Chapter 4. Growing Plants From Cuttings

Many native plants can be grown from cuttings. Cuttings are portions of plants (stems, leaves, roots) that when treated and planted will develop into new plants complete with stems, leaves, and roots. Although shoots, roots, bulbs, corms, tubers, and rhizomes all offer possible material to reproduce plants, shoots are perhaps the most commonly used for vegetative propagation. These vegetative propagules (see Section 1.3, Seeds and Other Propagules) can be collected from wild plants or from plants specifically maintained at the nursery for this practice. You may want to grow plants from cuttings, particularly if the plant is difficult to propagate from seeds or if the desired plant has an unusual growth habit or flower color. Using cuttings maintains these desired tracts because, as we discussed in Section 1.3 (Seeds and Other Propagules) and showed in Figure 1.5, all new daughter plants that arise from cuttings are genetically identical to the parent plant. Another advantage is that sometimes using cuttings will result in a larger plant in a shorter time than the plants can be grown from seeds. A disadvantage is that cuttings generally require more care and can be more expensive to produce than plants from seeds. If you plan to grow plants from cuttings, follow the procedures described below to ensure success.

4.1 Shoot Cuttings

Although cuttings can be taken from a variety of plant parts, using portions of the shoots is the most common method. Some species, such as cottonwood and willow, have shoots containing pre-formed roots, an adaptation to living near streams, and therefore are very easy to root. Most species lack this adaptation and must be given special treatment before roots develop. Cuttings are classified as hardwood, softwood, or semi-hardwood (Figure 4.1) depending on when they are collected.

Hardwood shoot cuttings are collected during the winter dormant season. Softwood cuttings, which includes cuttings of herbaceous plants, are collected in the spring and early summer when shoots are actively growing and leaves are present. Semi-hardwood cuttings are collected in late summer and early fall when shoot tissue has hardened and terminal buds are set.

4.1.1 Hardwood Cuttings

Hardwood cuttings are collected during the winter dormant season. Many woody species can be grown from hardwood cuttings. With easy-to root species, like willow and cottonwood, you can collect shoot cuttings that are large or small, depending on how you are using them. Large cuttings of willows and poplars, or "live stakes," can be outplanted directly, foregoing any time in the nursery (Figure 4.2A). Smaller cuttings (2 to 6 inches long) are used for propagation in the nursery. Some native plants, such as juniper, rhododendron, and manzanita (Figure 4.2B & C), may be easier to grow from cuttings than from seeds. Species other than the willows and cottonwoods typically require treatment with a rooting hormone, and even then, may require several weeks or even months before roots appear. Placing the cuttings in hot frame or rooting chamber usually improves rooting success (see Section 4.3.3, Rooting Environment).

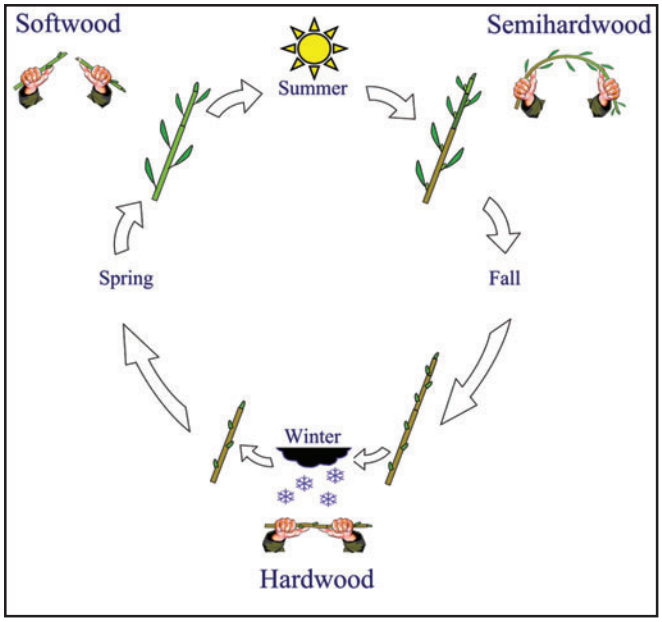

***Figure 4.1**—Hardwood cuttings are collected during winter dormancy. In late spring and early summer, softwood cuttings are taken from new shoots that bend but do not break. Cuttings of non-woody herbaceous plants are considered softwood as well. Semi-hardwood cuttings come from hardened stems later in the growing season.*

