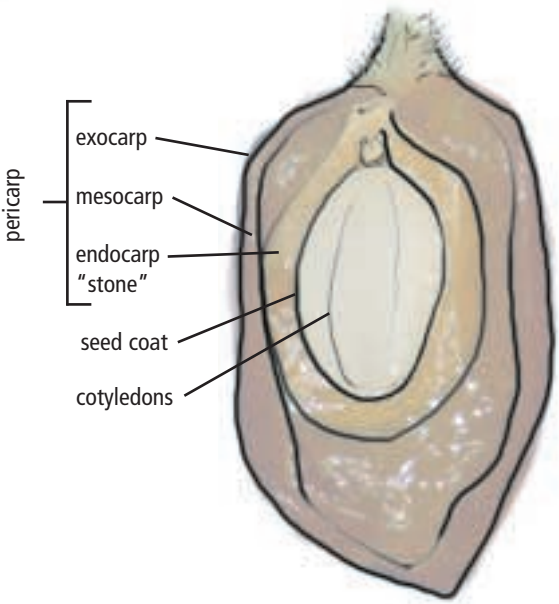


Figure 4. *Prunus emarginata* (bitter cherry) drupe and seed (× 6).

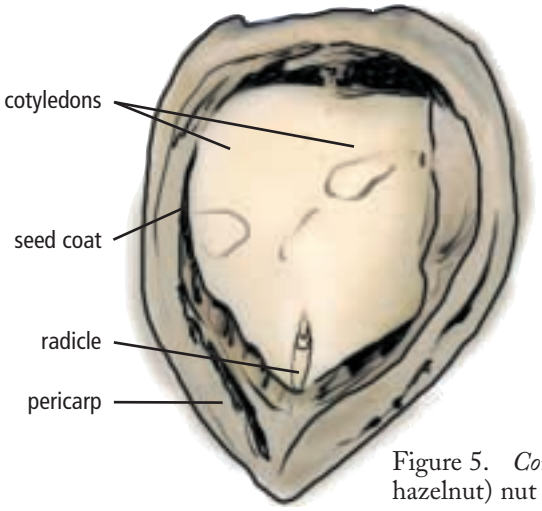


Figure 5. *Corylus cornuta* (beaked hazelnut) nut and seed (× 4).

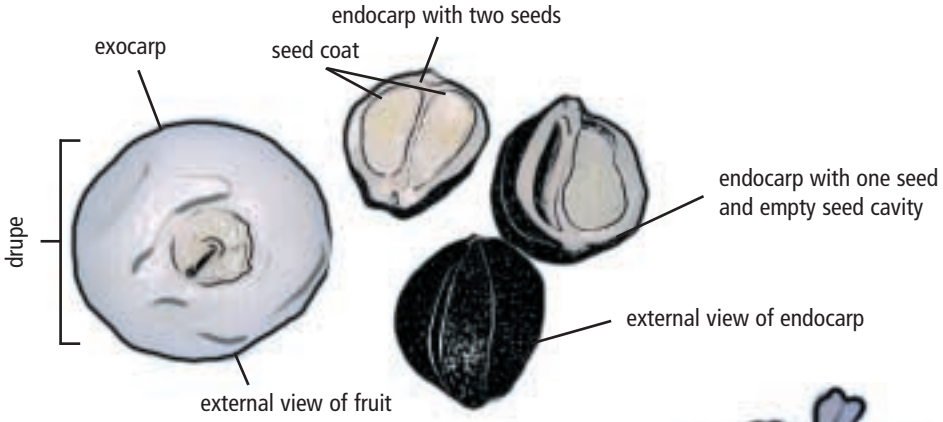


Figure 6. *Cornus stolonifera* (red-osier dogwood) drupe and seed (× 4).

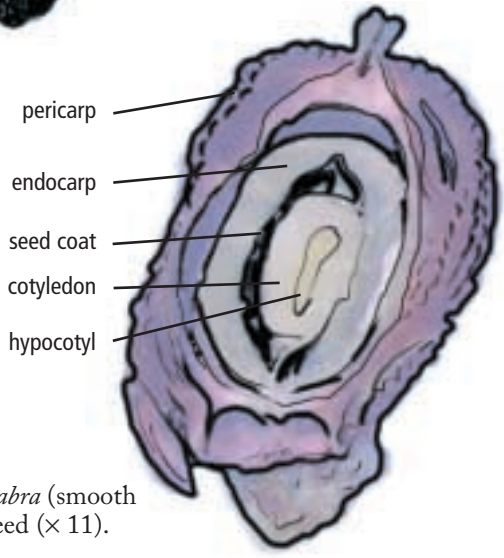


Figure 7. *Rhus glabra* (smooth sumac) fruit and seed (× 11).

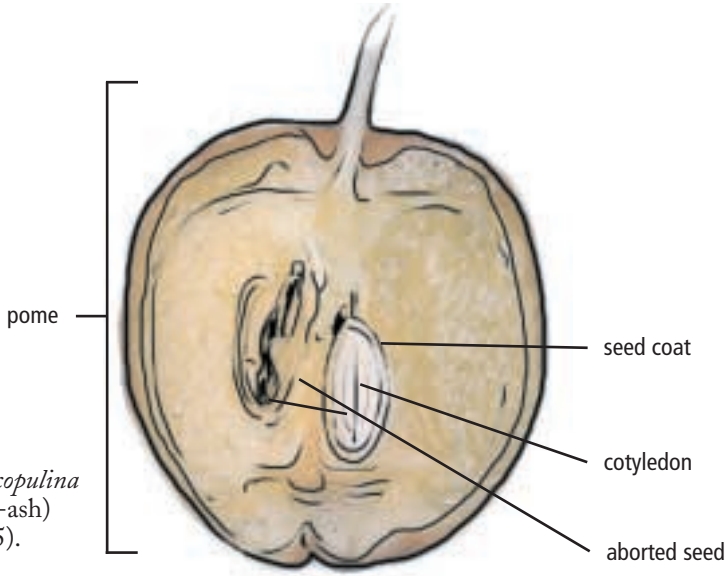


Figure 8. *Sorbus scopulina* (western mountain-ash) pome and seed (× 5).

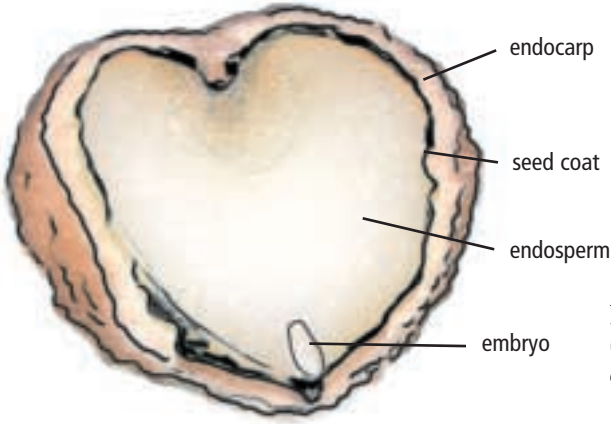


Figure 9. *Viburnum edule* (highbush-cranberry) drupe and seed (× 5).

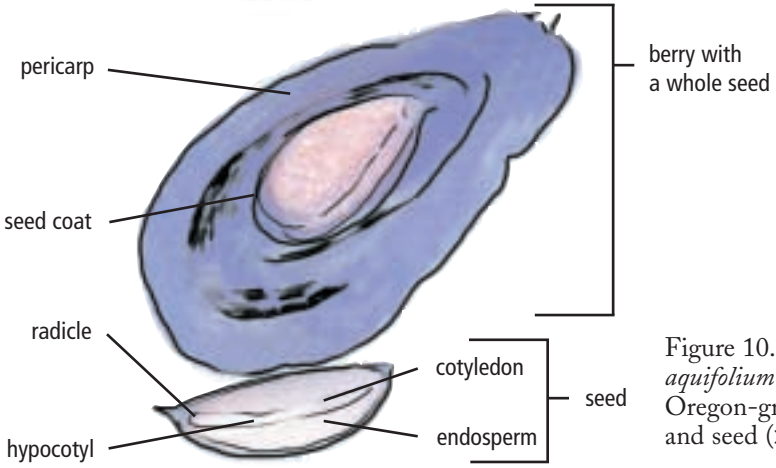


Figure 10. *Mahonia aquifolium* (tall Oregon-grape) berry and seed (× 7).

Why and When to Monitor

Monitoring is essential to assessing seed quality through all stages of collection, propagation, and growing cycles. Field monitoring ends only when the decision to collect or not to collect is made. Furthermore, species identification must be well established prior to any monitoring.

Forecasting can be considered your initial monitoring. It should occur at the point where flowering is ending and fruits are first noticeable. Forecasting provides information to guide seed collectors to the best sites and helps you plan effective use of workers, time, and funds.

Many native species produce large seed crops only periodically. In good crop years, seed yields and quality tend to be higher. Intervals between good crop years usually follow a pattern referred to as periodicity.

Generally, fruits can be observed several weeks after flowering. Forecasting periods for each species are given in this guide, but geographic differences will be evident, particularly for those species with a province-wide range. Your final monitoring occurs on the collection date, and becomes a part of quality control during collection.

How frequently you monitor depends on your familiarity and experience with the collection sites and species. The less familiar you are, the greater the need for monitoring the crop, either through formal evaluations of fruit and seed conditions, or simply through visiting the site and looking at how the fruits seem to be developing. After several years of working with a species, or on a particular collection site, you may develop very good local guidelines regarding the general timing and patterns of seed development.

There are two goals when assessing potential crops:

1. Finding sites with high-quality fruits (abundant fruits, no obvious disease, good probability of a high seed set).
2. Determining whether the seeds within the fruits are nearing maturity (are the seeds visible, do they seem to have well-developed embryos, has the seed coat begun to harden?).

At least two assessments should be carried out. The first assessment — forecasting — should be done just as flowering is ending and fruits are becoming visible (this is when you traditionally forecast). The second assessment should be done as the fruit crop is maturing. The goal of the early forecasting is to find suitable sites and estimate crop potential, while the goal of the later assessments is to track crop maturity. The final evaluations are completed at the time of collection.

Make sure that you base your initial forecast and subsequent monitoring on a range of individuals — not a single

plant. A reasonable goal is to try to sample at least five fruits from 10 plants at a site for the species you wish to collect.

Necessary Field Equipment

Standard equipment for monitoring includes:

- notebook and pencil to maintain records;
- a pair of high-quality binoculars;
- pruning shears or an extendible pruning pole;
- sample bags;
- pocket knife and/or single-edge razor blades and/or seed/cone cutter for dissecting fruits and seeds;
- ceramic cutting tile;
- pocket magnifier;
- cooler and coldpacks or ice to store samples;
- hand cleaner and paper towels;
- wildlife protection (bells for bears);
- method of contact with outside world; and
- bandages, just in case.

Crop Ratings Based on Fruit

Crops are often qualitatively rated based on visible fruits. Below is a seven-point scale, which has often been used for conifer crops and may be applied to the species listed in this guide (Eremko et al. 1989).

Some species may produce heavy to bumper crops periodically. Other species may not produce such crops at all. Similarly, how many is "many fruit" is a judgement call. Photographic documentation of crops over several years is a good approach to developing a rating system for new species.

Estimating Seed Yields

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

Potential seed yields can be determined by utilizing the cutting test. Cutting test instructions are provided

Crop rating based on the relative number of fruits on the plants

Crop rating	Definition
1 No Crop	No fruits are seen on any plants.
2 Very Light	Fruits are seen on less than 25% of plants.
3 Light[a]	Some fruits are seen on more than 25% of plants.
4 Light[a]	Many fruits are seen on less than 25% of plants.
5 Medium	Many fruits are seen on 25–50% of plants.
6 Heavy	Many fruits are seen on more than 50% of plants.
7 Bumper	Many fruits are seen on almost all plants.

[a] Note that code ratings 3 and 4 are both "light," but that the criteria differ.

in Appendix 2 (p. 128) of this guide. For some species, such as maples, it is necessary to sample in mid-summer (late July) for potential embryo development, as embryos are barely visible in the early summer. A visual assessment in conjunction with cutting test evaluations is necessary to estimate the potential quantity and quality of the developing fruit crop.

The following formula could be used as a rough guide to quantitatively estimate seed yields from a sampling program:

Estimated number of seeds
= average number of **viable seeds/fruit**
× average number of **fruits/plant**
× the number of **plants to collect from collection site**.

The average number of viable seeds/fruit is determined from your sampling program. It should be the average number of seeds found in at least 10 fruits. Ideally, it would be based on 30 or more fruits.

The average number of fruits/plant can be counted on some species, but must be estimated for others. Use at least 10 plants for calculating an average.

Factors Affecting Monitoring

Factors that must be considered in monitoring are flowering habits, crop periodicity, specific environmental conditions during critical developmental periods in a given year, and variation in developmental timing and crop maturity with elevation and aspect.

Flowering Habits

Understanding the dynamics of the flower–seed relationship for a particular species is important when forecasting crops. Several weeks after flowering, developing fruits will become evident. Structurally, flowers are either perfect (also called bisexual) and have both functional male and female organs (stamens and pistils, respectively) on the same flower, or imperfect (also called unisexual) with male and female organs appearing on separate flowers. In this case, the male flowers are called staminate, while the female flowers are called pistillate. If flowers are imperfect, and the separate male and female flowers occur on the same individual plant, the flowering habit is termed monoecious (one house). When the male and female flowers occur on different individual plants, the flowering habit is termed dioecious (two houses). It is the flowers with female parts that will develop into seed-bearing fruits. Once pollination is complete and fertilization has begun, fruits begin to develop and can be observed several weeks after flowering.

Periodicity

Periodicity is the interval between good crop years. It refers to woody angiosperm species frequently having

irregular seed production capabilities from year to year resulting in the cyclic effects in crop production. Heavy crops generally occur several years apart and seldom occur in successive years. Heavy crops in one year are often followed by a light crop in the subsequent year.

Environmental Conditions

Environmental factors can be either detrimental or beneficial to flowering and seed development. Weather patterns and weather variants (e.g., local fluctuations in rainfall, temperature, daily sunlight hours, and winds), can enhance or hinder the process of seed crop production. Elevation and aspect can also cause differences in the timing of crop maturation, due to changes in local microclimates. While these effects are species-specific, and the interactions among the various weather factors can be complex, some general patterns can be identified.

In some woody plants, cessation of growth and flowering initiation are both induced by short days. In some species, flowering initiation is dependent on plants first being exposed to a specific critical temperature. Flower buds of temperate zone woody plants often require exposure to extended periods of cool temperature, and flower buds may fail to open properly after a very mild winter.

Pollen dispersal is dependent on both fluctuations in temperature and humidity. The window for pollen dispersal is often brief, since pollen dispersal from male flowers must be synchronized with receptivity of the female flowers, and the weather during this period can be critical. Low humidity often initiates pollen dispersal by promoting anthers to open. Rain can stop the opening of anthers. Plants reliant on wind dispersal of pollen, are also influenced by the prevailing wind directions during pollen dispersal. Rain can wash pollen straight down, limiting wind dispersal. Also, cold and rainy weather can limit insect activity required by insect-pollinated plants.

Seed maturation is a temperature-dependent phenomenon and is therefore affected by elevation, aspect, and latitude. At very high elevations, it is often difficult to find fully mature seed because of a truncated growing season. Aspect can also affect maturation, in that south and west aspects tend to accumulate more heat than north and east aspects. The effect of a particular aspect depends on geographic location. In south coastal British Columbia, south-west aspects are often particularly harsh locations for plant growth, being extremely hot and dry in the summer. In the north-central interior, north-east aspects can be particularly harsh, being extremely cold and wet in the winter, with an extremely short summer growing season.

Moisture is also important because extreme desiccation before seed crops have matured can cause seed to abort prematurely. Fruit development is often negatively affected by shading,

and fruits are more abundant on plants that are in the open.

Assessing the Crop

Collection is not an exact science, as many interacting factors must converge for a successful collection. Several factors are critical to the success of a collection.

The most important factor is to properly assess the crop for the species you wish to collect, both in terms of quality and in terms of maturity of the seeds. Other additional factors to consider are environmental conditions for that particular growing season and records of past collections.

Crop assessment requires frequent visits to the selected site to monitor crop progress and development. During crop assessment, sampling is required. Use the cutting test method described in Appendix 2 to note maturation, development, and potential pest problems in both the fruits and the seeds.

Some general changes that accompany maturation in fruits and seeds and some detailed indicators of maturity are listed in the pages on individual species. As a fruit ripens, it changes colour and will often turn from green to shades of orange, scarlet, white, or purple. As seeds mature, the seed coats will often darken to shades of brown or tan. For dry-fruited species, flower clusters once vivid with colour will change to grey and brown. At maturity, fleshy fruits begin to fall and some dry fruits may begin to open.

Certain species have a great degree of variability in maturity both among and within plants, and produce mature fruit over an extended period (e.g., salal), while other species may produce several distinct fruit crops in a season within individual plants (e.g., red-osier dogwood). In such cases, collection may be broken up into early, middle, and late collections during the period of seed availability. This approach is particularly recommended if the goal is to capture the genetic variability in the population.

Selecting the Collection Area

Native woody plant seeds are usually collected from natural or unmanaged sites. Therefore, every collection site is unique and different. Collection sites are often chosen based on their ease of access, availability of several species of interest, and moderate to large potential crops for those species. Always obtain landowners' permission and other required legal permits prior to any monitoring or collection activity and follow ethical plant collection guidelines or standards for your locale.

Given crop periodicity, it is important to collect in years when seed production is very prolific because:

- usually seeds will have higher germination capacity and vigour;
- seeds will retain viability longer in storage;
- pest damage can have a lower impact; and
- cost of collection can be significantly lower due to the higher crop yield.

Collection Methods

Among the native woody plant species included in this guide, appropriate collection methods can be as diverse as the plants themselves. The most important point is, whichever method of collection is required, seeds must be collected when mature to avoid problems with picking, processing, and germinating the seed.

Methods of gathering or collection include:

- hand-picking;
- cutting fruit clusters and branch material;
- raking fruits/seeds from the ground;
- climbing;
- flailing branches using bamboo poles or racquets; and
- bagging and collecting.

All aspects of seed gathering require suitable care to ensure that the seeds collected are not damaged due to abrasive collection methods, and that seeds that are either raked or picked from the ground have not been bruised, crushed, or damaged in any way prior to collecting. Keeping both hands free is important for efficiency when hand-picking.

Collection Summary

Proper planning is essential for project success. Ensure that collection areas have been monitored throughout the season. Be sure that species are properly identified and any required permits or permissions are obtained prior to collection. Collect from areas with minimal pest damage. Do not collect from sites containing numerous poorly formed, off-coloured, abnormal, or diseased plants or fruits. Monitor the crop closely to identify the earliest collection time. In cases where rapid

Hand-picking fruits into collection bag (big sagebrush).

seed dispersal can be a problem (e.g., snowbrush), bagging prior to dispersal may be required. Just prior to collection, assess whether seeds are mature and timing is right.

Collect from plants that reflect the purpose of the collection. If high seed quality is the collection goal, collect from healthy vigorous plants of better than average growth. If representing genetic variation in a natural population is the collection goal, collect from a representative sample of the population. During collection, complete and record cut-test information and crop evaluation, and ensure that all collected material is correctly labelled and properly identified with the necessary source information.

Good collecting practices are an important consideration in our interactions with the natural world. This raises the question of how many seeds should be collected from wild plants, and how such collection can affect the natural population. The fewer the plants from which collections are taken, and the gentler the method of collection from the plants, the less impact there will be on a population or ecosystem. Such considerations must be balanced by the need for a representative population sample if genetic variability is an issue. Some other ethical considerations during collection are soil disturbance and damage to plants that may result due to a collection effort. In the absence of detailed

Collecting fruits using hand pruners (big sagebrush).

Bagging for seed collection of species with rapid dispersal (e.g., snowbrush).

species population information, one must often use rules of thumb and common sense guidelines regarding what constitutes minimal disturbance of sites and plants.

