Layering and Grafting
for
Native Plant Propagation

Layering:

What is Layering?

Layering is a form of vegetative propagation where cuttings are made to form adventitious roots while the cutting is still attached to the mother plant. Stems of the mother plant are covered in a growing medium in various ways to exclude light, increase the moisture level, and stimulate root growth. Once roots are formed the new plant (layer) can be dug and transplanted to the desired location.

Layering is an ancient technique for vegetative propagation. It was used extensively in European nurseries from the 18th to the early 20th century for propagating woody shrubs and tree species. It is no longer a primary nursery technique for propagating most plants, but does provide some advantages for propagating native species where time or resources may be scarce.

What are the advantages of layering?

The advantages of layering include:

- Less maintenance than cuttings
- Allows propagation to be performed on-site
- Natural accumulation of photosynthates and hormones due to girdling, incision, or bending
- Often times a large plant is the product
- Easy to do with little investment

Major Advantages or Restoration:

Less Maintenance

Unlike regular stem cuttings, those produced by layering are still attached to the mother plant and therefore require less maintenance. Their supply of water is not significantly decreased since they are still attached to the root system of the

mother plant. This eliminates the need for resource and labor intensive practices such as shading or regularly misting of young cuttings. Layering also reduces or eliminates the need to harden off cuttings before planting since they are already in their native environment.

Propagating on-site

Layer can be done on site where there may be well established plants of a species that you want propagate. Since layering usually consists of bending a branch down below the soil line, often times the only required materials are a shovel, and stakes to hold the branch below ground and to keep shoot tips upright. This can seriously reduce the amount of time and resources needed in hauling plants and supplies from place to place.

Disadvantages

- Takes a long time to produce new plants
- Produces only a few plants per mother. Not ideal for plants that you want a lot of from only a few mothers, or for sites where resources and time are not particularly in short supply.

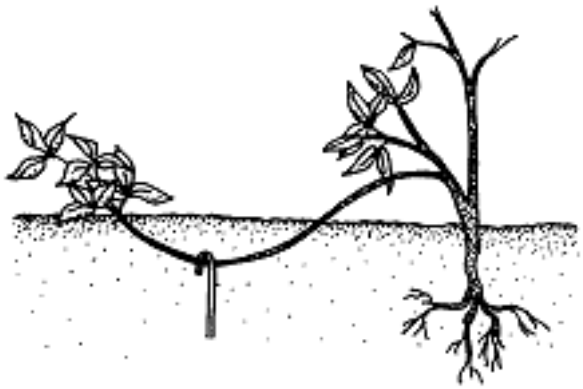
Keys to Success

- Light exclusion form the rooting section of the stem is a must. If light is allowed to penetrate root formation will not be successful.

- Girdling, incision, bending, or cracking the stem. Wounding the stem in some form triggers the release of hormones and increases the likelihood of successful propagation.

Types of Layers

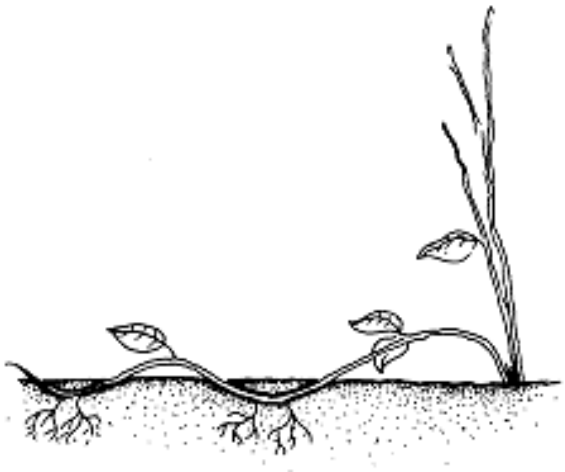
Simple Layer – A type of layer where shoots from the previous year are bent to the ground (sometimes girdled) and covered in soil and "pegged down" 6-9 inches form the tip. Shoot tips are left emerging from the soil forming a U shape. Shoots are held in place using stakes.



Simple layer with stake holding shoot in place

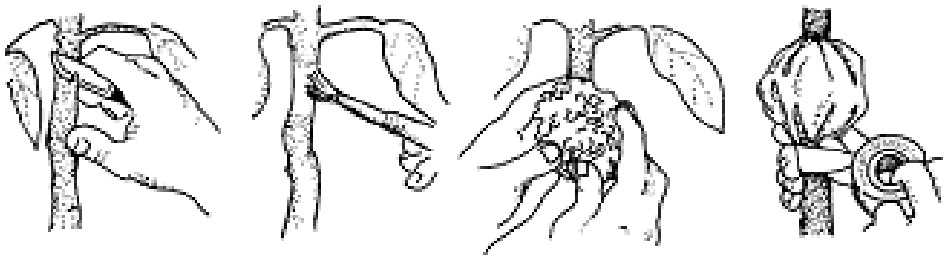
Compound Layer - A type of layer in which entire horizontal shoots are covered in media causing the formation of numerous rooted layers per branch rather than just one.