4.1.2 Softwood Cuttings

Softwood shoot cuttings are prepared from the new, succulent growth of herbaceous and woody deciduous or evergreen species. They generally require more attention, treatment with rooting hormones, and a specialized propagation environment. For woody plants, the best softwood cutting material has some flexibility but is mature enough to break when bent sharply (Figure 4.2D); avoid using the extremely fast-growing, tender shoots.

4.1.3 Semi-Hardwood Cuttings

As the name implies, this type of cutting is intermediate between the succulent growth of a softwood cutting and the completely dormant stage of a hardwood cutting. Semi-hardwood (or greenwood) cuttings are usually taken from woody species during the late summer and early fall after the last flush of growth and as the wood is partially mature, often with a terminal bud present for the next growing season (Figure 4.2F).

4.2 Collecting and Storing Shoot Cuttings

Regardless of when you collect cuttings, some important points must be remembered. As with seeds, collect cuttings near the area where you intend to outplant them to ensure they are properly adapted to the environment (see Section 2.1.2, Seed Source). A good cutting will always consist of healthy stem tissue with some intact buds or leaves, and with enough stored food reserves to sustain it until new roots are formed. Also recall that for dioecious species (see Section 1.3, Seeds and Other Propagules),

Figure 4.2—*Types of cuttings. Large, dormant hardwood cuttings ("live stakes") of willow and cottonwood can be stuck directly into the soil on the outplanting site without any nursery culture (A). Other hardwood cuttings, such as bearberry (B & C), require rooting hormones and special propagation structures. Softwood cuttings of woody plants have some degree of flexibility but are mature enough to break when bent sharply (D). Rooted softwood snowberry shoot cutting (E). Semi-hardwood cuttings, collected from lateral branches, should have a maturing terminal bud when collected in late summer (F).*

such as willow, cottonwood, and buffaloberry, individual plants are either male or female (Figure 1.5), requiring you to identify the sex of the parent plant in advance to ensure that you collect both male and female cuttings. Where you collect the cutting on a plant can also influence your success.

Older, large woody plants, such as shrubs and trees, are composed of two types of tissue: juvenile and mature. Cuttings from the juvenile parts of plants root much more easily than those from mature tissue, which produces flowers and fruits. In some plants, juvenile tissue can be distinguished from the adult phase by differences in leaf shape or color, and the overall habit of the plant. This is easily seen in junipers, where juvenile leaves are feathery and needle-like and often differ in color from mature leaves that are more rounded at the tips that bear cones. In other conifers, juvenile wood is usually found on the lower portion of the tree crown. In deciduous plants, juvenile wood is found near the stem base or root crown and can be discerned as "sucker" shoots (Figure 4.3A). In some extreme cases, difficult-to-root species will only root from stems collected from young seedlings. One way to ensure a good source of juvenile material for cuttings is to grow a few "mother plants" at your nursery that can be trimmed regularly to produce long, straight juvenile cuttings. "Donor plants" in natural stands can also be selected for hedging on an annual basis if cuttings will be collected from the area for several years. Note however, cuttings taken from mature lateral branches of trees will often continue to grow sideways. Therefore, collect cuttings from upright branches to obtain upright plants in the nursery (Figure 4.3B).

4.2.1 Cutting Size, Labeling, and Temporary Storage

When collecting cuttings from donor plants, make a cut just below a node; rooting is more likely to occur there. Make sure that some buds or leaves are present. The best size of cutting varies from species to species and the time of year it is collected. Small micro-cuttings, typically less than 2 inches long but having at least a bud, can be taken from easily rooted species (Figure 4.4A). Most other species, however, are rooted from cuttings that are 4 to 18 inches long and contain at least two buds (Figure 4.4B). Don't worry about making the cuttings to exact sizes in the field; just cut them half again as long as you think you'll need and trim them to desired size back at the nursery. Try to collect cuttings during mornings on cloudy, cool, humid days so the donor plants and cuttings are subject to less stress. Immediately place cuttings inside white plastic bags that don't allow sunlight to penetrate, label them noting origin and date, and place them in a cooler with some "blue ice" (Figure 4.4C & D). Never expose bags of cuttings to full sun.