Please refer to government, native plant society, and conservation society guidelines for your area, as well as other local constraints to seed collection.

Close-up of the bagging process.

The key to field storage and transportation is the maintenance of environmental conditions within the optimal range for each type of fruit/seed listed.

The key environmental factors to optimize during transportation and storage are:

1. temperature;
2. moisture; and
3. ventilation.

The interaction of these three factors determines the maintenance of seed viability during transport. Optimal conditions extend seed quality. Sub-optimal conditions either reduce seed vigour directly, or indirectly through the pathogens that can attack seed.

Considerations by Fruit Class

From the perspective of field storage and transportation, fruits may be divided into three general classes:

1. fleshy or succulent fruits;
2. dry fruits; and
3. a more problematic class, fruits with recalcitrant seed.

Fleshy Fruits

The major challenge with these fruits is to prevent over-heating during temporary storage and transportation. Once seeds are extracted from fleshy fruits, the seeds can usually be dried to 10% moisture content or less.

Dry Fruits

The major challenge with these fruits is to allow adequate ventilation for even drying, and to prevent any moisture buildup that could lead to pathogen problems. Once seeds are extracted from dry fruits, the seed can usually be dried to 10% moisture content or less.

Seeds that can be dried to 10% or less moisture content for storage purposes are called “orthodox” seeds. These can be contrasted with “recalcitrant” seeds, whose fruit requires special handling.

Recalcitrant Seeds

This term refers to seeds that cannot withstand drying below a critical moisture level (usually the critical moisture content is over 30%, and varies by species) and can not be stored at sub-zero temperatures. These seeds must be maintained at a high moisture content. The primary concerns for these species are that their seeds do not dry out during any interim storage, while being adequately ventilated so they do not mould, and that they be sown soon after being collected. Interim storage should, therefore, be

exceedingly brief or eliminated altogether. Examples of recalcitrant seeds are the seeds contained in the nuts (acorns) of many oak species, where the nuts have a very limited shelf life. However, nuts of other species, such as California hazelnut, are orthodox, and their seeds can be dried. Another group of species with recalcitrant seeds are those in the willow family, whose seeds have a shelf life as short as several days after collection. Remember, recalcitrance is a property of the seed, due to the seed's inability to maintain viability with drying, but its presence requires you to handle the fruits differently, and more delicately, than fruits containing orthodox seeds.

Temporary Storage Applications

Freshly collected fruits and seeds must be handled and stored correctly in order to prevent problems such as heating and moulding. Except for the species with fleshy fruit, seeds or seed material collected should be held in such a manner that keeps it cool, dry, and well ventilated. Burlap bags, netted bags, light cotton bags, and plastic stackable trays serve the purpose well. During a collection, collected fruits should always be in a shaded area, rather than under direct sun, and should never be placed directly on the ground where they can pick up soil-borne pathogens. If necessary, collapsible storage racks or portable drying sheds can be assembled. Bags or trays of collected seeds can be laid openly on rails or within a portable drying shed under roof cover. Stir the seeds or seed material in trays and turn bags to ensure that the seeds receive adequate ventilation throughout the interim storage period.

Bags should not be filled to any more than half their volume and should be tied at the top to allow for expansion and moisture dissipation. Trays, on the other hand, require that seeds or seed material be spread across the tray in a thin layer, again to allow for any expansion and dissipation of moisture. If the seed material is so light that seeds blowing away is a problem, the trays can be covered with a breathable mesh.

Fleshy fruits that are to be stored before processing must be kept cool and moist to prevent heating and fermentation. Such fruits can be placed in tubs of cold water, with the water changed daily over the holding time. Dry pulpy fruits (e.g., wolf-willow) just need to be kept cool and dry.

Heat and Moisture Concerns

Proper drying takes place at 15–20°C and in low relative humidity. Freshly collected seeds often have a very high initial seed moisture content. Seeds and fruits collected need to be kept in cool, dry, ventilated areas and out of direct sunlight in order to facilitate proper drying.

Damage to seeds or fruits by heating is caused by inadequate air circulation. If the seeds have been bagged, they need to be held in a manner that allows air to circulate in and around the bags. Placing bags on rails in a drying shed serves the purpose well. Bags will need to be frequently turned initially to promote even drying of the contents.

Similarly, seeds or fruits kept within stacked plastic trays also require attention. Seeds must be stirred frequently after initial collection to minimize heating and potential seed damage.

As the drying period progresses, vigilant turning of the bags and stirring of the seeds held on trays can be reduced.

Rotary roof vents and fan systems increase the air flow within a permanent drying shed and improve air movement throughout the building. As a word of caution, some pathogens can become airborne if storage sheds have been constructed with dirt floors and fans generate turbulence near the floor.

Transportation

There are four key elements to success in the transportation of seeds:

1. direct delivery;
2. cool collections;
3. dry conditions; and
4. adequate ventilation.

Collections should be taken promptly to the processing centre. It is essential that proper documentation accompany the shipment and the necessary delivery arrangements have been made with the processing facility prior to shipping.

In certain instances, refrigerated transit may be necessary, especially when fresh seeds or fruits are being hauled over long distances. Inside trailer temperatures should be in the range of 5–10°C. Sacks or trays should be organized in a manner that allows cool air to circulate in and around them with no chance of spillage.

Travel during the earlier morning hours is recommended to reduce the potential for heating.

Ship pulpy fruits to the processing centre in plastic containers. This could be in the form of a 6 mm plastic insert for a burlap bag or some kind of sturdy plastic container with a sealed lid. In any event, spillage or seepage is unacceptable.

Seeds that have been dried somewhat prior to interim storage can be shipped more safely than freshly collected seeds. Remember, however, that the seeds, seed materials, and fruits are living biological organisms with needs specific to sustaining life.

Below are three general sets of field storage and transportation guidelines applying to species with fleshy fruits, dry fruits, and recalcitrant seeds. Additional details can be found in the sections on individual species.

Guidelines

Fleshy Fruits

These guidelines apply to succulent or fleshy fruits, which are often called "berries," whether they are true berries or not. Fleshy fruits include true berries, drupes, pomes, and hips.

- Twigs, leaves, and other debris must be removed prior to bagging and shipping.
- For shipping, fruits should be placed in plastic bags inside burlap bags, or in plastic shipping boxes with insulated cool packs inside.
- Fruits should not be left in bags for long periods, as the juices can ferment and heat, causing damage to the seeds.
- If fruits are being held prior to shipment, they should be placed in tubs of cold water; water must be changed at least once every 24 hours.
- Coolers at temperatures of 2–5°C can be used as interim storage facilities.
- It is very important not to allow fruits to dry out, as this causes difficulty in processing and can reduce the overall germination capacity of the seeds.

Dry Fruits

These guidelines apply to both the dry dehiscent and dry indehiscent fruits.

- Twigs, leaves, and other debris should be removed prior to bagging and shipping.
- If possible, ship fruits immediately to the processing centre.
- If temporary storage is necessary, fruits should be kept on trays with fine mesh screened bottoms or in fine nylon net bags under cool, dry, shaded, and well-ventilated conditions to prevent heating and major losses in seed viability.
- For dehiscent fruits, caution should be taken to ensure that seeds will not be blown away during windy conditions when fruits split open to release seeds. A fine-mesh netting placed over the fruits can be used to allow good ventilation, while preventing seeds from blowing away.

Recalcitrant Seeds

These guidelines apply to seeds originating from various fruit types, where the key feature of the seeds is their loss of viability if dried, and thus a very limited shelf life.

- Twigs, leaves, and other debris should be removed prior to bagging and shipping.
- Ship immediately by the fastest available means.
- Do not allow fruits to dry out, but do allow fruits to breathe. This may require placing fruits in semi-permeable "breathable" bags (such as used to store vegetables for longer shelf life) where moisture is held in, but air can pass through.
- The best approach to temporary storage for recalcitrant seeds is to eliminate the stage entirely. This means logistically integrating the collection strategy into the sowing strategy (i.e., be ready to sow before you collect).

Introduction to the Species Section

Species included in the guide are, for the most part, broadly distributed in British Columbia and have a diversity of uses. There was not enough time or space to include all species in British Columbia that met these criteria so an attempt was made to select the most commonly available native plant species currently collected.

The guide is organized in this section alphabetically by family, then by genera, and species Latin names. Arranging plants in the guide by family groupings will provide the reader with insights into handling related species including identification, monitoring, seed collection, field storage and transportation procedures.

For every species, where possible, four photographs are provided: flowering, monitoring/forecasting, collection, and seed/fruit. Each species description notes crop intervals, flowering habits, forecasting/monitoring information, and collection information. Reference is made to the general sections at the beginning of the guide for field storage and transportation procedures.

Details about stratification, seed preparation, and plant production are not included in this guide.

Accurate species identification should always be the first step in any collection process. Identification of species should be made in conjunction with local and provincial plant identification guides listed in the references section. Species identification is extremely important due to naturalization of some ornamental species, especially in urbanized areas, and the tendency of some species to hybridize. Know your local flora before you collect and avoid collecting uncommon, rare, or endangered species.

Selection of species and plants to collect should be made with consideration of local ethical and conservation guidelines. Practice good stewardship.

For all species, certain common points should be kept in mind:

- Be absolutely certain of species identification.
- Forecast based on fruit, not flowers.
- Check frequently prior to collection to determine collection time and avoid losses due to the direct effect and inter-relationship of elevation, aspect, and geographical location.
- Use cutting tests to determine fruit and seed development.

Vine Maple

Acer circinatum Pursh

Flowering

Crop Intervals

- annual (irregular)

Flowering Habits

- perfect or male and female flowers in small flat-topped clusters occur on the same tree; the tiny flowers have white petals (6–9 mm wide) and red sepals
- flowering mid-April to late June

Forecasting

WHEN TO FORECAST

- mid-July to late July

WHAT TO LOOK FOR

- fruits are green in colour, and mature looking in size and shape

FORECASTING NOTES

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

Forecasting

Further Monitoring

- check seeds during the latter part of July for embryo development
- check frequently prior to collection to determine collection timing and to avoid losses

Collecting

Collection

WHEN TO COLLECT

- mid-September to early/mid-November

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- fruits are approximately 20–40 mm in length and spreading almost 180 degrees apart; fused together where their seed cavities meet
- ripe fruits are light brown to reddish brown in colour
- mature seed is firm, with crisp, yellow cotyledons completely filling the seed cavity

COLLECTION METHODS

- collect fruits only when seeds are mature
- collections soon after seeds are mature can be done by hand-picking from standing trees
- collection after leaves have fallen is easier and can be done by spreading tarpaulins beneath the tree and flailing the branches with a pole to dislodge fruits

COLLECTION NOTES

- seeds mature as fruits change colour from green to light brown

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for dry fruits

Seed cross-section (× 8)

Douglas Maple, Rocky Mountain Maple

Acer glabrum Torr. var. *douglasii* (Hook.) Dippel

Flowering

Crop Intervals

- annual (irregular)

Flowering Habits

- flat-topped clusters of approximately 10 yellowish green male and female flowers; male and female flowers usually occur on separate or occasionally the same trees at the same time as leaves emerge
- flowering mid-April to late June

Forecasting

WHEN TO FORECAST

- mid- to late July

WHAT TO LOOK FOR

- fruits are green in colour, and mature looking in size and shape

FORECASTING NOTES

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

Forecasting

Further Monitoring

- check seeds during the latter part of July for embryo development
- check frequently prior to collection to determine collection timing and to avoid losses

Collection

Collecting

WHEN TO COLLECT

- mid-September to early/mid-November

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- fruits are approximately 20–30 mm in length, fused together where their seed cavities meet and spreading at an angle from 75 to 90 degrees
- ripe fruits are light brown in colour
- mature seeds are firm, with crisp yellow cotyledons completely filling the seed cavity

COLLECTION METHODS

- collect fruits only when seeds are mature
- collections soon after seeds are mature can be done by hand-picking from standing trees
- collection after leaves have fallen is easier and can be done by spreading tarpaulins beneath the tree and flailing the branches with a pole to dislodge fruits

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for dry fruits

Seed cross-section (× 7)

Bigleaf Maple, Oregon Maple

Acer macrophyllum Pursh

Flowering

Crop Intervals

- annual (irregular)

Flowering Habits

- female and male flowers on the same plant
- flowers are pale green to yellow-green in long pendulous cylindrical clusters; flowers emerge with or before leaves have expanded
- flowering April to May

Forecasting

WHEN TO FORECAST

- mid-June to late July

WHAT TO LOOK FOR

- fruits are green in colour, and mature in size and shape

FORECASTING NOTES

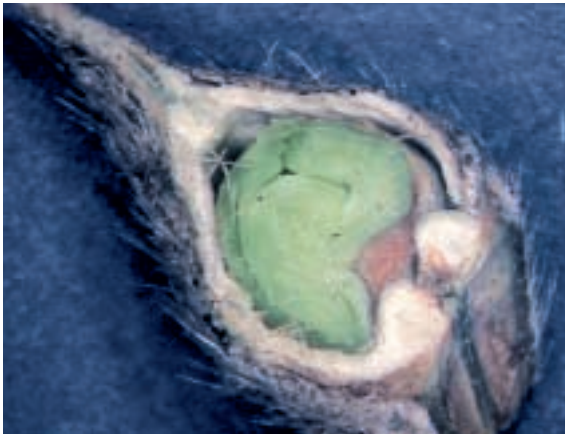
- do not look for seeds at this time because embryos appear as tiny specks, if at all

Forecasting

Further Monitoring

- check seeds during the latter part of July for embryo development
- check frequently prior to collection to determine collection timing and to avoid losses

Collection



Seed cross-section (× 5)

Detail on the cotyledons (× 13)

Collecting

WHEN TO COLLECT

- late September to early/ mid-November

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- fruits are approximately 30–60 mm in length, fused together where their seed cavities meet at a roughly 45–90 degree angle; there are bristly hairs on the fruit that may irritate skin
- ripe fruits are light brown in colour
- mature seeds are firm, crisp, green, folded cotyledons completely filling the seed cavity

COLLECTION METHODS

- collect fruits only when seeds are mature
- collections soon after seeds are mature can be done by hand-picking from standing trees
- collection after leaves have fallen is easier and can be done by spreading tarpaulins beneath the tree and flailing the branches with a pole to dislodge fruits, or with pole pruners

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for dry fruits

Smooth Sumac

Rhus glabra L.

Flowering

Crop Intervals

- annual

Flowering Habits

- either male and female or perfect flowers, flowering June to early August
- flowers are tiny, yellow to greenish and arranged into finely pubescent, pyramid-shaped panicles

Forecasting

WHEN TO FORECAST

- first week of August

WHAT TO LOOK FOR

- fruits go through a colour change where they become more maroon and less pubescent

FORECASTING NOTES

- check identification of species as ornamental sumacs are similar

Further Monitoring

- check frequently prior to collection to determine collection timing and to avoid losses

Forecasting

Collecting

WHEN TO COLLECT

- late September through early winter

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- fruits are smooth, berry-like drupes containing a single bony nutlet (actually the endocarp) within which is the seed
- fruit clusters will be deep red in colour
- mature seeds are approximately 2.5 mm in length and oval in shape
- endocarp is very hard, and grey in colour

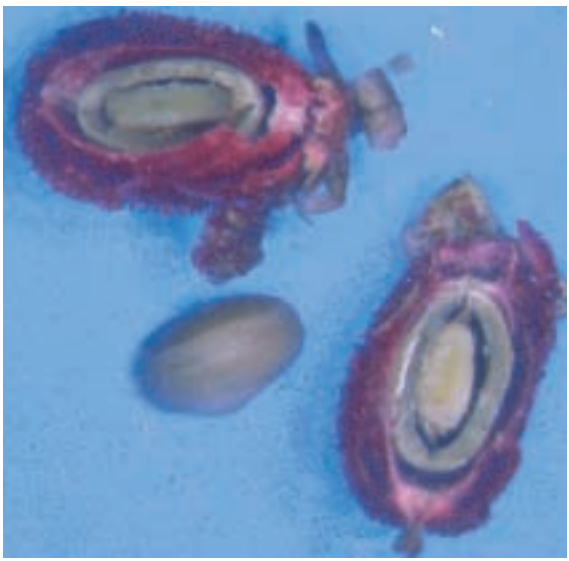
Collection

COLLECTION METHODS

- dense fruit clusters are collected by hand-picking the fruit directly into picking bags

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for dry fruits



Fruit and seed cross-section (× 8)

Big Sagebrush

Artemisia tridentata Nutt.

Flowering

Forecasting

Crop Intervals

- 2–4 years

Flowering Habits

- perfect, late August to late September
- flowers are tiny, yellow to greenish in colour, and tubular, with three to numerous flowers per head

Forecasting

WHEN TO FORECAST

- mid- to late October

WHAT TO LOOK FOR

- forecast when flowers shrivel and fruits become visible

FORECASTING NOTES

- be sure of species identification as some of the other *Artemesia* species look very similar
- use a 10× hand lens when assessing fruit development

Further Monitoring

- check frequently prior to collection to determine collection timing and to avoid losses

Collecting

Collection

WHEN TO COLLECT

- mature fruits are set very late in the fall or early winter
- fruits can be collected from late November to early January; at this time fruits become loosened and can be easily removed from heads by shaking; seed coats are dark brown in colour and have hardened to the point that they cannot be easily crushed with a thumbnail

DESCRIPTION OF RIPE FRUIT AND MATURE SEED

- the fruit are achenes
- achenes are very small, approximately 0.6–0.75 mm wide and 1.2–1.7 mm in length, brown in colour, and angular in shape
- as fruits ripen they change from a light yellowish brown colour to a very dark brown
- the time from the plant flowering until the fruits ripen is approximately 30–60 days

COLLECTION METHODS

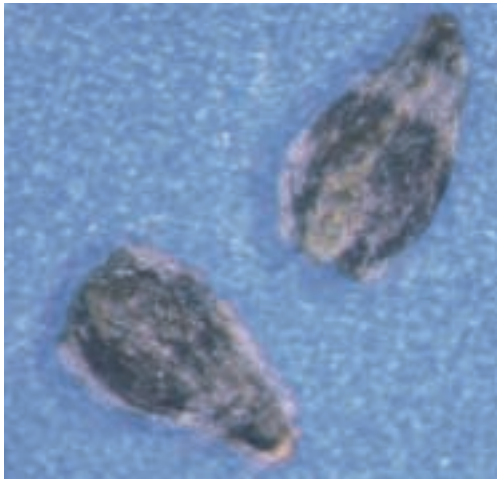
- mature fruit clusters are best collected by hand-picking directly into picking bags
- fruits can be collected directly from plants by placing/holding a tray, box, or netted hoop under the plant's branches and flailing them with a paddle or racquet

COLLECTION NOTES

- use a 10× hand lens when assessing development of fruits
- clipping seed stalks and bagging the material in bags that allow for proper air drying (i.e., very fine nylon mesh bags, paper bags, or cotton bags); drying of larger quantities of seeds can also be accomplished by spreading them out on drying screens or tarpaulins that are protected from rain and rodents
- because of late maturation, collect seeds quickly to avoid losses and storm damage

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for dry fruits



Seeds (× 25)

Common Rabbit-brush

Ericameria nauseosus (Pall. *ex* Pursh) Nesom & Baird
var. *speciosa* (Nutt.) Nesom & Baird

Flowering

Crop Intervals

- annual

Flowering Habits

- perfect, small, yellow flowers in dense inflorescences, August through September

Forecasting

Forecasting

WHEN TO FORECAST

- September

WHAT TO LOOK FOR

- flowers begin to shrivel and petals fall off
- pappus goes from whitish to silky grey in colour

Further Monitoring

- check frequently prior to collection to determine collection timing and to avoid losses
- quite variable maturation both within and among plants

Collecting

WHEN TO COLLECT

- collect from mid-September onwards
- fruits are quite persistent

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- the fruits are hairy achenes; achenes turn from greenish to dark brown, and are hard at maturity

COLLECTION METHODS

- strip fruits by hand into picking bags

COLLECTION NOTES

- check carefully to make sure that achenes are full; there can be a high proportion of empty fruits
- achenes should come away easily when hand-stripping

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- see field storage and transportation guidelines for dry fruits

Collection

Achene with pappus (× 16)

Tall Oregon-grape

Mahonia aquifolium (Pursh) Nutt.