Serpentine Layer - Just like a compound layer except that individual nodes are covered with media. Generally there is an alternation where every second node is covered. Most effective with plants that yield flexible shoots.



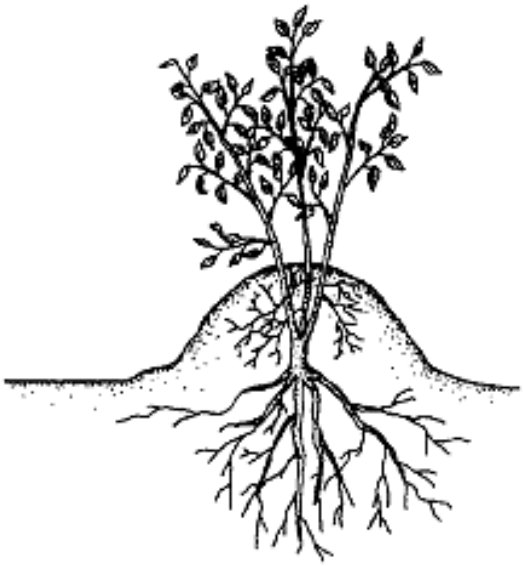
Serpentine Layer

Air Layering - Air layering is a technique performed without placing the layered branch or shoot below the soil line of the mother plant. The stem is first girdled. Proper girdle is key to causing the accumulation of carbohydrates at the cut. Then, the girdled section is wrapped in media like peat moss that is easy to work with. Adding hormone to the media or directly applying it to the stem is very beneficial. The media is then enclosed in plastic and tied off. Once roots have formed the layer can be removed from the mother and planted.



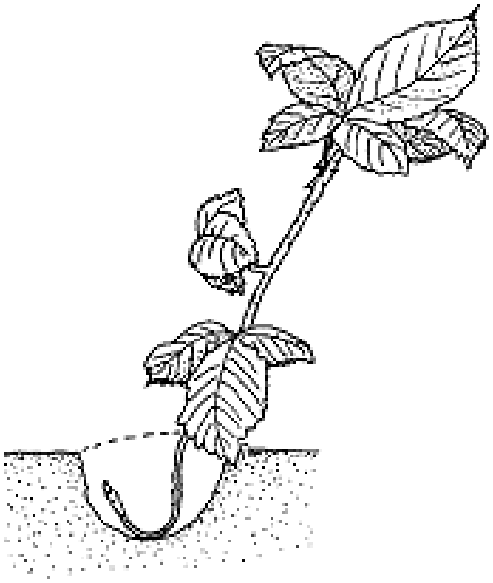
Sequence of air layering. Girdling, applying hormone, wrapping in media and plastic, and tying off.

Mound Layering - A type of layering that is useful with heavy-stemmed, closely branched shrubs. For a mound layer cut the plant back to 1 inch above the soil surface in the dormant season. The dormant buds will produce new shoots in the spring. Mound soil over the new shoots as they grow. Roots will develop at the bases of the young shoots. Remove the layers in the dormant season and either place in containers or transplant diriectly.



A mound layer well into the growing season

Tip Layer - Tip layers are a very quick way to layer a lot of branches. The branch of the existing mother plant are bent down to the ground and the tips of the branches are essentially buried in 3-4" deep holes. The shoot naturally grows into a U shape with roots developing at the bend. Remove and plant tip layer in late fall or early spring.



Tip layer with a Rubus species

Good Natives for Layering:

Layering is most effective on plants whose branches can be easily bent down to the ground or plants with ground hugging stems. It has been noted to work especially well with salal, kinniknnnik, twinflower, tailing honeysuckle, which have ground hugging stems. Layer has also been effective with snowberry, Indian plum, Oregon box and other plants whose stems or branches can be easily bent down. The literature on layering natives is quite thin, but it has a good chance of working on any plants with the above characteristics.

Grafting:

What is grafting?

Grafting is a horticultural technique used to join parts from two or more plants so that they appear to grow as a single plant. The upper part (scion) of one plant grows on the root system (rootstock) of another plant.

Grafting can only be done between reasonably closely related plants. Most often the limits of success are with other species in the same genus, though in some cases plants in

different but closely related genera can graft successfully (e.g. Larch will graft on Douglas-fir), and in other cases, not, even between some species in the same genus (e.g., Norway maple will not graft on Sugar maple).

Reasons for grafting

Grafting may increase the productivity of certain horticultural crops because it makes it possible to do the following things:

Change varieties or cultivars. An older established orchard of fruiting trees may become obsolete as newer varieties or cultivars are developed. The newer varieties may offer improved insect or disease resistance, better drought tolerance, or higher yields. As long as the scion is compatible with the rootstock, the older orchard may be top worked using the improved variety or cultivar.

Optimize cross-pollination and pollination. Certain fruit trees are not self-pollinating; they require pollination by a second fruit tree, usually of another variety. This process is known as cross-pollination. Portions of a tree or entire trees may be pollinated with the second variety to ensure fruit set. For example, some hollies are dioecious, meaning that a given plant has either male or female flowers but not both. To ensure good fruit set on the female (pistillate) plant, a male (staminate) plant must be growing nearby. Where this is not possible, the chances that cross-pollination will occur can be increased by grafting a scion from a male plant onto the female plant.