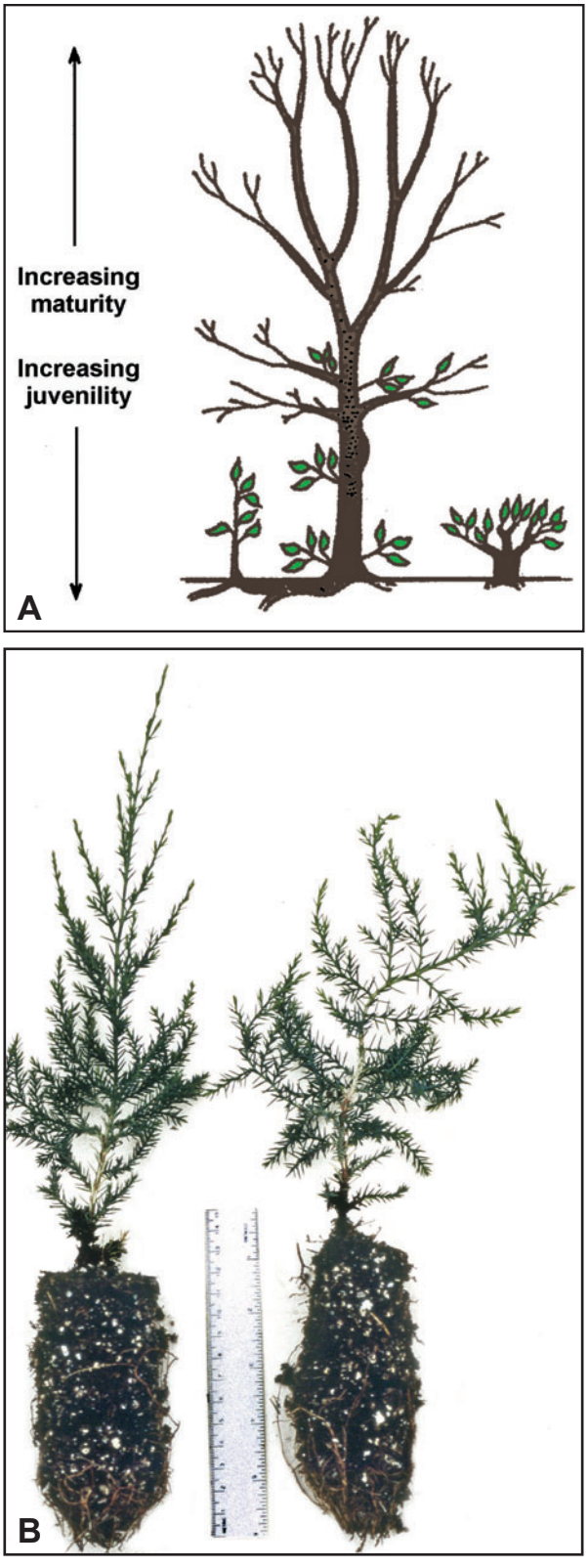

***Figure 4.3**—The part of the plant where you collect your cuttings is important. Although counterintuitive, the fact is that cuttings collected from the lower parts of large woody plants root easier than those higher up (A). With most woody plants, especially trees, cuttings should be collected from upright branches (B, left) or they may grow sideways after rooting (B, right).*