Flowering

Crop Intervals

- annual

Flowering Habits

- flowering mid-April to late May
- small, perfect flowers, yellow in colour, borne in closed, erect clusters
- flowers slightly fragrant

Forecasting

WHEN TO FORECAST

- last week of June to first week of July

WHAT TO LOOK FOR

- green berries

FORECASTING NOTES

- be sure of species identification — five to 11 glossy, evergreen, holly-like leaflets

Further Monitoring

- check fruits mid-July for seed development via a cutting test; assess developing seeds by removing the pulp from around seeds
- check frequently prior to collection to determine collection timing and to avoid losses to birds and animals

Forecasting

Collecting

WHEN TO COLLECT

- mid-July to late September

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- the ripe berries are blue with a pale bloom and contain a few large seeds
- mature seeds are dark burgundy in colour, 3–5 mm in length
- each seed contains a well-developed embryo and endosperm

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for fleshy fruits

Collection

Fruit and seeds (note embryo detail) (× 8)

Dull Oregon-grape

Mahonia nervosa (Pursh) Nutt.

Crop Intervals

- annual

Flowering Habits

- flowering mid-April to late May
- small, perfect flowers, yellow in colour, borne in closed, erect racemes to 20 cm long
- flowers slightly fragrant

Flowering

Forecasting

WHEN TO FORECAST

- last week of June to first week of July

WHAT TO LOOK FOR

- green berries

FORECASTING NOTES

- be sure of species identification — nine to 19 dull, evergreen leaflets with distinct vination and spiny teeth

Further Monitoring

- check fruits mid-July for seed development via a cutting test; assess developing seeds by removing the pulp from around seeds
- check frequently prior to collection to determine collection timing and to avoid losses to birds and animals

Forecasting

Collecting

WHEN TO COLLECT

- mid-August to late September

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- the ripe berries are blue in colour with a pale bloom
- mature seeds are dark burgundy in colour, 3–5 mm in length
- each seed contains a well-developed embryo and endosperm

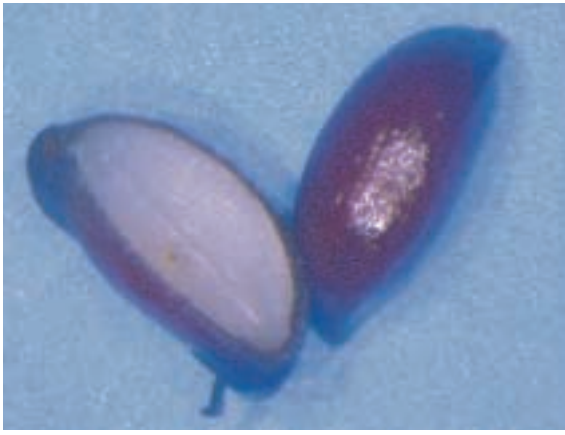
COLLECTION METHODS

- ripe berries are best collected by hand-picking directly into picking bags

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for fleshy fruits

Collection



Seed (× 11)

Red Alder

Alnus rubra Bong.

Male and female flowers

Forecasting

Crop Intervals

- at least once every 4 years

Flowering Habits

- flowering early April to mid-May
- male and female flowers occur separately on the same tree, appearing prior to leaves in the spring
- female catkins are thinner and shorter (2 cm long) than male catkins (5–12 cm), and the females initially extend upright
- male catkins are unstalked

Forecasting

WHEN TO FORECAST

- last week of June to first week of July

WHAT TO LOOK FOR

- green seed cones

FORECASTING NOTES

- be careful to distinguish female from male catkins
- male catkins generally occur in clusters on terminal portion of the branch

Further Monitoring

- check during the latter part of July for seed development
- check frequently prior to collection to determine collection timing and to avoid losses
- use cutting test, half-section method, to assess developing seed within seed cones

Collecting

WHEN TO COLLECT

- mid-August through late November

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- fruits are small nutlets arranged into a female cone. The nutlets are 15–25 mm in length, and have narrow, membraneous wings.
- female cones are composed of many small, closely overlapping bracts
- ripe cones are greenish brown in colour
- mature nutlets are golden brown in colour

Collection

COLLECTION METHODS

- female cones are best collected from standing trees by hand-picking or hand-stripping directly into picking bags
- in certain cases, ladders or mechanical lift equipment can be used to access the crown
- pole pruners or pruning shears can be used to remove branches to permit ground collections
- female cones can also be collected from trees felled during cutting operations but the timing must be coincident with cone maturity

Nutlet (× 9)

COLLECTION NOTES

- cones may be collected just when the bracts start to separate on the earliest cones, which often occurs following a few good night frosts
- if collecting from ornamental trees, care should be taken to avoid any kind of physical damage to the plant
- easiest to collect after leaves have fallen

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for dry fruits

Cross-section through "cone" showing seed

Sitka Alder

Alnus viridis (Chaix) DC ssp. *sinuata* (Regel) A. & D. Love

Flowering

Crop Intervals

- at least once every 4 years

Flowering Habits

- flowering early April to mid-May
- male and female catkins occur separately on the same plant, appearing prior to leaves in the spring and developing and opening at the same time as the leaves
- female seed cones are thinner and shorter (2 cm long) than male catkins (5–12 cm), and the females initially extend upright
- male catkins are unstalked

Forecasting

WHEN TO FORECAST

- last week of June to first week of July

WHAT TO LOOK FOR

- green female catkins (seed cones)

FORECASTING NOTES

- be careful to distinguish female catkins from male catkins
- male catkins generally occur in clusters on terminal portion of the branch

Further Monitoring

- check during the latter part of July for seed development
- check frequently prior to collection to determine collection timing and to avoid losses
- use cutting test, half-section method, to assess developing seeds within seed cones

Collecting

WHEN TO COLLECT

- mid-August through mid-October

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- fruits are small seed cones, egg shaped, occurring on stalks in clusters of three to six
- female cones are 15–20 cm in length and composed of many small, closely overlapping scales
- ripe seed cones are greenish brown in colour
- fruits are small nutlets 2–3 mm in length, having very broad translucent wings, about as wide as the body of the seed
- mature seeds are golden brown in colour

Collection

COLLECTION METHODS

- female seed cones are best collected from standing shrubs by hand-picking or hand-stripping directly into picking bags
- in certain cases, ladders or mechanical lift equipment could be used to access the crown
- pole pruners or pruning shears can be used to remove branches to permit ground collections

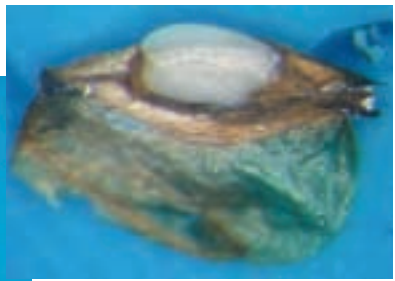
COLLECTION NOTES

- seed cones may be collected just when the bracts start to separate on the earliest cones, which often occurs following a few good night frosts

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for dry fruits

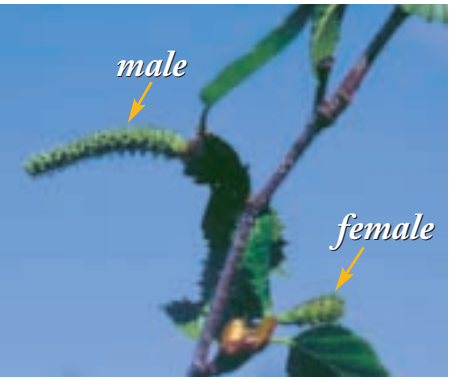
Nutlets (× 8)



Nutlet with seed detail (× 17)

Paper Birch, White Birch, Canoe Birch

Betula papyrifera Marsh.



Flowering

Forecasting

Crop Intervals

- 2 years

Flowering Habits

- flowering mid-April to late May
- male and female flowers occur separately on the same tree, appearing before, or just as, leaves emerge in the spring
- female catkins are thinner and shorter than male catkins and initially extend upward

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 female catkins from male catkins
- male catkins generally occur in clusters on terminal portion of the branch

Further Monitoring

- check during the latter part of July for seed development
- check frequently prior to collection to determine collection timing and to avoid losses
- use cutting test, half-section method, to assess developing seed within catkin

Collecting

WHEN TO COLLECT

- late August through late November

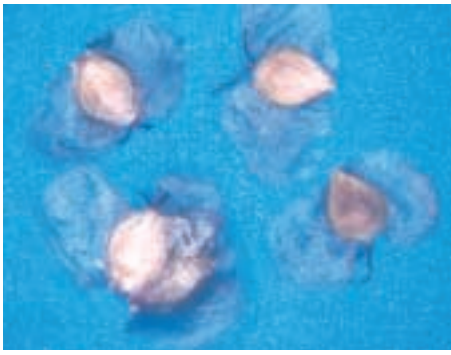
DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- fruits are small, winged nutlets within the catkins; the fruiting catkin is 4–5 cm in length
- female catkins are composed of many small, closely overlapping bracts (scales)
- ripe catkins are greenish brown in colour
- nutlets are 2–3 mm in length, oval- to heart-shaped, and surrounded by a wing
- mature nutlets are golden brown in colour

Collection

COLLECTION METHODS

- female catkins are best collected from standing trees by hand-picking or hand-stripping directly into picking bags
- ladders or mechanical lift equipment can be used to access the crown
- pole pruners or pruning shears can be used to remove branches to permit ground collections
- female catkins can also be collected from trees felled during cutting operations but the timing must be appropriate
- seeds can also be collected in very early winter, **on a very calm day**, by spreading tarpaulins beneath the tree and flailing the branches using a pole to dislodge seed



Nutlets (seeds) (× 9)

COLLECTION NOTES

- ripe catkins shatter easily, so collections should be timed to when seeds are mature but the catkins are still green enough to hold together
- if collecting from ornamental trees, care should be taken to avoid any kind of physical damage to the plant
- once collected, catkins are likely to shatter — care must be taken to distinguish nutlets from bracts
- in populated areas where ornamental birches are planted, hybridization between native and ornamental species can occur, and collection should be avoided

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for dry fruits

Beaked Hazelnut, California Hazelnut

Corylus cornuta Marsh.
Corylus cornuta var. *californica* (A.DC.) Sharp – Coast
Corylus cornuta var. *cornuta* – Interior

Flowering

Forecasting

Crop Intervals

- 1 to several years

Flowering Habits

- flowering January to February
- flowers open in the spring just before the leaves
- male and female catkins on the same plant; male catkins are 4–7 cm, yellowish to greyish in colour and hairy, while female catkins are miniscule and are noticeable by having tiny red stigmas

Forecasting

WHEN TO FORECAST

- July to August

WHAT TO LOOK FOR

- light tan coloured nuts that are surrounded by distinctive light green fringed bractlets

FORECASTING NOTES

- wait until nuts are evident before forecasting the crop

Further Monitoring

- check frequently prior to collection to determine collection timing and to avoid losses

Collecting

WHEN TO COLLECT

- August to September in the interior and September to October on the coast

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- the nuts are egg-shaped and brown to dark tan when mature and in clusters of two to three
- the seeds, contained within the nut, are dominated by the cotyledons

Collection

COLLECTION METHODS

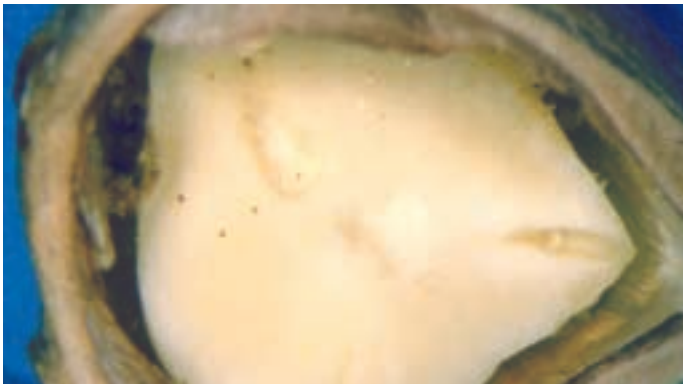
- ripe nuts are best collected by hand-picking directly into picking bags

COLLECTION NOTES

- begin collection as soon as edges of the bractlets turn from light green to brown
- use cutting test to determine seed condition; you may need a pruner for this because seed is hard
- the nuts are edible and tasty
- subject to predation by jays and squirrels, so early collection or protection may be necessary
- *C. cornuta* is easily confused with European hazelnut (*C. avellana),* which is grown as a food crop

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- nuts should be spread out in thin layers and allowed to dry until the husks open enough that seeds can be removed by flailing
- seeds should not be dried before storage, and high humidity should be maintained; partial drying can reduce germination and induce dormancy
- do not store nuts in piles or tubs for extended time periods; store at ambient temperature with good air flow to prevent heat damage
- nuts are best shipped for sowing as soon as possible, but can be held in unsealed containers at room temperature for up to a year
- if nuts are stored for any length of time, there will likely be a need to break dormancy prior to germination



Fruit and seed cross-section (× 6)

Black Twinberry, Bearberry Honeysuckle

Lonicera involucrata (Richards.) Banks *ex* Spreng.

Flowering

Crop Intervals

- annual

Flowering Habits

- flowering mid-May to June
- perfect yellow-coloured flowers, with trumpet-shaped corollas occurring in pairs in leaf axis
- flowers have five lobes and are 10–20 mm in length

Forecasting

WHEN TO FORECAST

- mid-June to first week of July

WHAT TO LOOK FOR

- green twin berries cupped by a pair of large greenish to purplish thickened bracts

Further Monitoring

- check fruit colour transition from green to black, and check seed condition via a cutting test of the berries
- check frequently prior to collection to determine collection timing and to avoid losses

Forecasting

Collection

Collecting

WHEN TO COLLECT

- mid-June to mid-August

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- the ripe fruits are shiny black twin berries containing few to many small seeds
- ripe fruits are 8–12 mm across

COLLECTION METHODS

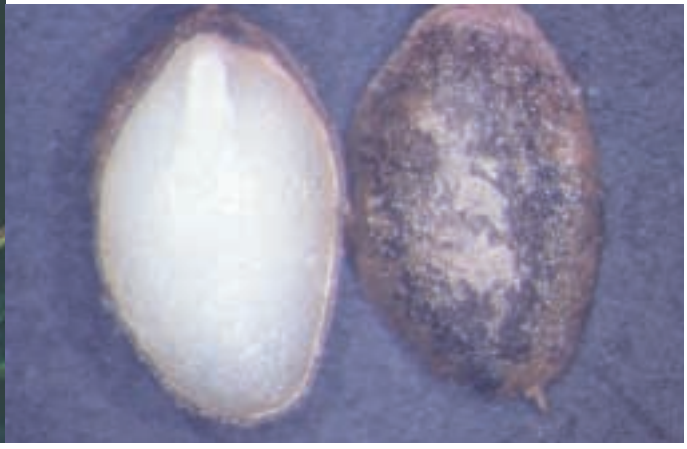
- ripe fruits are best collected by hand-picking directly into picking bags

COLLECTION NOTES

- collect when all fruits are uniformly shiny black in colour
- this species produces several flower and fruit cycles, allowing collection over an extended period

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for fleshy fruits



Seeds (× 20)

Blue Elderberry

Sambucus cerulea Raf. var. *cerulea*

Flowering

Crop Intervals

- annual

Flowering Habits

- flowering mid-June to late July
- tiny, perfect, white to cream-coloured flowers, flat-topped, five branch clusters 7–15 cm across, appearing in summer after leaves are fully grown

Forecasting

WHEN TO FORECAST

- mid-July to first week of August

WHAT TO LOOK FOR

- green berry-like fruits, slightly wider on the bottom than at the top

Further Monitoring

- check fruit colour transition from green to bluish black, and seed via a cutting test
- check frequently prior to collection to determine collection timing and to avoid losses

Forecasting

Collecting

Collection

WHEN TO COLLECT

- early September to mid-October

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- the ripe fruits are bluish black with three to five wrinkled stones, each containing a seed
- ripe fruits are 4–6 mm across and have a noticeable bloom

COLLECTION METHODS

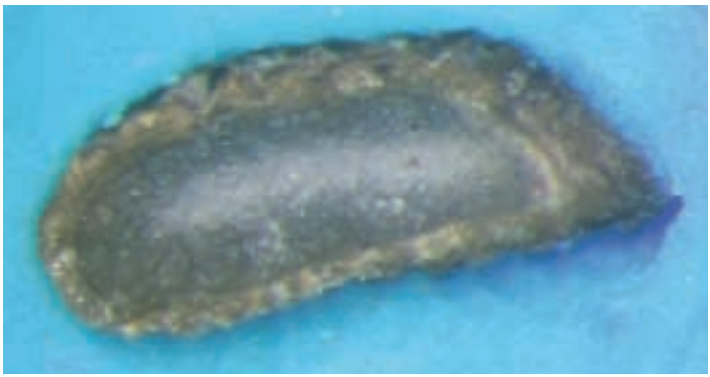
- ripe fruits are best collected by hand-picking directly into picking bags

COLLECTION NOTES

- collect when all fruits are uniformly bluish black in colour

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for fleshy fruits



Seed cross-section (× 28)

Red Elderberry, Red-berry Elder

Sambucus racemosa L. ssp. *pubens* (Michx.) House

Flowering

Crop Intervals

- annual

Flowering Habits

- flowering mid-April to July
- tiny, perfect, white to cream-coloured flowers, 3 to 6 mm across, in an elongated cluster (longer than wide)

Forecasting

WHEN TO FORECAST

- mid-May to first week of July

WHAT TO LOOK FOR

- green berry-like fruits

Further Monitoring

- check fruit colour transition from green to red, and seed maturity via a cutting test of the fruit
- check frequently prior to collection to determine collection timing and to avoid losses

Forecasting

Collecting

WHEN TO COLLECT

- mid-June to mid-August

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- the ripe fruits are scarlet red (occasionally yellow or brown) with three stones, each containing a seed
- ripe fruits are 5–6 mm across

COLLECTION METHODS

- ripe fruits are best collected by hand-picking directly into picking bags

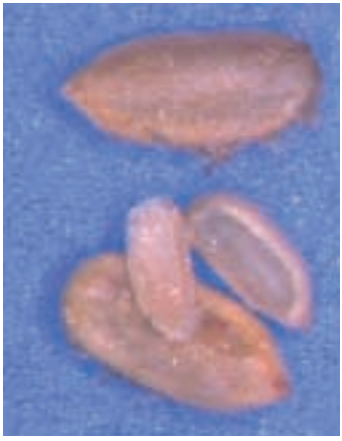
COLLECTION NOTES

- collect when all fruits are uniformly red-coloured

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for fleshy fruits

Collection



Seed cross-section
(× 11)

Common Snowberry, Waxberry

Symphoricarpos albus (L.) Blake

Flowering

Crop Intervals

- annual

Flowering Habits

- perfect, pink to white flowers, June through September

Forecasting

WHEN TO FORECAST

- late June through September

WHAT TO LOOK FOR

- white, berry-like clusters of fruits. Often fruiting and flowering are occurring together

Further Monitoring

- check frequently prior to collection to determine collection timing

Forecasting

Collecting

WHEN TO COLLECT

- mid-September through early winter

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- the fruits are berry-like, waxy white in colour
- each fruit has two (occasionally three) stones composed of a bony endocarp; each stone is 4–5 mm wide and contains a single seed
- mature seeds have an off-white endocarp and a small tan-coloured embryo surrounded by a large amount of endosperm

COLLECTION METHODS

- hand-picking or hand-stripping fruits directly into picking bags or onto groundsheets is the best method for collection

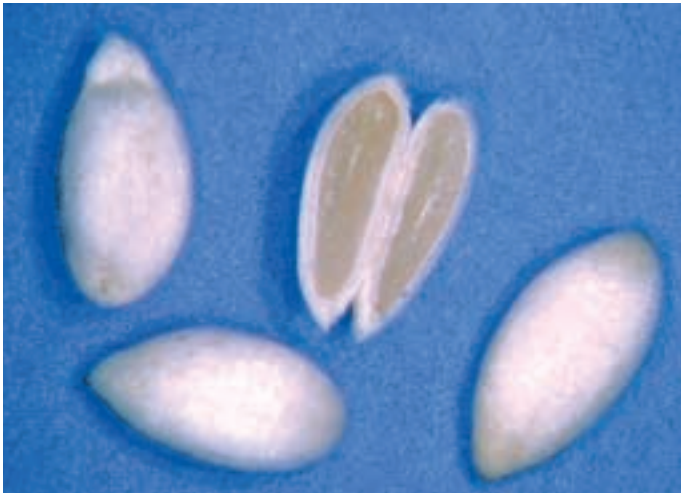
COLLECTION NOTES

- fruits can be collected through fall and into winter; fruits are persistent but often discoloured

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for fleshy fruits

Collection



Seeds and seed cross-section (× 13)

Highbush-cranberry

Viburnum edule (Michx.) Raf.

Crop Intervals

- annual

Flowering Habits

- flowering mid-April to mid-June
- small, white, perfect flowers, 4–7 mm across
- flowers borne on short stems between a pair of leaves in rounded clusters about 2.5 cm wide

Flowering

Forecasting

WHEN TO FORECAST

- end of June to first week in July

WHAT TO LOOK FOR

- small green to light orange drupes, one to five drupes per cluster

Further Monitoring

- check frequently prior to collection to determine collection timing and to avoid losses of fruits to birds and other wildlife

Forecasting

Collecting

WHEN TO COLLECT

- late July to late August

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- fruits are drupes, 8–15 mm in length with two to five drupes per cluster
- ripe fruits are red in colour, but may also be orange to yellow
- each fruit contains one flattened stone, 9 mm in length, which contains one seed (after processing, stone will be stained pink by the fruit juice)

Collection

COLLECTION METHODS

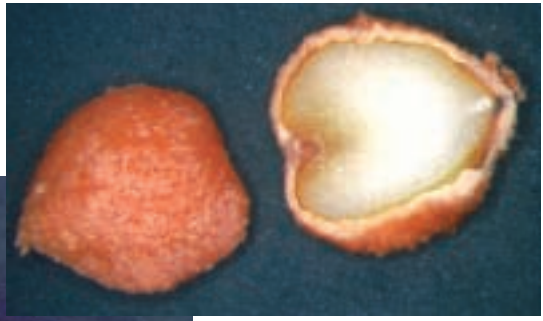
- ripe fruits are most easily collected by hand-picking using a picking bag

COLLECTION NOTES

- fruits should be collected when their colour changes from green to red-orange

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for fleshy fruits



Cross-section of stone (× 5)

Fruit

Red-osier Dogwood

Cornus stolonifera Michx.

Flowering

Crop Intervals

- annual

Flowering Habits

- perfect flowering, April to August
- flowering occurs up to three times in one growing season
- flower clusters are white to greenish white in colour, appointed with four petals and four stamens

Forecasting

WHEN TO FORECAST

- last week of June to first week of July

WHAT TO LOOK FOR

- green drupes in clusters

Further Monitoring

- check frequently prior to collection to determine collection timing and to avoid loss of fruits to birds

Forecasting

Collecting

Collection

WHEN TO COLLECT

- mid-July to mid-October

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- fruits are small drupes, 6–8 mm in diameter
- ripe fruits are snowy white to blue tinged
- each fruit contains a single bony stone that contains one to two seeds
- a mature seed has a very small, white embryo surrounded by a large amount of endosperm

COLLECTION METHODS

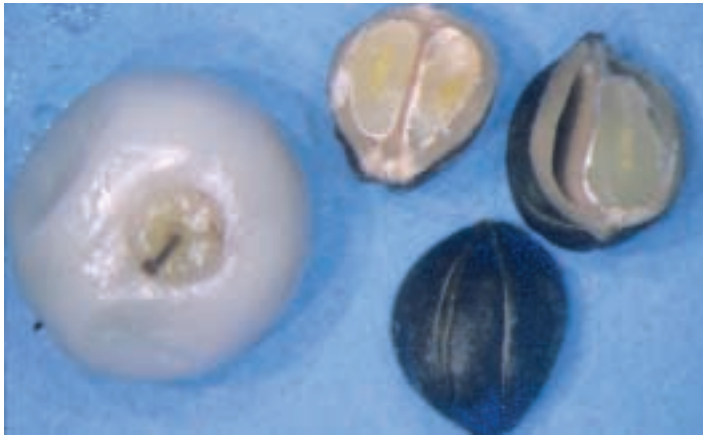
- hand-picking or hand-stripping fruits directly into picking bags or onto ground sheets is the best method of collection as soon as they are ripe

COLLECTION NOTES

- fruits should be collected when their colour changes from green to white
- fruits will turn dark bluish in colour when overripe
- the first crop of the season is usually the largest and has the most fruit; two crops per season would beconsidered normal, any more than that would be an exception

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for fleshy fruits



Fruit and seed cross-section (× 6)

Common Juniper, Ground Juniper

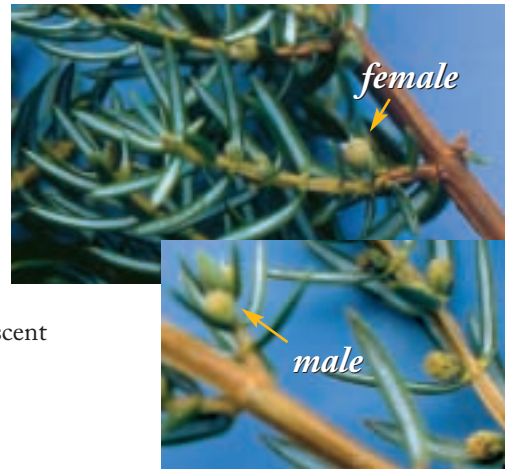
Juniperus communis L.

Crop Intervals

- irregular intervals

Flowering Habits

- flowering mid-April to late May
- male and female flowers occur separately on different trees
- male flowers are yellow and form a short catkin; female flowers are greenish, composed of three to eight pointed scales, which become fused to form a fleshy indehiscent strobilus and are often called a juniper berry



Flowering

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 waxy film
- seed cones are fleshy, berry-like, green in the first year, ripening in the second year to bluish-black

FORECASTING NOTES

- there is considerable genetic variation and hybridization within the genus *Juniperus*, so be sure to confirm species identification

Forecasting

Further Monitoring

- check during the latter part of July for seed development on second-year cones
- check frequently prior to collection to determine collection timing and to avoid losses
- use cutting test, half-section method, to assess developing seed within fruit
- number of filled seeds varies widely from tree to tree

Collecting

Collection

WHEN TO COLLECT

- mid-August through late November

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- cones are 10–15 mm in diameter, globose or broadly ovoid in shape, and coated with a thin resinous waxy coating
- ripe fruits are bluish black in colour
- seed coat has two layers: a thick, hard outer layer, and a thin membraneous inner layer
- mature seeds are golden brown in colour and tri-cornered

COLLECTION METHODS

- ripe fruits can be collected by hand-picking or hand-stripping directly into picking bags or by stripping fruit onto ground tarpaulins
- fruits can also be collected by spreading tarpaulins beneath the plant and flailing the branches using a pole

COLLECTION NOTES

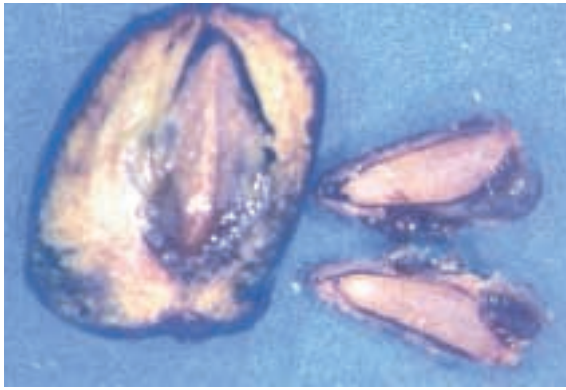
- avoid collecting from plants with large quantities of green fruits, because they are difficult to separate from mature fruits and will increase collection and processing costs significantly
- when picking juniper berries by hand, care should be exercised; gloves and other personal safety equipment should be worn as needles can cause serious injuries

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for fleshy fruits

SPECIAL NOTES

- juniper species are conifers with evergreen needles



Fruit and seed cross-section
(× 6)

Wolf-willow

Elaeagnus commutata Bernh. *ex* Rydb.

Flowering

Forecasting

Crop Intervals

- 1–2 years

Flowering Habits

- flowering early May to mid-June
- perfect, tubular-shaped flowers, with four pointed lobes, which are yellow inside and silvery outside, borne in clusters of three or four at leaf bases
- flowers tend to be very fragrant

Forecasting

WHEN TO FORECAST

- last week of June to first week of July

WHAT TO LOOK FOR

- small green clusters of berry-like fruits

Further Monitoring

- check during the latter part of July for seed development
- check frequently prior to collection to determine collection timing and to avoid losses
- use cutting test, half-section method, to assess developing seeds within the fruits

Collecting

Collection

WHEN TO COLLECT

- mid-September through late November

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- the fruits, small oval-shaped "berry-like" structures, are approximately 10–20 mm in length
- ripe fruits are silver in colour
- each fruit consists of a dry, indehiscent achene, which is covered with a mealy outer pulp, the "silver berry"
- mature achenes are 7–10 mm in length and woody, and with alternating dark (thicker) and tan (thinner) stripes
- within the hard woody achene is the true seed
- mature seeds are 5–8 mm in length, light brown in colour with dark-brown stripes extending the length of the seed coat
- each seed contains a seed coat and embryo, but no endosperm, although the fleshy cotyledons are often mistaken as such

COLLECTION METHODS

- fruits can be collected by hand-picking or hand-stripping directly into picking bags

COLLECTION NOTES

- when picking fruits by hand, care should be exercised

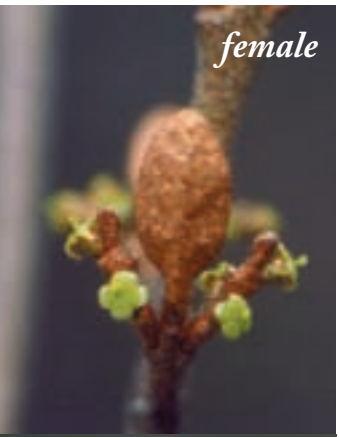
FIELD STORAGE AND TRANSPORTATION PROCEDURES

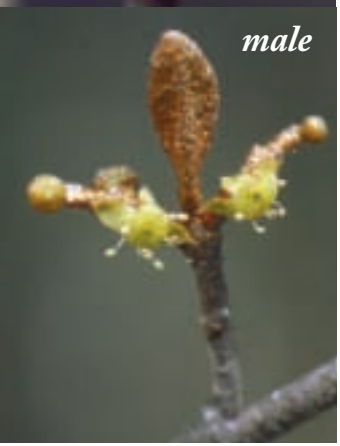
- fruits can be allowed to air dry, as the dry outer pulp can be removed by either wet maceration or by using a dry brushing
- if the dry processing method is being used, fruits should be kept on trays with fine mesh screened bottoms or in fine nylon net bags under cool, dry, shaded, and well-ventilated conditions to prevent heating and major losses in seed viability; careful and close monitoring is essential
- refer to field storage and transportation guidelines for dry fruits

Fruit and seed cross-section (× 5)

Soopolallie, Soapberry, Canadian Buffalo-berry

Shepherdia canadensis (L.) Nutt.





Flowering

Crop Intervals

- annual

Flowering Habits

- flowering late April to late May
- flowers are inconspicuous, yellowish brown in colour, and either single or in small clusters on stems in leaf axis
- male and female flowers occur on separate plants

Forecasting

WHEN TO FORECAST

- mid-June

WHAT TO LOOK FOR

- green berries, dotted with distinctive pale scales

Further Monitoring

- check fruit colour transition from green to bright red, and seed quality via a cutting test of the berries

Forecasting

Collecting

WHEN TO COLLECT

- late July through mid-August

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- the ripe fruits, which look like berries, are actually achenes with a fleshy covering that is derived from the flower
- the mature fruits are bright red in colour and somewhat translucent, 6–8 mm in length
- ripe seeds are oval to round and 4 mm in length, containing large cotyledons and a smaller portion of endosperm, which surrounds the radicle and hypocotyl

COLLECTION METHODS

- ripe fruits are best collected by hand-picking directly into picking bags or by flailing them from the plants onto heavy ground sheets

COLLECTION NOTES

- collect when all fruits are bright red or orange in colour

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for fleshy fruits

SPECIAL NOTES

- the fruits of this species can be either a bright red or distinctively orange in colour
- fruits are soapy to the touch when crushed

Collection

Fruit

Seed and seed cross-section (× 10)

Arbutus, Madrone, Pacific Madrone

Arbutus menziesii Pursh

Flowering

Crop Intervals

- annual (irregular)

Flowering Habits

- dense drooping clusters of perfect white flowers, March through June

Forecasting

WHEN TO FORECAST

- mid-July onwards

WHAT TO LOOK FOR

- green "citrus-like" rough-skinned fruits that turn orange and red as they ripen; the fruits are actually berries

FORECASTING NOTES

- within a plant, fruit maturity is highly variable; the sequence of fruit colours is roughly from green to orange or reddish, deepening in colour with maturity

Further Monitoring

- check frequently prior to collection to determine collection timing; within a single plant there is often a range of fruit maturity stages

Forecasting

Collecting

Collection (note variability in colour)

WHEN TO COLLECT

- October through December

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- the fruits are mealy upon dissection and contain about 10–30 seeds

COLLECTION METHODS

- hand-picking or hand-stripping berries directly into picking bags or onto groundsheets is the best method for collection; use pole pruners for larger trees

COLLECTION NOTES

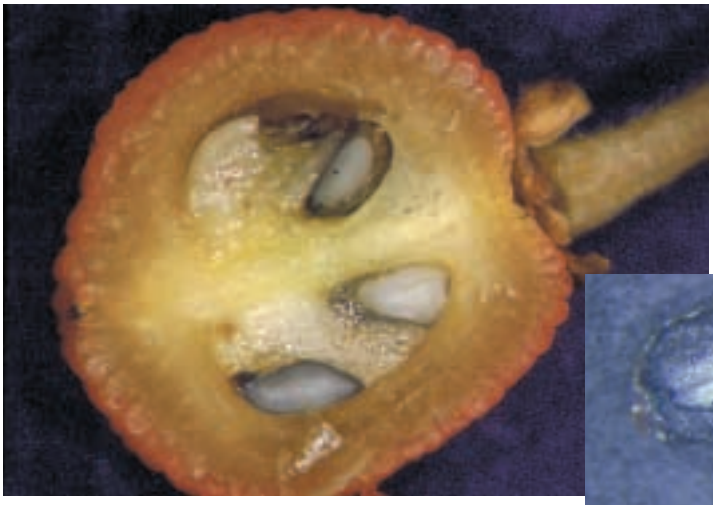
- be sure to collect only fruits that are mature; leave immature fruits for a collection later in the season

FIELD STORAGE AND TRANSPORTATION PROCEDURES

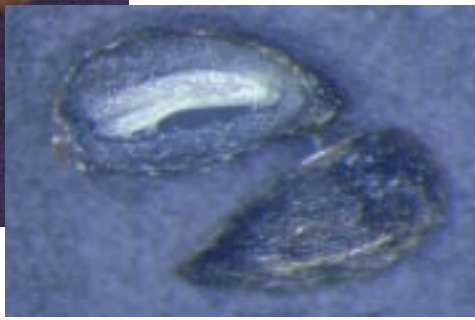
- fruits can be air dried at room temperature (16–20°C); they will need to be rehydrated before seeds are separated from fruits
- alternately, seeds can be separated from the pulp directly after harvest

SPECIAL NOTES

- this species is a broad-leaved evergreen



Fruit cross-section (× 9)



Seed cross-section showing embryos (× 16)

Kinnikinnick, Common Bearberry

Arctostaphylos uva-ursi (L.) Spreng.

Flowering

Crop Intervals

- annual

Flowering Habits

- flowering April to June
- small, drooping, perfect, white to pinkish-coloured flowers, urn-shaped, occurring in clusters or singularly at branch tips

Forecasting

WHEN TO FORECAST

- very late June to mid-July

WHAT TO LOOK FOR

- small green berries

Further Monitoring

- check fruit colour transition from green to red, and seed quality via a cutting test

Forecasting

Collecting

WHEN TO COLLECT

- late August to October
- ripened fruit will stay on plants through winter but snowfalls will make collection difficult

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- the ripe fruits are bright shiny red and berry-like, resembling miniature apples, with a white mealy interior, containing four to 10 stony seeds
- ripe fruits are 5–10 mm across

Collection

COLLECTION METHODS

- ripe fruits are best collected by hand-picking directly into picking bags

COLLECTION NOTES

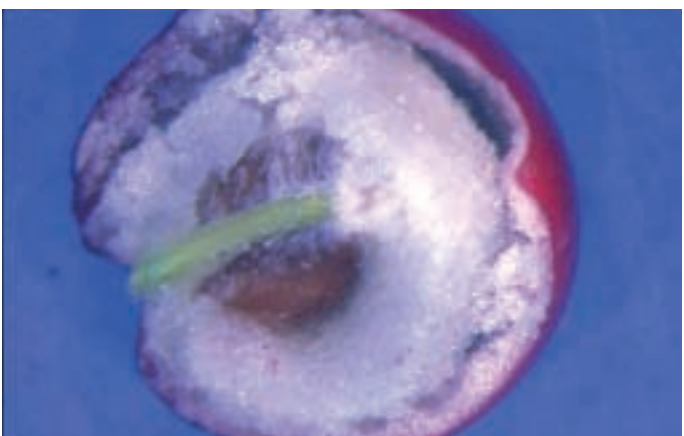
- collect when all fruits are uniformly shiny red in colour

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for fleshy fruits

SPECIAL NOTES

- this is a broad-leaved evergreen



Cross-section of fruit exposing seeds (× 8)

Salal

Gaultheria shallon Pursh

Flowering

Forecasting

Crop Intervals

- annual

Flowering Habits

- perfect, white to pinkish, urn-shaped flowers, March through July

Forecasting

WHEN TO FORECAST

- mid-July onwards

WHAT TO LOOK FOR

- green, reddish, to purple fruit

FORECASTING NOTES

- within a plant, fruit maturity is highly variable; the sequence of fruit colours is roughly from green, to reddish, to finally a deep purple-black at maturity

Further Monitoring

- check frequently prior to collection to determine collection timing; within a single plant there is often a range of fruit maturity stages

Collecting

WHEN TO COLLECT

- mid-August through September

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- the fruits are berry-like, containing many seeds

COLLECTION METHODS

- hand-picking or hand-stripping berries directly into picking bags or onto groundsheets is the best method for collection

COLLECTION NOTES

- fruits can be collected over a prolonged period
- be sure to collect only fruits that are mature; leave immature fruits for collection later in the season

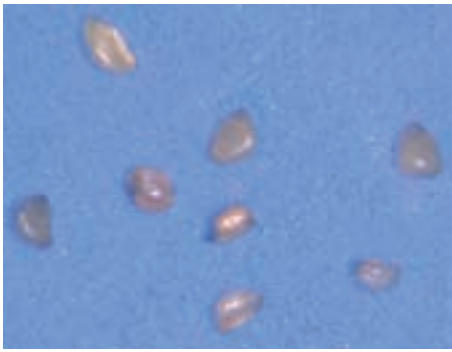
FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to storage and transportation guidelines for fleshy fruits

SPECIAL NOTES

- this species is a broad-leaved evergreen

Collection



Seeds (× 6)

False Azalea, Fool's Huckleberry

Menziesia ferruginea Sm.