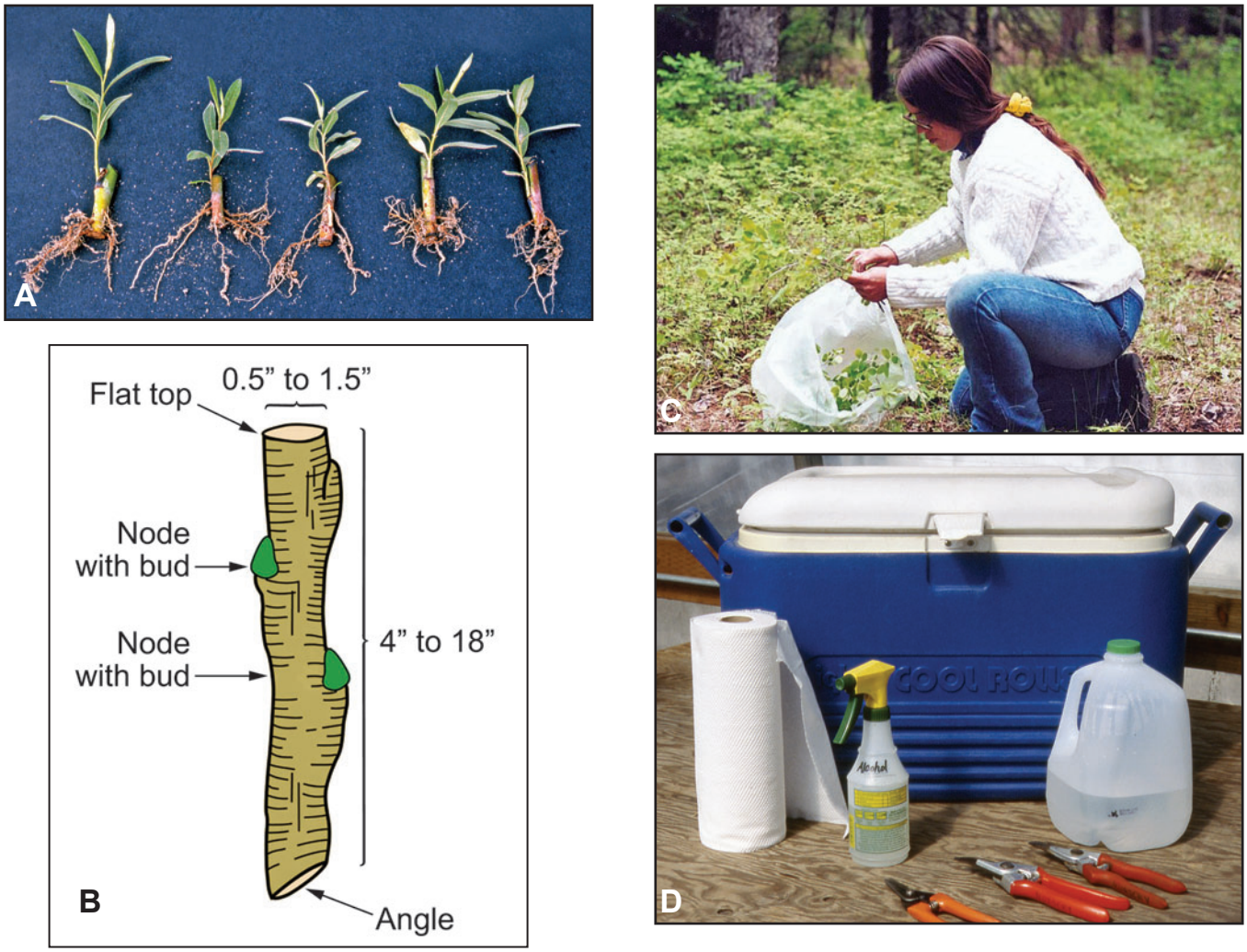

Figure 4.4—*Small "micro cuttings" are suitable for easy-to-root species (A), but most cuttings for most species should be 4 to 18 inches and contain at least two lateral buds (B). Hardwood cuttings collected during winter are dormant and hardy, but nondormant softwood cuttings must be handled more carefully (C). Your cutting collection kit should include "blue ice" and a cooler to keep cuttings cool during harvest and transportation (D).*

4.2.2 Storing Cuttings at the Nursery

Back at your nursery, deciduous hardwood cuttings should be wrapped in moist paper towels, peat moss, or burlap before being placed into refrigerated storage. Depending on species, cuttings can be stored for several days, weeks, or even months. Inspect stored cuttings frequently to ensure they are slightly moist and mold-free. Conifer hardwood cuttings, softwood cuttings, and semi-hardwood cuttings, because they have foliage, must be treated promptly and struck (that is, inserted) into the medium used to root them.

4.3 Rooting Shoot Cuttings

Because of their open wounds, cuttings are very susceptible to diseases. So, while preparing cuttings for planting, it is important to keep the work area sanitized by using a disinfectant like household bleach (Figure 4.5A) mixed 1 part bleach to 9 parts water. Use sharp, well-maintained shears and knives to make clean cuts, and disinfect them often with alcohol. Trim cuttings to a standard size and shape, which promotes side shoots and eliminates shoot tips that could die back during rooting. Leafy cuttings should have about one-third to one-half of the foliage removed to minimize water loss from the cutting. It is very important, however, to have some leaves so that the cutting can photosynthesize during rooting.

Shoot cuttings can be either directly struck (that is, inserted) into individual containers used to grow them to their final size, or into communal trays in a rooting chamber from which they will be transplanted once they form roots.

Easy-to-root hardwood cuttings can be struck directly into containers without any treatment or special environment. Most other species must be treated with hormones, struck into special media, and placed into a special propagation environment.

4.3.1 Rooting Hormones

Auxins are natural plant hormones that encourage root formation. Two common types are IAA (indole-3-butyric acid) and NAA (naphthaleneacidic acid). Although natural sources of auxins can be used, nurseries rely on synthetic sources because of purity, higher concentrations, and availability of ready-to-use liquid and powder forms, and because some preparations also contain fungicides (Figure 4.%B). Synthetic hormones can be purchased at specific concentrations (either expressed in parts per million or as a percentage) or you can mix your own to specific concentrations. The best type of auxin, IAA or NAA, or relative combination of auxins and their application rates will vary among species.

4.3.2 Rooting Media

An ideal rooting medium provides a good balance of aeration and moisture but is firm enough to support the cuttings. The optimum pH is 5.5 to 6.5 for most plants, but acid loving plants prefer a pH of 4.0 to 5.0. Some common components of rooting media generally include a combination of two or more of the following: large grade (#2) perlite, pumice, *Sphagnum* peat moss, coarse sand, and fine bark chips. Different combinations of the components are used depending on the species being propagated, but perlite is one of the most common ingredients in rooting media. Avoid very fine or very coarse grade sands because they tend to discourage root development, and roots that do form tend to be brittle and break off. Formulating a good rooting medium promotes development of fibrous root systems that retain a quantity of the rooting medium during lifting. This aids in establishment by reducing chances of transplant shock during transplanting.

4.3.3 Rooting Environment

Cuttings need moderate light levels so that their foliage can continue to photosynthesize and produce the necessary energy and hormones that stimulate rooting. Unfortunately, shoots and leaves of cuttings lose water as they photosynthesize, but lacking roots, the cuttings cannot replace that lost water. Therefore, you must keep the humidity around them high to reduce water loss. A good rooting environment protects the cuttings from excessive sunlight, wind, and precipitation and keeps the humidity around the cuttings high. Although a plastic bottle will work for an individual cutting (Figure 4.5C), or a plastic tent for a few seedlings, a hot frame is more appropriate if you plan to root any cuttings. Because the temperature can increase rapidly inside any rooting environment, diligent daily inspection is required to ensure proper rooting conditions. Frequent light waterings with a misting nozzle are recommended to keep humidity high. If large numbers of cuttings are being rooted, an automated misting system can reduce the labor required. In general, cuttings should not be fertilized until after roots form, but cuttings that take a long time to root may benefit from a dilute liquid fertilizer application. Many species root better if the rooting medium is warmer than the air, so some growers place heating cables underneath the flats of cuttings.

4.4 Transplanting

Transplanting is always one of the major stress periods during nursery culture, and transplant shock is even greater with rooted cuttings. Therefore, prepare containers, media, labels, wet paper towels, and transplanting tools ahead of time. Fill the containers about halfway, and water so that the growing medium is "moist, but not wet." Transplant rooted cuttings early or late in the day while keeping them out of direct sunlight. More than likely, all of your cuttings will not all be ready to transplant at the same time. Hold the cutting gently by the stem, carefully remove it from the rooting media without disturbing any media that remains attached to the roots, examine the root development, and select only those with an adequate root system (Figure 4.5D). Loosely wrap a moist paper towel around the root systems and keep the cuttings in the shade until they are transplanted. Hold the rooted cutting by the stem, insert it into the half-full container, and then backfill around the root system with moistened growing medium. Gently tamp the medium around the plants and then label, water, and move them to the growing area.