Flowering

Crop Intervals

- annual

Flowering Habits

- small, urn-shaped flowers, ranging in colour from pink to salmon to greenish orange, May to July

Forecasting

WHEN TO FORECAST

- mid-July onwards

WHAT TO LOOK FOR

- green, four-valved upright capsules

Further Monitoring

- check frequently prior to collection to determine collection timing; within a single plant there is often a range of fruit maturity stages

Forecasting

Collecting

WHEN TO COLLECT

- mid-August through October, depending on elevation of occurrence

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- the fruits are four-valved capsules, 5–7 mm long, that look like elongated teardrops when mature, containing many tiny, dry, feather-like seeds, dispersed by wind; at maturity, colour rapidly shifts from green to brown just prior to opening of capsules

COLLECTION METHODS

- hand-picking or hand-stripping capsules directly into picking bags or onto groundsheets is the best method for collection

COLLECTION NOTES

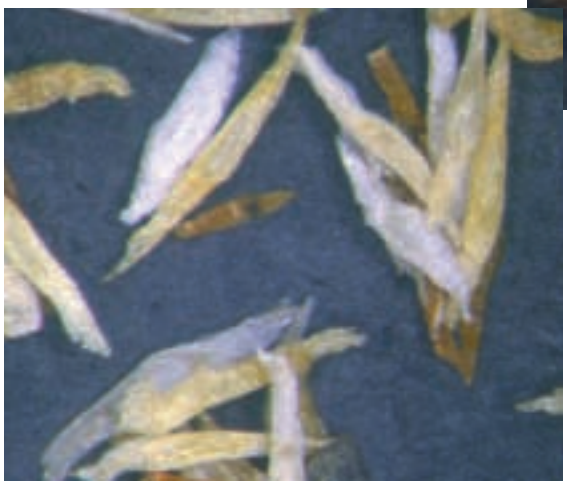
- timing of collection is important, as fruits are dehiscent, and delay can cause loss of seeds

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for dry fruits

Collection

Capsule and seeds (× 10)



Seeds (× 20)

Velvet-leaved Blueberry

Vaccinium myrtilloides Michx.

Crop Intervals
- annual

Flowering Habits
- perfect, white to pink-tinged, open, bell-shaped flowers in clusters, April through July

Flowering

Forecasting

WHEN TO FORECAST
- mid-June onwards

WHAT TO LOOK FOR
- green fruit

FORECASTING NOTES
- within a plant, fruit maturity is variable; the sequence of fruit colours is roughly from green to bluish to light purple to dark blue, with a waxy bloom at maturity

Further Monitoring
- check frequently prior to collection to determine collection timing; within a single plant there is often a range of fruit maturity stages

Forecasting

Collecting

Collection

WHEN TO COLLECT

- June through August

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- the fruits are blue berries with noticeable bloom, 6–10 mm in diameter, containing many seeds
- seeds are small and half-moon shaped, with a textured surface, and tend to be stained the colour of the berry juice (purplish)

COLLECTION METHODS

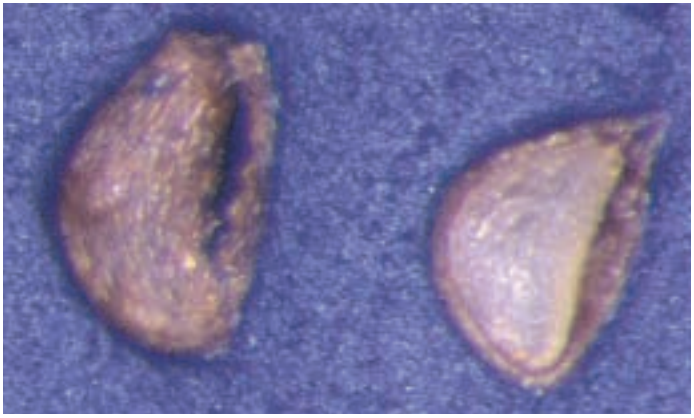
- hand-picking or hand-stripping berries directly into picking bags or onto groundsheets is the best method for collection

COLLECTION NOTES

- fruits can be collected over a prolonged period
- be sure to collect only mature fruits; leave immature fruits for a collection later in the season

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for fleshy fruits



Seeds (× 39)

Red Huckleberry

Vaccinium parvifolium Sm.

Flowering

Forecasting

Crop Intervals

- annual

Flowering Habits

- perfect, greenish yellow to pinkish, urn-shaped flowers, April through June

Forecasting

WHEN TO FORECAST

- mid-June onwards

WHAT TO LOOK FOR

- green fruit

FORECASTING NOTES

- within a plant, fruit maturity is highly variable; the sequence of fruit colours is roughly from green to pale red to bright red at maturity

Further Monitoring

- check frequently prior to collection to determine collection timing; within a single plant there is often a range of fruit maturity stages

Collection

Collecting

WHEN TO COLLECT

- late June to mid-August

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- the fruits are bright red berries with many small seeds
- seeds are half-moon to irregularly shaped with textured surface, and take on the hue of the berry juice (pinkish)

COLLECTION METHODS

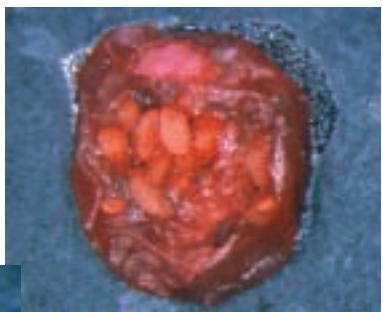
- hand-picking or hand-stripping berries directly into picking bags or onto groundsheets is the best method for collection

COLLECTION NOTES

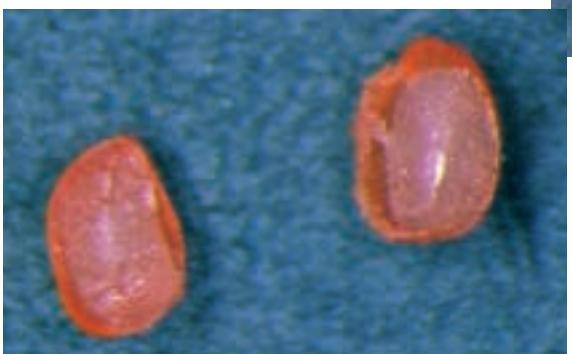
- fruits can be collected over a prolonged period
- be sure to collect only mature fruits; leave immature fruits for collection later in the season

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for fleshy fruits



Berry with seeds (× 7)



Seeds (× 25)

Garry Oak

Quercus garryana Dougl.

Flowering

Crop Intervals

- 2–3 years

Flowering Habits

- flowering February to May
- inconspicuous male and female flowers on different inflorescences on the same tree; male flowers in hanging catkins, female flowers in single or small clusters

Forecasting

WHEN TO FORECAST

- June to July

WHAT TO LOOK FOR

- green acorns

Forecasting

Collecting

Collection

WHEN TO COLLECT

- September to October

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- the fruits are nuts (acorns)
- the acorns are 2–3 cm long, with fine ribbing on the surface, and held in rough acorn caps — at maturity acorns easily fall out of the caps with gentle handling
- the single seed, contained within the acorn, is dominated by the cotyledons, of a creamy yellow colour

COLLECTION METHODS

- ripe acorns are best collected by hand-picking directly into picking bags

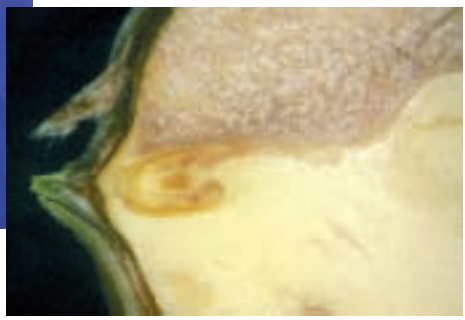
COLLECTION NOTES

- begin collection as soon as acorns turn from light green to brown
- there is some developmental variation, and greenish tan and brown acorns are often side-by-side
- use cutting test to determine seed condition; you may need a pruner for this as the fruit is hard
- avoid collecting mature fallen acorns to which the caps are still attached
- fruits are prone to insect damage evident from bore holes; damaged seeds can be identified by floating acorns in water

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for recalcitrant seeds
- to avoid heating or drying concerns during transit, ship acorns by the quickest method in damp burlap cone sacks

Acorn cross-section (× 2)



Seed cross-section detail (× 12)

Waxy Currant

Ribes cereum Dougl. var. *cereum*

Crop Intervals

- annual

Flowering Habits

- flowering April to June
- tiny, perfect, greenish white to pink-shaded, cream-coloured flowers, tubular-shaped, borne either singly or in small clusters of two to eight

Flowering

Forecasting

WHEN TO FORECAST

- mid-June

WHAT TO LOOK FOR

- green berries

Further Monitoring

- check fruit colour transition from green to red (or orange), and seed quality via a cutting test of the berries

Forecasting

Collecting

WHEN TO COLLECT

- late July to mid-August

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- the fruits are many-seeded berries, usually red in colour, but often orange
- ripe seeds contain a large endosperm in which there is a tiny embryo, mainly visible due to the cotyledons

COLLECTION METHODS

- ripe fruits are best collected by hand-picking directly into picking bags

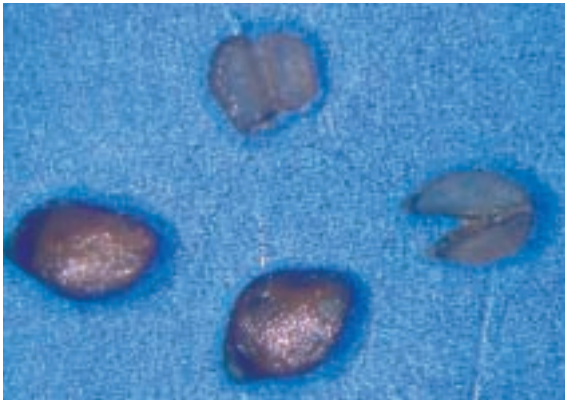
COLLECTION NOTES

- collect when all fruits are uniformly red (or orange) in colour

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for fleshy fruits

Collection



Seed cross-sections (× 8)

Red-flowering Currant

Ribes sanguineum Pursh var. *sanguineum*

Flowering

Crop Intervals

- annual (irregular)

Flowering Habits

- flowering April to May
- perfect pink to white flowers, tubular-shaped, in fragrant drooping clusters of 10–20 flowers; often sepals and petals are different shades

Forecasting

WHEN TO FORECAST

- June

WHAT TO LOOK FOR

- green glandular-haired berries, which still have withered remnants of the tubular flowers

Further Monitoring

- check fruit colour transition from green to blue-black, and seed quality via a cutting test of the berries

Forecasting

Collecting

WHEN TO COLLECT

- late July to mid-August

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- the ripe fruits are many-seeded berries, blue-black in colour, with a pale bloom
- ripe seeds contain a large endosperm in which there is a tiny embryo, mainly visible due to the cotyledons

COLLECTION METHODS

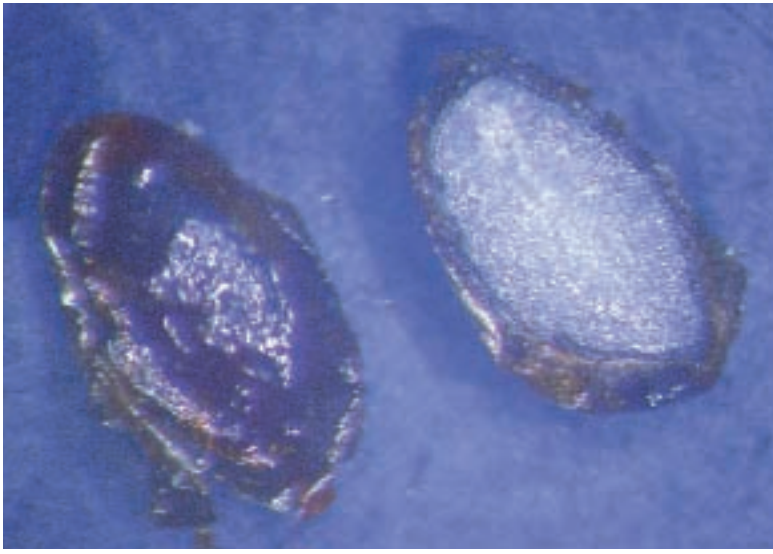
- ripe fruits are best collected by hand-picking directly into picking bags

COLLECTION NOTES

- collect when all fruits are uniformly black

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for fleshy fruits



Fruit and seeds (× 22)

Mock-orange

Philadelphus lewisii Pursh

Flowering

Crop Intervals

- annual

Flowering Habits

- flowering early May to mid-July
- fragrant, perfect, white, showy flowers with usually four oblong petals occurring in showy clusters of three to 15 flowers at branch ends

Forecasting

WHEN TO FORECAST

- last week of June to late July

WHAT TO LOOK FOR

- green, four-chambered capsules

Further Monitoring

- check during mid-August for seed development
- check frequently prior to collection to determine collection timing and to avoid losses
- use cutting test, half-section method, to assess developing seeds within capsules

Forecasting

Collecting

WHEN TO COLLECT

- mid-September through late October

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- fruits are small four-chambered capsules, 6–10 mm in length
- ripe capsules are brown in colour
- seeds within the capsules are 2 mm long and rod-like in shape with a fringed outgrowth, called a caruncle, on the micropylar end
- mature seeds are golden brown in colour

COLLECTION METHODS

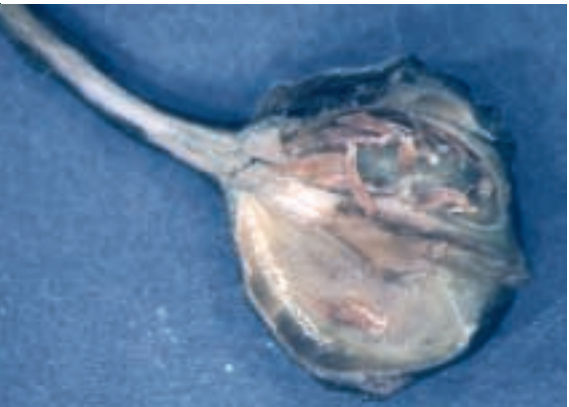
- capsules are best collected from standing shrubs by hand-picking or hand-stripping directly into picking bags
- in certain cases, ladders or mechanical lift equipment could be used to access the crown
- pole pruners or pruning shears can be used to remove branches to permit ground collections

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for dry fruits

Collection

Seeds (× 4)



Capsule with visible seeds (× 15)

Redstem Ceanothus

Ceanothus sanguineus Pursh

Flowering

Crop Intervals

- annual

Flowering Habits

- perfect flowers, April through June
- fragrant, tiny white flowers in dense clusters on reddish stalks

Forecasting

WHEN TO FORECAST

- mid-June

WHAT TO LOOK FOR

- green three-lobed capsule containing three seeds

FORECASTING NOTES

- be sure of species identification: *C. velutinus* has thick leathery evergreen leaves whereas *C. sanguineus* has thin deciduous leaves

Forecasting

Collecting

WHEN TO COLLECT

- mid-June to late July

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- fruit is a three-lobed capsule containing one seed per lobe
- seeds are very small, approximately 2.5 mm long, dark brown in colour, and round in shape

COLLECTION METHODS

- branches bearing capsules can be covered with cotton, fine-mesh bags to collect seeds when capsules explode
- ripening capsules should not be cut from the plant, as seeds will not ripen correctly

COLLECTION NOTES

- explosive capsules

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for dry fruits

Seed cross-section (× 28)

Snowbrush

Ceanothus velutinus Dougl. *ex* Hook.

Flowering

Crop Intervals

- annual

Flowering Habits

- perfect, late May through June
- fragrant, tiny white flowers in dense pyramidal clusters

Forecasting

WHEN TO FORECAST

- mid-July

WHAT TO LOOK FOR

- green three-lobed capsules

FORECASTING NOTES

- be sure of species identification: *C. sanguineus* has thin deciduous leaves whereas *C. velutinus* has thick leathery evergreen leaves

Forecasting

Collecting

WHEN TO COLLECT

- mid- to late August

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- seeds are very small, approximately 2.5 mm long, dark brown in colour, and round in shape

COLLECTION METHODS

- branches bearing capsules can be covered with cotton, fine-mesh bags to collect seeds when capsules explode
- ripening capsules should not be cut from the plant, as seeds will not ripen correctly

COLLECTION NOTES

- explosive capsules

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for dry fruits

Collection

Saskatoon

Amelanchier alnifolia Nutt.

Flowering

Crop Intervals

- annual

Flowering Habits

- perfect, flowering May to June
- large fragrant flowers are white in colour, appointed with five petals in erect clusters at the branch ends

Forecasting

WHEN TO FORECAST

- end of June to first week in July

WHAT TO LOOK FOR

- small green fruit

Further Monitoring

- check frequently prior to collection to determine collection timing and to avoid loss of fruits to birds

Forecasting

Collecting

WHEN TO COLLECT

- mid-July

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- ripe fruits are small, dull reddish purple pomes, with a white bloom, 12–15 mm in diameter, and resemble miniature apples
- seeds are 3–4 mm in length and are somewhat crescent-shaped
- mature seeds are hard and dark brown in colour
- mature seeds have a large, white, well-developed cotyledon that fills the seed cavity

COLLECTION METHODS

- ripe fruits are most easily collected by hand-picking using a picking bag

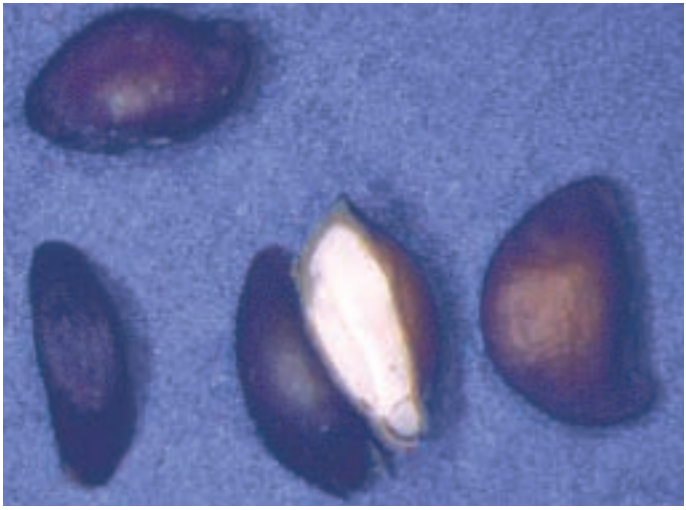
COLLECTION NOTES

- collections are often missed due to the very early ripening date of the fruit
- fruits ripen in stages, so plan your collection accordingly
- fruits should be collected as soon as they are ripe to reduce losses to birds

Collection

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for fleshy fruits



Seeds and seed cross-section (× 10)

Black Hawthorn

Crataegus douglasii Lindl.

Flowering

Crop Intervals

- 1–2 years

Flowering Habits

- flowering late April to late May
- perfect, white, showy, saucer-shaped flowers with five rounded petals occurring at branch tips; the stamens have distinct pink anthers

Forecasting

WHEN TO FORECAST

- last week of June to first week of July

WHAT TO LOOK FOR

- small green clusters of apple-like pomes

Further Monitoring

- check during the latter part of July for seed development

Forecasting

Collecting

Collection

WHEN TO COLLECT

- mid-August to mid-September

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- the fruits are small oval-shaped pomes, 15–19 mm in diameter
- ripe fruits are deep red to blackish purple in colour
- each fruit consists of a fleshy outer pulp in which are embedded up to five stones
- mature stones are golden brown to brown in colour and 7–9 mm in length
- the mature stone is quite hard, so you may need pruners or a sharp knife for cutting tests rather than a single-edged razor blade
- each stone contains a well-developed embryo but no endosperm, although the fleshy cotyledons are often mistaken as such

COLLECTION METHODS

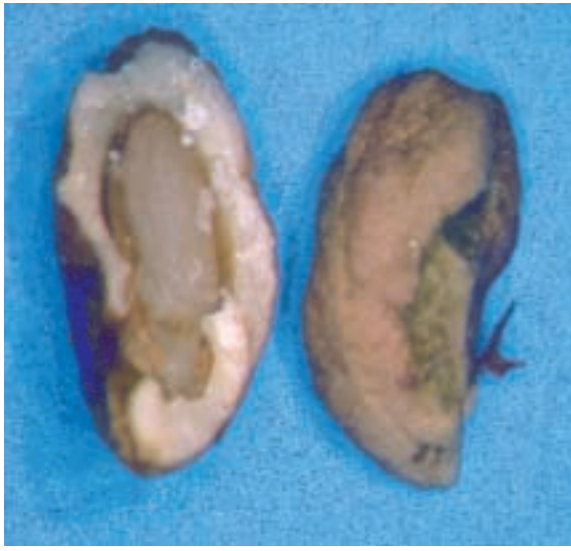
- fruits can be collected from standing trees by hand-picking or hand-stripping directly into picking bags
- fruits can also be gathered from the ground once natural dispersal occurs; however, avoid collecting fruits that may have aborted earlier
- fruits can also be collected by spreading tarpaulins beneath the tree and flailing the branches using a pole

COLLECTION NOTES

- when picking fruits by hand, exercise care and wear gloves and other personal safety equipment, as thorns can cause serious injuries

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for fleshy fruits



Stone cross-section (× 9)

Oceanspray, Creambush

Holodiscus discolor (Pursh) Maxim.