If cuttings lack a good root system by the end of summer, they should be left in the rooting media and transplanted the following spring. These cuttings should be hardened, as described above, at least 6 weeks before the first frost.

If, during fall, cuttings are just beginning to form new roots, these cuttings will need extra protection during the winter. Ideally, the root temperature should be kept at 34 to 41 °F. Placing cuttings inside a well-insulated cold frame works well.

4.5 Other Propagules Used in Vegetative Propagation

Bulbs, tubers, corms, and rhizomes are specialized plant structures that function in the storage of food, nutrients, and water. Bulbs are underground storage organs consisting of a short fleshy stem surrounded by fleshy modified

Figure 4.5—*Sanitation is critical while preparing cuttings for striking, and a dilute solution of household bleach is an excellent disinfectant (A). Most cuttings require treatment with special rooting hormones (B) and a protected environment to keep humidity high (C). Cuttings will develop roots at different rates, so transplant only those with adequate roots (middle and right) and return the others to the rooting chamber (D).*

leaves (scales). Tunicate bulbs have outer scales that are dry and membranous that can be used for propagation (Figure 4.6A). Corms are very similar to tunicate bulbs and are comprised of a swollen stem base enclosed by the dry scale-like leaves (Figure 4.6B). Cormels are miniature corms that form between the old and new corms which, because of their small size, require more time in the nursery to produce an acceptable plant for outplanting. Tubers, like the common garden potato, are swollen modified stems that serve as underground storage organs, and the "eyes" are actually nodes containing buds. Propagation by tubers involves planting the entire tuber or dividing it into sections containing at least one eye. Rhizomes are specialized stems in which the main axis of the plant grows horizontally or vertically at or below the soil surface. Many herbaceous plants and woody shrubs can be easily propagated with rhizomes (Figure 4.6C). Rhizomes are cut into sections containing some roots and at least one shoot or bud; these "divisions" can then be planted in containers or bareroot beds. Many herbaceous forbs, grasses, and grass-like plants can be multiplied by dividing their crowns; crown division is usually done just before shoot growth begins in the spring. Plants are dug up and the crown cut into sections that contain a substantial portion of the root system; these divisions are then planted into containers or bareroot beds. Plants that produce runners, like strawberries, can be propagated by cutting the nodal sections of the runners containing roots, and planting them (Figure 4.6D).

4.6 Post Transplanting Care

Transplanted cuttings should be placed in a shaded, protected area of the nursery. During the next month or so, cuttings should be hardened by exposing them to progressively more sunlight by moving them to different areas of the nursery. Be vigilant to ensure the rooted cuttings are not stressed. Once the rooted cuttings have acclimated to conditions outside the rooting environment, they can be cultured in the same manner as container seedlings (see Chapter 3).

Figure 4.6—*In addition to shoot cuttings, native plants can also be propagated using other vegetative structures, such as bulbs (A), corms (B), rhizomes (C), and runners (D).*

4.7 Additional Reading

Cullina, W. 2000. Growing and propagating wildflowers of the United States and Canada. The New England Wild Flower Society. New York: Houghton Mifflin Company. 322 p.

Landis, T.D.; Tinus, R.W.; Barnett, J.P. 1999. The container tree nursery manual. Volume 6, Seedling propagation. Agric. Handb. 674. Washington, DC: U.S. Department of Agriculture, Forest Service. 167 p.

Luna, T. 2008. Vegetative propagation. In: Dumroese, R.K.; Luna, T.; Landis, T.D., eds. Nursery manual for native plants: a guide for tribal nurseries. Volume 1, Nursery management. Agric. Handb. 730. Washington, DC: U.S. Department of Agriculture, Forest Service: 152-175.