Flowering

Crop Intervals

- annual

Flowering Habits

- perfect, flowering in late June to late July
- clustered pyramidal-shaped flower head, cream to white in colour

Forecasting

WHEN TO FORECAST

- last week of July to first week of August

WHAT TO LOOK FOR

- plants occur on dry to moist open sites, open woods, harvested areas, thickets, and clearings
- fruits are tiny, hairy achenes appearing after flowering is complete

Forecasting

Collecting

WHEN TO COLLECT

- late August to late October

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- ripe fruits are tiny, approximately 2 mm in length, and yellowish brown in colour

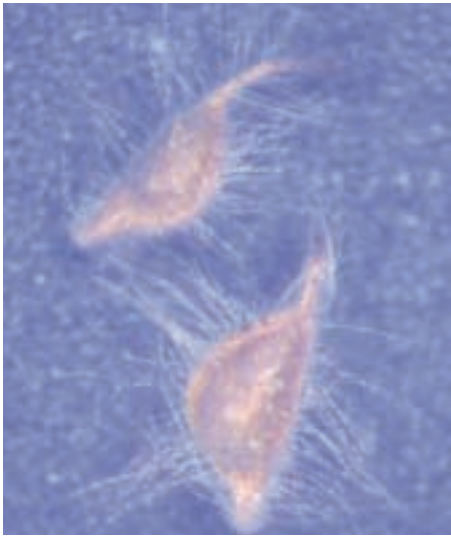
COLLECTION METHODS

- mature fruit clusters are best collected by hand-picking directly into picking bags
- fruits can be collected directly from plants by placing a tray, box, or netted hoop under the plant's branches and flailing them with a paddle or racquet

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for dry fruits

Collection



Fruits (× 14)

Pacific Crab Apple

Malus fusca (Raf.) Schneid

Flowering

Crop Intervals

- 2–4 years

Flowering Habits

- flowering mid-April to late May
- fragrant, perfect, white to pink, showy, saucer-shaped flowers with five rounded petals occurring in flat-topped clusters at branch tips on spur shoots

Forecasting

WHEN TO FORECAST

- last week of June to first week of July

WHAT TO LOOK FOR

- small green clusters of apple-like pomes

Further Monitoring

- check during the latter part of July for seed development
- check frequently prior to collection to determine collection timing and to avoid losses due to insects
- use cutting test, half-section method, to assess developing seeds within the pome

Forecasting

Collecting

WHEN TO COLLECT

- mid-September through late November

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- the fruits are small, egg-shaped pomes, 10–15 mm in length
- ripe fruits are purplish red in colour or yellow with red patches
- the fruits have a fleshy outer pulp in which are embedded up to five carpels with each carpel containing two seeds or only one due to abortive characteristics
- mature seeds are brown to dark brown in colour and 7–8 mm in length

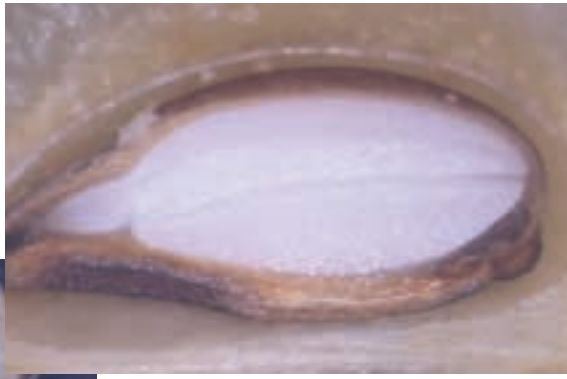
Collection

COLLECTION METHODS

- fruits can be collected from standing trees by hand-picking or hand-stripping directly into picking bags
- fruits can also be gathered from the ground once natural dispersal occurs; however, avoid collecting fruits that may have aborted earlier
- fruits can also be collected by spreading tarpaulins beneath the tree and flailing the branches using a pole

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for fleshy fruits



Seed (× 16)

Fruit and seed (× 6)

Pacific Ninebark

Physocarpus capitatus (Pursh) Kuntze

Flowering

Crop Intervals

- annual

Flowering Habits

- perfect, flowering May to June
- flowers are small, white in colour, with five petals and approximately 30 pink stamens

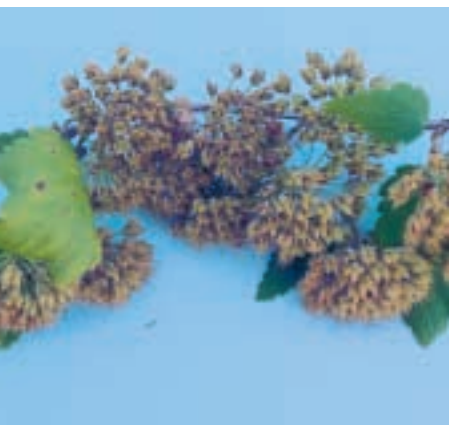
Forecasting

WHEN TO FORECAST

- last week of June to first week of July

WHAT TO LOOK FOR

- greenish fruits with tinges of red, hanging in clusters



Forecasting

Collecting

WHEN TO COLLECT

- mid-September to late October; some fruits may persist until the end of winter

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- ripe fruits are light brown in colour
- fruits are follicles, with a cluster of three to five follicles lightly joined at the basal end, with each follicle having one to four seeds
- mature seeds are golden brown and very shiny
- seeds are 2 mm in length, somewhat oval in shape, narrowing towards the radicle area of the seed

COLLECTION METHODS

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

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for dry fruits

Collection

Seeds and seed cross-section (× 13)

Bitter Cherry

Prunus emarginata (Dougl.) Walp.

Crop Intervals

- annual

Flowering Habits

- perfect, flowering in late April to early June
- fragrant, flat-topped flower clusters, white or pinkish in colour, occurring from leaf axis
- flowers are small, saucer-shaped, 1–1.5 cm wide, with 20 to 30 stamens and five petals

Flowering

Forecasting

WHEN TO FORECAST

- mid-June to last week of June

WHAT TO LOOK FOR

- fruits are green, shiny, egg-shaped, somewhat longer than wide, on a single stem

Forecasting

Collecting

Collection

WHEN TO COLLECT

- mid-July to mid-August

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- fruits are drupes approximately 8–12 mm in diameter and egg-shaped
- ripe fruits are shiny, and bright to deep red in colour, and consist of a mass of juicy pulp in which a single stone is contained
- mature stones are brown in colour

COLLECTION METHODS

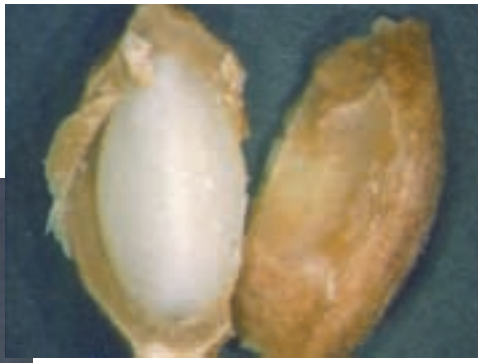
- collect ripe fruits by hand-picking directly into picking bags or by spreading ground tarpaulins under the trees to catch natural fall or to catch fruits that have been stripped from tree
- fruits can also be flailed from the crowns onto ground tarpaulins using poles

COLLECTION NOTES

- be sure of species identification
- fruits of *Prunus* species should be collected when fully mature; this facilitates cleaning and is likely to result in good germination
- wait until cherries soften before collecting and once softened, collect promptly to avoid excessive losses to birds and other wildlife
- timing of collection is important, since fruits generally persist on the tree for only a few weeks after seeds mature

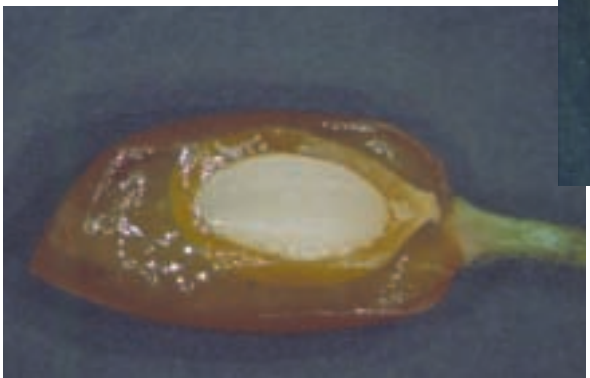
FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for fleshy fruits



Stone and seed cross-section (× 8)

Fruit (× 5)



Pin Cherry, Bird Cherry

Prunus pensylvanica L. f.

Crop Intervals

- annual

Flowering Habits

- perfect, flowering in late April to early June
- fragrant, flat-topped flower clusters, white in colour, occurring from leaf axis
- flowers are small, saucer-shaped, 1–1.5 cm wide, with about 20 stamens and five petals

Flowering

Forecasting

WHEN TO FORECAST

- mid-June to last week of June

WHAT TO LOOK FOR

- fruits are green on a single stem

Forecasting

Collecting

WHEN TO COLLECT

- mid- to late July

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- "cherries" are drupes approximately 4–7 mm in diameter and round in shape
- ripe fruits are bright red in colour
- mature stones are brown in colour

COLLECTION METHODS

- collect ripe fruits by hand-picking directly into picking bags or by spreading ground tarpaulins under the trees to catch natural fall or to catch fruits that have been stripped from tree
- fruits can also be flailed from the crowns onto ground tarpaulins using poles

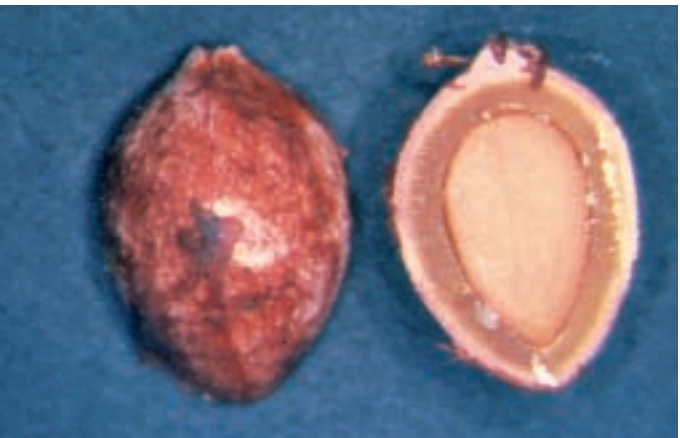
COLLECTION NOTES

- be sure of species identification
- fruits of *Prunus* species should be collected when fully mature; this facilitates cleaning and is likely to result in good germination
- wait until cherries soften before collecting and once softened, collect promptly to avoid excessive losses to birds and other wildlife
- timing of collection is important since fruits can persist on the tree for only a few weeks after seeds mature

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for fleshy fruits

Collection



Stone and seed cross-section (× 8)

Choke Cherry

Prunus virginiana L.

Flowering

Crop Intervals

- annual

Flowering Habits

- perfect, flowering in late April to mid-May
- fragrant white flowers in elongated clusters

Forecasting

WHEN TO FORECAST

- last week of June to first week of July

WHAT TO LOOK FOR

- fruits are green
- many fruits on a single stem

Forecasting

Collecting

Collection

WHEN TO COLLECT

- mid-August to late September

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- "cherries" are drupes; the drupes are approximately 6–12 mm in diameter, egg- to globe-shaped
- ripe fruits are reddish purple to black in colour and consist of a mass of juicy pulp, in which a single stone is contained
- mature stones are brown in colour

COLLECTION METHODS

- collect ripe fruits by hand-picking directly into picking bags or by spreading ground tarpaulins under the trees to catch natural fall or to catch fruits that have been stripped from the tree
- fruits can also be flailed from the crowns onto ground tarpaulins using poles

COLLECTION NOTES

- be sure of species identification
- fruits of *Prunus* species should be collected when fully mature; this facilitates cleaning and is likely to result in good germination
- wait until cherries soften before collecting and once softened, collect promptly to avoid excessive losses to birds
- timing of collection is important since fruits can persist on the tree for only a few weeks after seeds mature

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for fleshy fruits

Stone and seed cross-section (× 7)

Antelope-brush, Bitter-brush

Purshia tridentata (Pursh) DC.

Flowering

Forecasting

Crop Intervals

- 1–2 years

Flowering Habits

- flowering mid-April to early May
- perfect flowers, five petals, bright yellow in colour, and funnel-like in shape

Forecasting

WHEN TO FORECAST

- first week of June to mid-June

WHAT TO LOOK FOR

- light red to dark red, spindle-shaped, glandular, pubescent achene, approximately 10–15 mm in length

FORECASTING NOTES

- wait until achenes are evident before forecasting the crop

Further Monitoring

- check during the later part of June for seed development

Collecting

WHEN TO COLLECT

- mid-July through very early August

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- mature achenes are tan brown in colour
- mature achenes become loose in their receptacles
- seeds are contained within the achenes, and have a distinct maroon pericarp surrounding the seed coat

COLLECTION METHODS

- achenes can be collected by spreading tarpaulins beneath the bush and flailing the branches using a short stick or club to dislodge seeds
- achenes can also be collected from the plants by placing a tray, box, or netted hoop under the plant's branches and flailing them with a paddle or racquet

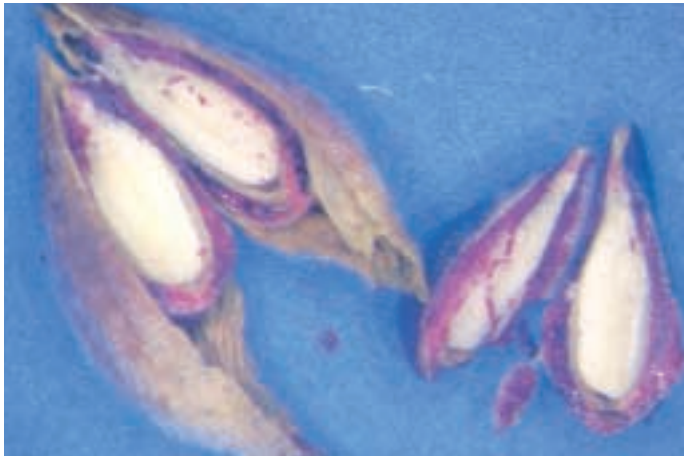
Collection

COLLECTION NOTES

- use cutting test to determine seed maturity and development
- ripe achenes dislodge easily; therefore, in order to maximize collection yields, careful monitoring and accurate collection timing is required to determine when seeds are mature

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for dry fruits



Seed cross-section
(× 6)

Prickly Rose

Rosa acicularis Lindl. ssp. *sayi* (Schwein) W.H. Lewis

Flowering

Crop Intervals

- 1–2 years

Flowering Habits

- perfect, flowering late May to late July
- flowers are pink in colour and fairly large (4–7 cm across)
- flowers are usually solitary or occasionally in twos or threes on lateral branches

Forecasting

WHEN TO FORECAST

- late July

WHAT TO LOOK FOR

- green fruits occurring at the ends of short lateral branches

FORECASTING NOTES

- be sure of species identification

Forecasting

Collecting

WHEN TO COLLECT

- late September to mid-November

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- fruits are achenes surrounded by a fleshy hypanthium (together with receptacle = hip)
- hips are bright red or orange-red in colour, 5–15 mm in length, with terminal sepal lobes
- mature achenes are golden brown in colour

COLLECTION METHODS

- rose hips are collected by hand-picking the fruits directly into picking bags

COLLECTION NOTES

- gloves should be worn during collection
- use cutting test to establish seed maturity and estimate seed yield
- fruits collected shortly after ripening may germinate more readily than those allowed to dry out

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for fleshy fruits

Collection

Hip and achenes (× 6)

Achene cross-section (× 17)

Baldhip Rose

Rosa gymnocarpa Nutt.

Flowering

Crop Intervals

- 1–2 years

Flowering Habits

- perfect, flowering late May to mid-July
- flowers are light pink in colour
- flowers are usually solitary or occasionally in twos or threes

Forecasting

WHEN TO FORECAST

- last week of July

WHAT TO LOOK FOR

- green fruits occurring at the ends of branches

FORECASTING NOTES

- be sure of species identification

Forecasting

Collecting

WHEN TO COLLECT

- late September to mid-November

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- fruits are achenes surrounded by a fleshy hypanthium (together with receptacle = hip)
- hips are orange to scarlet red in colour, 6–10 mm in length, and without attached sepal lobes
- mature achenes are golden brown in colour, and there are one to seven achenes per hip

COLLECTION METHODS

- rose hips are collected by hand-picking the fruits directly into picking bags

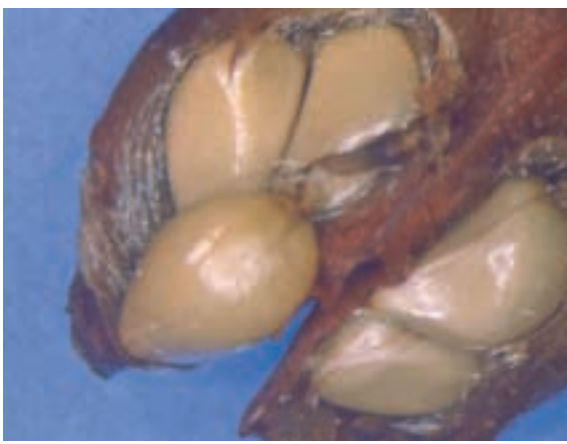
COLLECTION NOTES

- gloves should be worn during collection
- use cutting test to establish seed maturity and estimate seed yield
- fruits collected shortly after ripening may germinate more readily than those allowed to dry out

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for fleshy fruits

Collection



Hip and achenes (× 7)

Nootka Rose

Rosa nutkana Presl
Rosa nutkana var. *hispida* Fern. – Interior
Rosa nutkana var. *nutkana* – Coast

Flowering

Crop Intervals

- 1–2 years

Flowering Habits

- perfect, flowering late May to mid-July
- flowers are pink in colour and usually borne singly, occasionally in twos or threes, and are fairly large (2.5–4 cm across)

Forecasting

WHEN TO FORECAST

- late July

WHAT TO LOOK FOR

- green fruits, usually occurring at the ends of branches

FORECASTING NOTES

- be sure of species identification

Forecasting

Collecting

WHEN TO COLLECT

- late September through winter

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- fruits are achenes surrounded by a fleshy hypanthium (together with receptacle = hip)
- hips are bright red or orange-red in colour, 5–20 mm in length, with attached sepal lobes
- mature achenes are golden brown in colour

COLLECTION METHODS

- rose hips are collected by hand-picking the fruits directly into picking bags

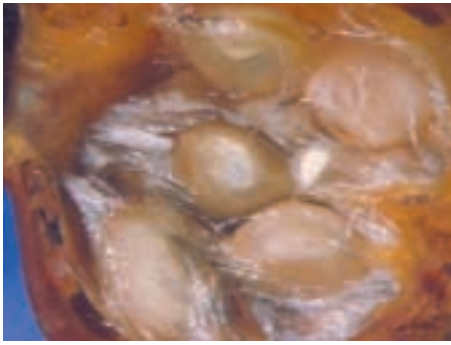
COLLECTION NOTES

- gloves should be worn during collection
- use cutting test to establish seed maturity and estimate seed yield
- fruits collected shortly after ripening may germinate more readily than those allowed to dry out

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for fleshy fruits

Collection



Hip and achenes (× 6)

Prairie Rose, Wood's Rose

Rosa woodsii Lindl. ssp. *ultramontana* (S. Wats) Taylor & MacBryde

Flowering

Crop Intervals

- 1–2 years

Flowering Habits

- perfect, flowering early June to late July
- flowers are light to dark pink in colour and can occasionally be white in colour
- flowers occur in clusters of one to five borne at the branch terminal

Forecasting

WHEN TO FORECAST

- late July

WHAT TO LOOK FOR

- green fruits occurring in terminal clusters on short side branches

FORECASTING NOTES

- be sure of species identification

Forecasting

Collecting

WHEN TO COLLECT

- late September through winter

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- fruits are achenes surrounded by a fleshy hypanthium (together with receptacle = hip)
- hips are bright red or orange-red in colour, 6–12 mm in length, with attached sepal lobes
- mature achenes are golden brown in colour; numerous achenes per hip

COLLECTION METHODS

- rose hips are collected by hand-picking fruits directly into picking bags

COLLECTION NOTES

- gloves should be worn during collection
- use cutting test to establish seed maturity and estimate seed yield
- fruits collected shortly after ripening may germinate more readily than those allowed to dry out

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for fleshy fruits

Collection

Hip and achenes (× 8)

Thimbleberry

Rubus parviflorus Nutt. var. *parviflorus*

Flowering

Crop Intervals

- annual

Flowering Habits

- flowering mid-May to latter part of June
- large perfect flowers can be up to 4 cm across, white in colour with five broad petals; flowers in clusters of two to nine

Forecasting

WHEN TO FORECAST

- last week of June to first week of July

WHAT TO LOOK FOR

- light pink coloured, shallow-domed, hairy aggregated drupelets (like raspberries)

FORECASTING NOTES

- flowering and fruiting can occur simultaneously on the same plant, therefore fruit will develop unevenly

Forecasting

Further Monitoring

- check fruits mid-July for seed development by removing the pulp from around seeds to assess developing seeds

Collecting

Collection

WHEN TO COLLECT

- early July to mid-August

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- the ripe fruits are shallowly domed aggregates of small, scarlet red, hairy drupes (drupelets)
- ripe fruits are 12–17 mm in diameter
- mature seeds are golden brown in colour, 2 mm in length (after processing, the stone coat will be stained by the fruit juice, therefore giving the appearance of having a pink stone)
- each seed contains a well-developed radicle, hypocotyl, cotyledons, and a negligible amount of endosperm, although the cotyledons are often mistaken as such

COLLECTION METHODS

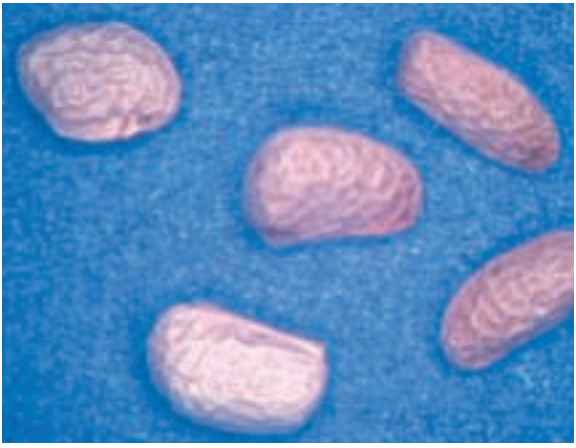
- ripe fruits are best collected by hand-picking directly into picking bags

COLLECTION NOTES

- fruits ripen over a period of several weeks, therefore only some fruits may be mature on each plant at any one time

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for fleshy fruits



Stones (× 7)

Salmonberry

Rubus spectabilis Pursh

Flowering

Crop Intervals

- annual

Flowering Habits

- flowering May to June
- large perfect flowers can be up to 4 cm across, pink to reddish in colour, with five petals

Forecasting

WHEN TO FORECAST

- late May through June

WHAT TO LOOK FOR

- yellow to pink and red aggregated hairy drupelets (like raspberries)

FORECASTING NOTES

- flowering and fruiting can occur simultaneously on the same plant, therefore fruits will develop unevenly

Further Monitoring

- check fruits in mid-June for seed development

Forecasting

Collecting

WHEN TO COLLECT

- early June to August

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- the ripe fruits are aggregates of small, yellow to red, hairy drupes (drupelets)
- mature stones are golden brown in colour, 3 mm in length (after processing, the stones will be stained by the fruit juice, therefore giving the appearance of having a pink stone)
- each seed contains a well-developed radicle, hypocotyl, cotyledons, and a negligible amount of endosperm, although the cotyledons are often mistaken as such

COLLECTION METHODS

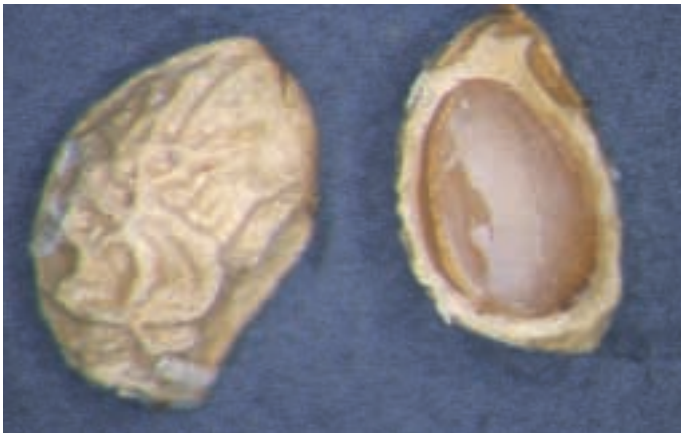
- ripe fruits are best collected by hand-picking directly into picking bags

COLLECTION NOTES

- fruits ripen over a period of several weeks, therefore only a few fruits may be mature on each plant at any one time

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for fleshy fruits



Stone (× 14)

Western Mountain-ash

Sorbus scopulina Greene
Sorbus scopulina var. *scopulina* – east of Coast-Cascades
Sorbus scopulina var. *cascadensis* (G.N. Jones) C.L. Hitchc. – west slopes of Cascades

Crop Intervals

- annual (irregular)

Flowering Habits

- flowering mid-April to late May
- white, perfect flowers are borne in large flat-topped to rounded clusters with up to 200 showy flowers per cluster

Flowering

Forecasting

WHEN TO FORECAST

- last week of June to first week of July

WHAT TO LOOK FOR

- green fruits occurring in large flat clusters

FORECASTING NOTES

- be sure of species identification

Forecasting

Collecting

WHEN TO COLLECT

- mid-August to late September

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

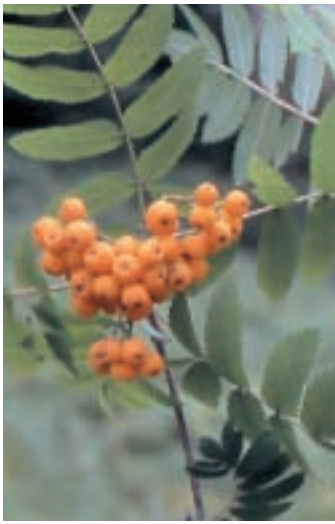
- fruits are pomes, 7–10 mm in diameter
- ripe fruits are glossy orange to scarlet red in colour
- each fruit contains one or two brown-coloured seeds, 4–5 mm in length

COLLECTION METHODS

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

COLLECTION NOTES

- fruits should be collected when their colour changes from green to orange-scarlet, or to avoid losses, they may be picked as soon as they begin to colour



Collection

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for fleshy fruits

SPECIAL NOTES

- hybrids between species of *Sorbus* occur readily and many *Sorbus* spp. you might encounter are escaped ornamentals

Fruit (× 4)

Pome with seed cross-section (× 8)

Hardhack, Pink Spirea, Steeplebush

Spiraea douglasii Hook.
Spiraea douglasii ssp. *douglasii* – Coast
Spiraea douglasii ssp. *menziesii* (Hook.) Calder & Taylor – Interior

Flowering

Forecasting

Crop Intervals

- annual

Flowering Habits

- flowering late May to early July
- perfect, very small, pink flowers borne in dense, elongated terminal clusters, appearing fuzzy due to many protruding stamens

Forecasting

WHEN TO FORECAST

- mid-July to late July at lower elevations
- first week of August to mid-August at subalpine elevations

WHAT TO LOOK FOR

- small greenish yellow follicles

FORECASTING NOTES

- be sure of species identification — coastal subspecies occurring in the extreme west of the coast/interior transition has matted grey hairs on the lower surface of the leaf; interior species has smooth leaves
- wait until seeds are evident before forecasting the crop

Further Monitoring

- pull apart follicle to assess seeds developing within

Collecting

WHEN TO COLLECT

- late July to mid-October

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

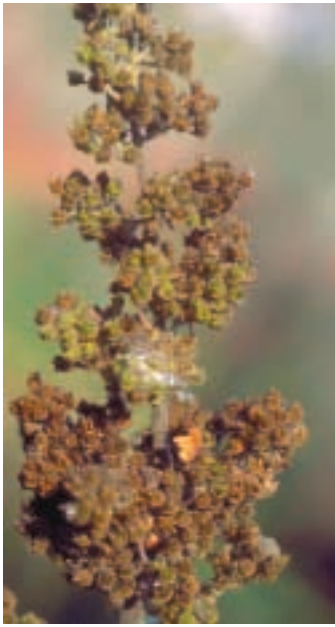
- seeds are borne in a follicle 2–3 mm in length and are shed when follicle becomes brown in colour and splits down one side
- mature follicles contain five to six seeds
- mature seeds are dark brown and very small — approximately 2 mm in length

COLLECTION METHODS

- seeds are best collected by hand-clipping fruit clusters with closed follicles directly into picking bags before follicles split

COLLECTION NOTES

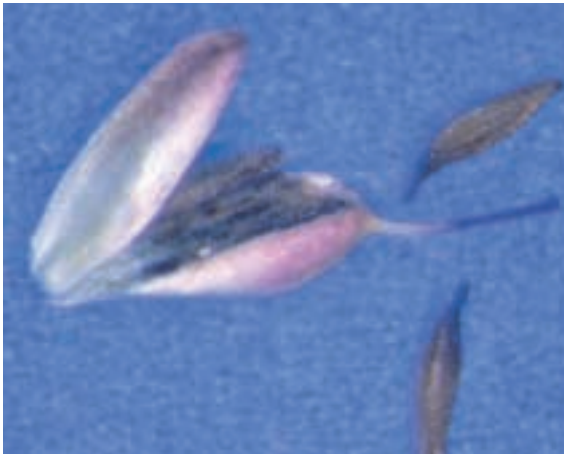
- pull apart follicles to assess seed development
- ripe follicles will split when seeds are ready for dispersal, so collections should be timed to when seeds are mature but follicles are still "green" enough to remain closed



Collection

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for dry fruits



Follicle releasing seeds (× 13)

Black Cottonwood

Populus balsamifera L. ssp. *trichocarpa* (T. & G.) Brayshaw

Crop Intervals

- annual

Flowering Habits

- flowering early April to May
- male and female catkins occur on different plants, appearing prior to leaves in the spring
- male catkins have eight to 60 stamens; female catkins have three stigma

Forecasting

WHEN TO FORECAST

- June

WHAT TO LOOK FOR

- green female capsules

FORECASTING NOTES

- be sure of species identification
- be careful to distinguish female from male catkins
- male catkins generally occur in clusters on branch ends
- female capsules are round, slightly longer than wide, with distinct "ribbing" visible

Further Monitoring

- check frequently prior to collection to determine collection timing and to avoid losses; seed dispersal is rapid

Forecasting

Collection

Collecting

WHEN TO COLLECT

- June to early July

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- fruits are small capsules; seeds are very tiny, mixed with "cotton fluff"

COLLECTION METHODS

- branches with nearly mature capsules can be collected and placed in water to allow capsules to open
- seeds can be collected directly from capsules on trees with a vacuum cleaner

COLLECTION NOTES

- timing is crucial — collect when some capsules have begun to open, but majority have not

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for dry fruits
- poplar seeds have a short shelf life, but with appropriate drying and storage conditions, germination potential can be maintained for several years
- seeds are either sown directly after collection, **or** prestorage drying is required immediately to preserve viability

Close-up of "fluff" and seeds

Trembling Aspen

Populus tremuloides Michx.

Flowering

Crop Intervals

- major crops once every 3–5 years

Flowering Habits

- flowering early March to May
- male and female catkins occur on different plants appearing prior to leaves in the spring
- male catkins have six to 14 stamens; female catkins have two stigma

Forecasting

WHEN TO FORECAST

- late May

WHAT TO LOOK FOR

- green female capsules

FORECASTING NOTES

- be sure of species identification
- be careful to distinguish female from male catkins
- female catkins have distinct green capsules that are flask-shaped

Further Monitoring

- check frequently during June for development of capsules within catkins
- check frequently prior to collection to determine collection timing and to avoid losses

Forecasting

Collecting

WHEN TO COLLECT

- June

DESCRIPTION OF RIPE FRUITS AND MATURE SEEDS

- fruits are slender, elliptical, two-valved capsules
- seeds are very tiny, mixed with "cotton fluff"

COLLECTION METHODS

- collect branches with nearly mature capsules and place in water to allow capsules to open
- seeds can be collected directly from capsules on trees with a vacuum cleaner

COLLECTION NOTES

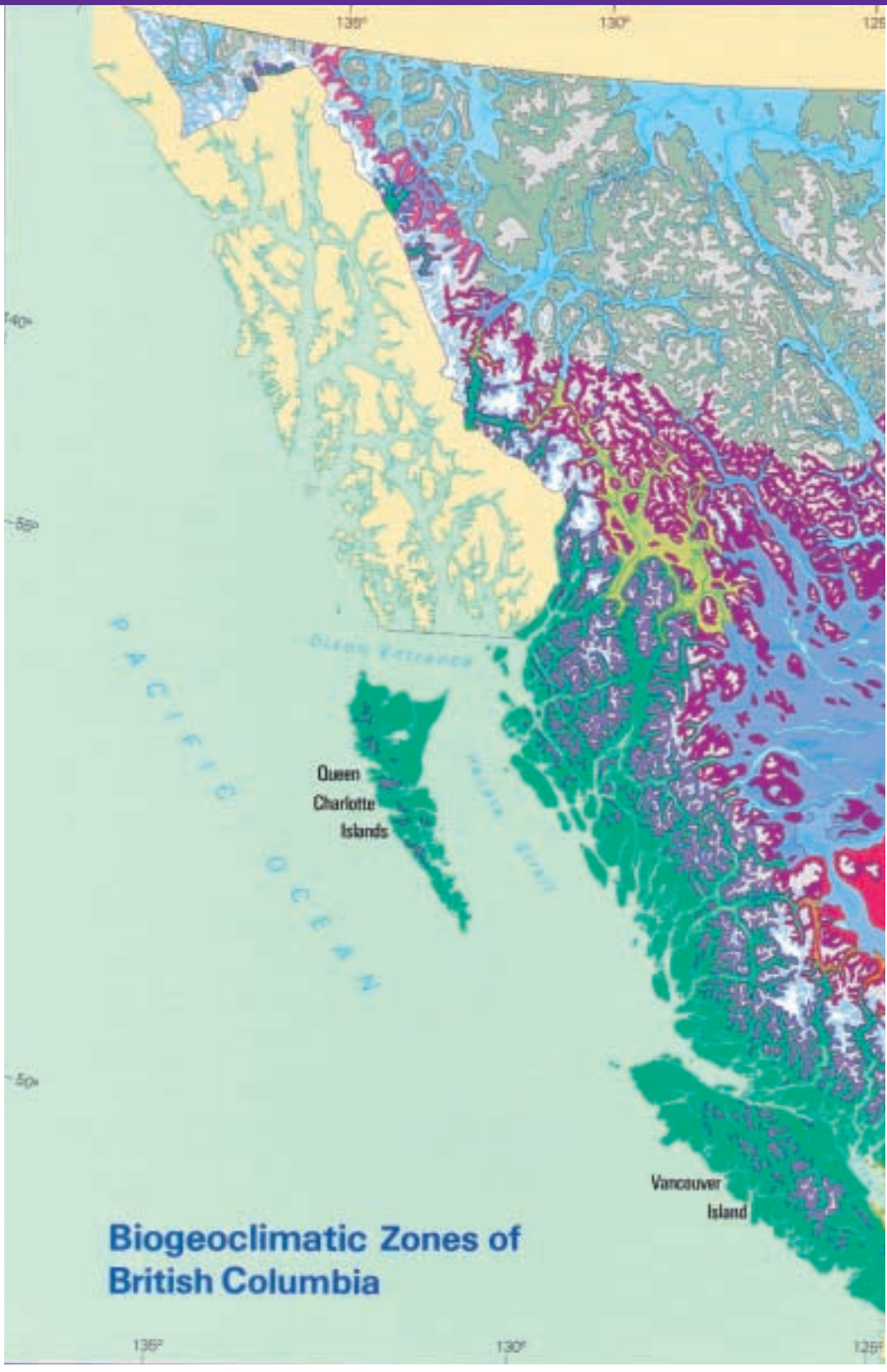
- timing is crucial — collect when some capsules have begun to open, but majority have not

FIELD STORAGE AND TRANSPORTATION PROCEDURES

- refer to field storage and transportation guidelines for dry fruits
- aspen seeds have a short shelf life, but with appropriate drying and storage conditions, viability can be maintained for several years
- seeds are either sown directly after collection, **or** prestorage drying is required immediately to preserve viability

Collection and seed

Appendix 1


135°
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Charlotte
Islands
Vancouver
Island
Biogeoclimatic Zones of
British Columbia
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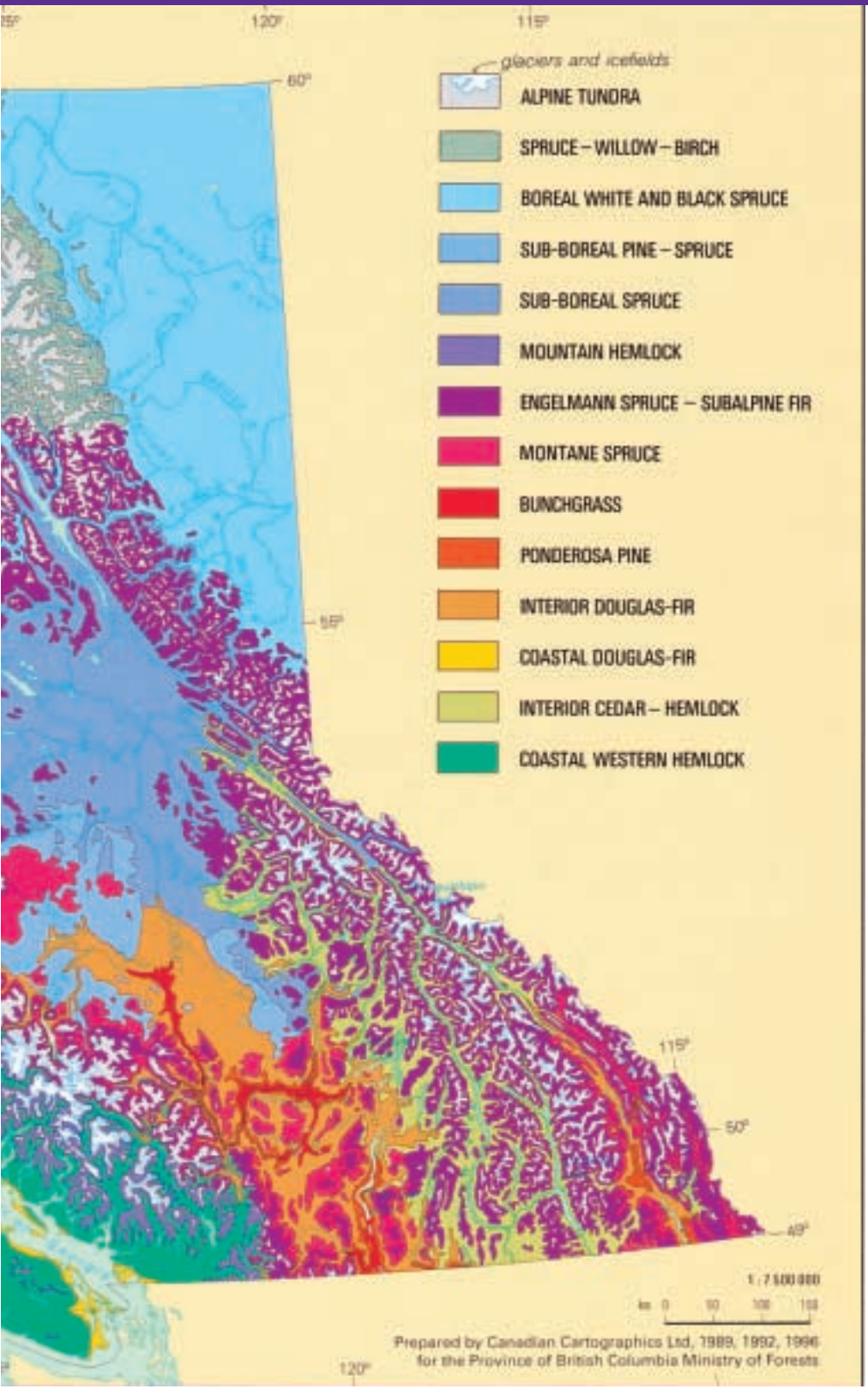
120°
115°
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49°
glaciers and icefields
ALPINE TUNDRA
SPRUCE – WILLOW – BIRCH
BOREAL WHITE AND BLACK SPRUCE
SUB-BOREAL PINE – SPRUCE
SUB-BOREAL SPRUCE
MOUNTAIN HEMLOCK
ENGELMANN SPRUCE – SUBALPINE FIR
MONTANE SPRUCE
BUNCHGRASS
PONDEROSA PINE
INTERIOR DOUGLAS-FIR
COASTAL DOUGLAS-FIR
INTERIOR CEDAR – HEMLOCK
COASTAL WESTERN HEMLOCK
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Prepared by Canadian Cartographics Ltd, 1989, 1992, 1996
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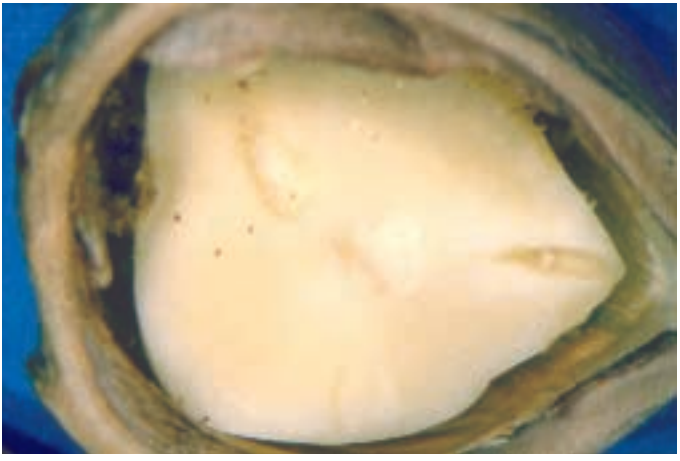
Cutting Tests

When performing cutting tests, a hand lens or dissecting microscope is useful. The only other tool you will need is a single-edge razor blade, scalpel or a sharp blade. Each will provide the leverage needed to cut the seed/fruit apart.

Cutting Tests on Fruits and Seed

The simplest method is to cut the fruit or seed in half along its longest axis. Fruits that are drupes present some problems when it comes to a cutting test. The hard, bony endocarp can be difficult to cut through (e.g., *Prunus, Crataegus*).

Once the seed has been halved, note the anatomical completeness and internal colouring of the seed. Embryos may extend and fill the length of the seed as in *Cornus*, or develop in the embryo axis area located in the basal section of the cotyledon material, and are tiny in comparison, as in *Crataegus*.



Fruit and seed cross-section *Corylus cornuta* (× 6)

Cutting Test on "Cone-like" Fruit

Using a single-edge razor bade or, if available, a cone cutter, cut each fruit longitudinally along its central axis. Note percentage of filled, healthy seeds, damaged seeds, and empty seeds.

Betula papyrifera (white birch)

Half "cone" section of birch (× 5)

Rationale

The cutting test is used to determine the occurrence of physically abnormal seeds and the proportion of potentially viable seeds. Empty, immature, infested, or otherwise abnormal seeds cannot germinate properly. The cutting test also gives an indication of both the developmental stage and uniformity of a seedlot.

Method

1. Use 50 seeds for the test and adjust the quantity up or down, based on availability of seed. If seeds are fresh, you can go immediately to step 4. If seeds have been dried, go to step 2.
2. Place seeds in a cup with water; approximately three times water to seed volume.
3. Soak at room temperature until seeds sink. Depending on species this can take from 24 to 72 hours, or longer. Seeds of some species will not sink due to physical properties of the seeds.
4. Cut each seed longitudinally, and note the number of **filled**, **empty, immature, and damaged and discoloured** seeds. For the most part, limit yourself to placing seeds into the four categories marked in bold. However, the damaged and discoloured fractions, in particular, can be subdivided into more categories in special cases. For example, you may choose to distinguish between seeds with damaged endosperms (which may still germinate) and seeds with damaged embryos (which will not germinate). Depending on species, immature seeds may germinate, but usually with less vigour than fully mature seeds.

   What to look for:

   a. Filled seeds — firm, yellowish or white embryos and endosperms.
   b. Empty seeds — no embryos. These seeds are either empty when cut through, have a thin paper-like husk, or are often "woody" on the inside.
   c. Immature seeds — embryos are thin, do not fully fill seed cavities; cotyledons are more lightly coloured than in mature seeds, or smaller than in mature seeds.
   d. Damaged and discoloured seeds — translucent embryos and/or endosperms; often discoloured contents.
   e. Seed coats — are they cracked, thin, hardened?
   f. Are there any other abnormalities of note?

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Ph. 307-568-3361 Fax 307-568-3361
www.windriverseed.com
e-mail: wrseed@windriverseed.com
- reclamation species and information on equipment used in collection of range species and some suppliers

Seed Collection Form: A Guided Tour

Included with this guide is a seed collection form, which includes data fields for the major types of information one needs while monitoring a potential crop, and collecting and processing the seed. The form may look rather complicated, but with a little practice, you should find it easy to use.

General Information

This section includes fields to note species being collected, assign a personal collection identifier or label, note the beginning and end dates for collection, and note who is doing the collection and processing. Also, this section has fields to note crop rating (check which box applies) and the number of plants your collection is based on (check which box applies).

Site and Community Information

Site information relates to a basic description of what kind of site your collection is on. In this area you provide basic geographic and topographic information, as well as identifying the biogeoclimatic zone and subzone. More detailed site information such as hygrotope (moisture regime) and trophotope (nutrient regime) are accommodated, as well as soil texture. This section is particularly important for restoration from, or to, ecologically sensitive areas. The information you need to complete this section is contained in the appropriate site identification and interpretation field guides for your forest region, published by the B.C. Ministry of Forests, Crown Publications, (ph) 250-386-4636, (fax) 250-386-0221, or www.crownpub.bc.ca.

Community information is a listing of the most common vegetation surrounding the species you wish to collect. This information is useful when you wish to collect from several species.

Collection Monitoring Information
This section includes information that you can use to monitor your populations from forecasting through to collection. Specifically, it asks you to identify what criteria you are using to identify crop maturity, at both the fruit and seed level. Check maturity notes associated with individual species descriptions for fruit and seed maturity criteria. Since many native species have not been well-documented, there is uncertainty about timing and of exact maturity criteria. Careful notes in this section will help you build a body of knowledge and experience on how crops mature.

Storage and Processing Quality Control Information
This section contains information to determine seed quality during processing. Specifically, there are fields to compare seed quality before and after processing. There are fields to record production information, which you can use for cost/benefit analysis or pricing. Finally, there is space to note details of germination of your seeds, and the methods you used to germinate the seeds.

Seed Collection Form

Datasheet #:

General Information

Species | Seedlot # (optional) | Date collected: Begin | End | Collector / Processor

Crop rating

No crop	
Very light	
Light	
Medium	
Heavy	
Very heavy	

No. of plants seed collected from

<10 plants		101–250 plants	
10–25 plants		251–500 plants	
26–50 plants		501–1000 plants	
51–100 plants		>1000 plants	

Moisture content at collection

Site and Plant Community Information

Site information

Location	
Longitude	
Latitude	
Elevation	
Aspect	
BGC zone	
BGC subzone	
BGC variant	
Hygrotope	
Trophotope	
Edaphic grid #	
Site series	
Soil texture	

Species list

1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Storage and Processing Quality Control Information

Date received
Date processed

Processing quality control

MC at collection*
MC dried to

	% Filled	% Damaged	% Empty
Cutting test raw seeds			
Cutting test final seeds			

Tetrazolium raw seeds
Tetrazolium final seeds

MC & quality notes

Production summary

Collection method
hours
grams or litres of fruit
Grams final seeds
Seed yield
1000 SDWT*
Seeds/gram
Viable seeds/gram
Purity

Collection cost
Cost/Kg

Final seedlot germination

% Germination
Peak value
Days in test
Germination notes (stratification and other treatment methods)

* MC = moisture content
SDWT = seed weight

Collection Monitoring Information

(Refer to individual species descriptions for maturity criteria)

Date sampled	
Maturity criteria: fruits	
Maturity criteria: seeds	
Endosperm condition	
Embryo visible	
# seed sampled	
Fill seed estimate (%)	
Insects/disease	
Maturity notes	
Insect/disease details	

Date sampled	
Maturity criteria: fruits	
Maturity criteria: seeds	
Endosperm condition	
Embryo visible	
# seed sampled	
Fill seed estimate (%)	
Insects/disease	
Maturity notes	
Insect/disease details	

Date sampled	
Maturity criteria: fruits	
Maturity criteria: seeds	
Endosperm condition	
Embryo visible	
# seed sampled	
Fill seed estimate (%)	
Insects/disease	
Maturity notes	
Insect/disease details	

Additional notes and comments

Native Plant Societies

Canada

Alberta Native Plant Council
Box 52099, Gameau PO
Edmonton, AB T6G 2T5
www.anpc.ab.ca

NPSBC – Native Plant Society
of British Columbia
2012 William Street
Vancouver, BC V5L 2X6
Ph. 604-255-5719
Fax 604-258-0201
e-mail: npsbc@hotmail.com

Native Plant Society of Saskatchewan
PO Box 21099
Saskatoon, SK S7H 5N9
www.npss.sk.ca

United States

California Native Plant Society
1722 J Street, Suite 17
Sacramento, CA 95814
www.cnps.org

Idaho Native Plant Society
PO Box 9451
Boise, ID 83707
www.idahonativeplants.org

Native Plant Society of Oregon
Membership Chair
2584 NW Savier Street
Portland, OR 97210-2412
www.npsoregon.org

Washington Native Plant Society
7400 Sand Point Way NE
Seattle, WA 98115
Ph. 206-527-3210 or 888-288-8022
www.wnps.org

Seed Suppliers

Canada

Commercial suppliers of native plant seed in Canada

Alberta

Alberta Tree Improvement and Seed Centre
Forests, Alberta Environment
PO Box 750
Smoky Lake, AB T0A 3C0
Ph. 780-656-5072
Fax 780-656-2120

British Columbia

Linnaea Nurseries Ltd.
3666 224th Street
Langley, BC V2Z 2G7
Ph. 604-533-8381
Fax 604-533-8246

PRT Reid Collins
2396 272 St.
PO Box 430
Aldergrove, BC V4W 2T9
Ph. 604-856-6408
Fax 604-856-4218

Quality Seed Collections Ltd.
Box 1531
Kamloops, BC V2C 6L8
Ph. 250-374-9689
Fax 250-374-9654

Silva Enterprises Ltd..
PO Box 2888 Stn B
Prince George, BC V2N 4T7
Ph. 250-963-8617
Fax 250-963-3490

Tree Seed Centre
Tree Improvement Branch
B.C. Ministry of Forests
Ph. 604-541-1683
Fax 604-541-1685
www.for.gov.bc.ca/TIP/

Yellow Point Propagation
13735 Quennell Road
Ladysmith, BC V9G 1G8
Ph. 250-245-4635
Fax 250-245-5935

Ontario

Ontario Tree Seed Plant
Ontario Ministry of Natural Resources
PO Box 70
Angus, ON L0M 1B0
Ph. 705-424-5311
Fax 705-424-9282
www.ontariotreeseed.com

Sources of planting material for ecological restoration in Ontario: www.trentu.ca/ser

United States

Commercial suppliers of native plant seeds in the United States

F.W. Schumacher Co., Inc.
36 Spring Hill Road
Sandwhich, MA 02563
Ph. 508-888-0659
Fax 508-888-0322
www.treeshrubseed.com

Lawyer Nursery Inc.
950 Highway 200 West
Plains, MT 59859-9706
Ph. 406-826-3881; 800-551-9875
Fax 406-826-5700
www.lawyernsy.com

Sheffield's Seed Co., Inc.
273 Auburn Road, Route 34
Locke, NY 13092
Ph. 315-497-1058
Fax 315-497-1059
www.sheffields.com

Basic Botany

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Plant Identification

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_____. 1999. Illustrated Flora of British Columbia. Volume 3. Dicotyledons (Diapensiacea through Onagraceae). B.C. Min. of Environ., Lands and Parks and B.C. Min. For., Victoria, B.C.

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Seed and Fruit

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Periodicals and Web Sites

USDA Forest Service
Reforestation, Nurseries, and Genetic Resources
(On-line publications including Bareroot Nursery Equipment Catalog and Nursery Equipment Drawings, which include seed handling and processing.)
Native Plant Network
www.na.fs.fed.us/spfo/rngr

Forest Nursery Notes
Tom Landis
USDA Forest Service
Cooperative Programs
2606 Old Stage Road
Central Point, OR 97502–1300

Native Plants Journal
University of Idaho Press
PO Box 441107
Moscow, ID 83844-1107
www.nativeplants.for.uidaho.edu

Wildflower
Box 335
Postal Station F
Toronto, ON M4Y 2L7
www.wildflowermag.com

Washington State University
Native Plants
http://gardening.wsu.edu/text/nwnative.htm

accessory fruit	fruit that is comprised of the ovary and surrounding floral tissues
achene	single-seeded fruit that is dry and indehiscent
aggregate fruit	fruit developing from several separate carpels of a single flower
angiosperm	plants whose seeds are borne within a mature ovary — covered seeds
anthers	pollen-bearing portion of a stamen
berry	simple fleshy fruit with fleshy ovary wall and one or more carpels and seeds
bisexual flower	flower with male and female sex organs
bloom	whitish, powdery coating
bract	a modified leaf-like structure below an inflorescence
capsule	dry, dehiscent fruit with more than one carpel
carpel	leaf-like organ in angiosperms that encloses one or more ovules
catkin	pendulous, spike-like inflorescence with unisexual flowers without petals
conifer	gymnosperm that produces cones and ovules — naked seed
cotyledon	primary leaves of an embryo or seedling
cutting test	test to evaluate fruit or seed quality where a median, longitudinal section is made
dehiscent	dry fruit that opens to release seeds at maturity
dioecious	male and female reproductive structures borne on different plants
double samara	two-winged indehiscent fruit
drupe	fleshy one-stoned fruit with three distinct layers, exocarp (skin), mesocarp (fleshy), and endocarp (stone)
embryo	product of fusion of a male gamete with an ovule
endocarp	innermost layer of the three layers providing the ovary wall of a fruit
endosperm	nutrient storage tissue of seed

epicotyl	portion of the embryo above the cotyledon leaves
exocarp	external layer of the three layers providing the ovary wall of a fruit
flower	reproductive structure of angiosperms
follicle	dry, dehiscent fruit with one carpel that splits at the side
fruit	mature and ripened ovary
hip	fruit of a rose, several achenes enclosed in the perianth
hypanthium	cup-like structure surrounding the ovary formed by the fusion of the basal portions of the flower
hypocotyl	portion of the embryo below the cotyledon leaves and above the radicle
imperfect flower	flowers lacking male or female parts
indehiscent fruit	dry fruit that does not open at maturity
inflorescence	flower cluster
mesocarp	middle layer of the three layers providing the ovary wall of a fruit
monoecious	male and female reproductive structures borne on the same plant
nut	dry, indehiscent hard, one-seeded fruit
nutlet	term used for small hard fruit not botanically defined
orthodox seed	seed that can withstand severe desiccation and can be stored at low moisture content (less than 10%)
ovary	enlarged basal portion of a carpel(s) that develops into the fruit
pappus	modified calyx at the base of a single floret in the Asteraceae — bristle or scale-like
perfect flower	flower with both male and female sex organs
pericarp	collective term for all layers that comprise the ovary wall of a fruit
pistil	female sex organ of a flower
pistillate	female flower

pome	accessory fleshy fruit as found in apples
pseudocarp	false fruit that includes the ovary and additional tissues (e.g., pome, hip)
pubescent	hairy
raceme	indeterminate elongated inflorescence with single flowers borne on pedicels arranged on a single axis
radicle	embryonic root
recalcitrant seed	seed that cannot be dried below a certain moisture level (generally quite high) without affecting their ability to germinate
seed	structure formed by maturation of the ovule of seed plants following fertilization
seed coat	outer, protective cover of a seed
seed leaves	synonym for cotyledons
simple fruit	fruit derived from one carpel or several united carpels
stamen	male sex organ of a flower
staminate	male flower
stone	synonym for endocarp of drupe
strobilis	a number of modified leaves or ovule-bearing scales grouped terminally on a stem. In angiosperms, multiple-seeded fruits with catkins or cone-like structures (e.g., birch) and in gymnosperms, a cone.
testa	seed coat
unisexual	flowers lacking either male or female parts, staminate or pistillate

P. Adams: cover c, 24a, 40a, 41a, 46a,b, 54a,b, 55a, 63a, 72b, 73a, 118a,b, 122a, 123a,b, 124a,b, 125a

S.M. Banerjee: cover a,d, 23b, 27c, 36b, 37a, 39c, 41b,c, 44b, 47b, 48a,b, 49a,b, 50b, 55b,c, 61b, 63b,c, 64a,b, 65a,b,c, 70a,b, 71a,b,c, 72a, 73b, 74a,b, 75b,c, 76a,b,c, 77a,b,c, 80a,b, 81a, 84a,b, 85a, 94a,b, 95a,b,c, 98a,b, 99a,b,c, 101b, 106a, 114a,b, 116a,b, 117a,b, 119b,c, 120a,b, 121a, 129a

B. Compton: 22a, 34a, 38a, 47a, 50a, 68a, 90a

K. Creasey: cover b,e, 13a, 14a, 15a,b, 22b, 23a, 24b, 25a,b, 26a,b, 27a,b, 28a,b, 29a,b, 30a,b, 31a,b, 32a,b, 33a,b, 34b, 35a,b, 36a, 37b, 38b, 39a,b, 42a,b, 43a,b, 44a, 45a,b, 51a,b, 52a,b, 53a,b, 56a,b, 57a,b, 58a,b,c, 59a,b, 60a,b, 61a, 62c, 66a,b, 67a,b, 68b, 69a,b, 75a, 78a,b, 79a,b, 82a,b, 83a,b,c, 86a,b, 87a, 88a,b, 89a,b, 90b, 91a,b, 92a,b, 93a,b, 96a,b, 97a,b, 100a,b, 101a, 102a,b, 103a,b, 104b, 105a,b, 106b, 107a,b,c, 108a,b, 109a,b, 110a,b, 111a,b, 112a,b, 113a,b, 115a,b, 119a, 121b, 128

B. Hammersley: 104a

D. Williams: 62a,b

Index to Common and Scientific Names

Notes