Take advantage of particular rootstocks. Compared to the selected scion, certain rootstocks have superior growth habits, disease and insect resistance, and drought tolerance. For example, when used as rootstock for commercial apple varieties, the French crabapple *(Malus sylvestris,* Mill.) can increase resistance to crown gall and hairy root. Malling VIII and Malling IX are used as dwarfing rootstocks for apple trees when full-sized trees are not desired, such as in the home garden.

Benefit from interstocks. An interstock can be particularly valuable when the scion and rootstock are incompatible. In such cases, an interstock that is compatible with both rootstock and scion is used. An interstock could increase the disease resistance or cold hardiness of the scion. Plants also may be double worked to impart dwarfness or influence flowering and fruiting of a scion.

Perpetuate clones. Clones of numerous species of conifers cannot be economically reproduced from vegetative cuttings because the percentage of cuttings that root successfully is low. Many can be grafted, however, onto seedling rootstocks. Colorado blue spruce *(Picea pungens,* Engelm), Koster blue spruce *(Picea pungens var. Kosteriana,* Henry), and Moerheim spruce *(Picea pungens var. Moerheimii,* Rujis) are commonly grafted onto Norway spruce *(Picea abies,* Karst.) or Sitka spruce *(Picea sitchensis, Carr.)* rootstock to perpetuate desirable clones. Numerous clones of Japanese maple *(Acer palmatum,* Thunb.) that either root poorly or lack an extensive root system are grafted onto seedling *Acer palma*tum rootstock.

Produce certain plant forms. Numerous horticultural plants owe their beauty to the fact that they are grafted onto a standard, especially those that have a weeping or cascading form. Examples include weeping hemlock *(Tsuga canadensi.3,* Carr. *var. pendula,* Beissn.), which is grafted onto seedling hemlock rootstock *(Tsuga canadensis,* Carr.);

weeping flowering cherry *(Prunus subhietella var. pendula,* Tanaka), which is grafted onto Mazzard cherry rootstock (Prunus avium, L.); and weeping dogwood *(Cornus florida, L. var. pendula,* Dipp.), which is grafted onto flowering dogwood rootstock (Cor*nus florida,* L.). In most cases, multiple scions are grafted 3 feet or higher on the main stem of the rootstock. When used this way, the rootstock is referred to as a standard. It may require staking for several years until the standard is large enough to support the cascading or weeping top.

Repair damaged plants. Large trees or specimen plants can be damaged easily at or slightly above the soil line. The damage may be caused by maintenance equipment (such as lawn mowers, trenchers, or construction equipment), or by disease, rodents, or winter storms. The damage can often be repaired by planting several seedlings of the same species around the injured tree and grafting them above the injury. This procedure is referred to as inarching, approach grafting, or bridge grafting.

Increase the growth rate of seedlings. The seedling progeny of many fruit and nut breeding programs, if left to develop naturally, may require 8 to 12 years to become fruitful. However, if these progeny are grafted onto established plants, the time required for them to flower and fruit is reduced dramatically. Another way to increase the growth rate of seedlings is to graft more than one seedling onto a mature plant. Using this procedure as a breeding tool saves time, space, and money.

Index viruses. Many plants carry viruses, although the symptoms may not always be obvious or even visible. The presence or absence of the virus in the suspect plant can be confirmed by grafting scions from the plant onto another plant that is highly susceptible and will display prominent symptoms.

Simply the reasons for grafting usually are:
To perpetuate a variety.
To increase the ease and speed of multiplication.
To produce some radical change in the size, nature, habit, adaptation, or disease resistance of rootstock or scion.

When to graft

Most grafting is done during winter and early spring while both scion and rootstock are still dormant. Containerized plants may be moved indoors during the actual grafting process; after grafting, these plants are placed in protected areas or in unheated overwintering houses. Field-grown stock, of course, must be grafted in place. Some deciduous trees are commonly grafted as bare rootstock during the winter and stored until spring planting. Indoor winter grafting is often referred to as bench grafting because it is accomplished at a bench.

How to graft

These are just general guidelines when collecting scion, each grafting technique may have additional requirements of the scion.

1. *Timing.* The best time of year to gather scionwood will vary with bio-regional climate and type of fruit. The wood should be in the dormant stage and inspected for freeze damage.
2. *Authenticity*. The best wood will be taken from healthy trees that have proven themselves as productive and true to name and type. Label each variety carefully at cutting time. Use a water proof label and marker.
3. *Selection*. For most types of dormant grafting, one-year old wood (last season's growth) is generally considered best. Wood about a pencil diameter and 6 to 10 inches long is usually ideal.
4. *Storage*. The essential requirements are to keep the wood moist and viable, but not so wet as to rot, and maintaining a cool enough temperature to prevent premature bud-swelling and protecting against freeze damage. Store scions in tightly sealed plastic bags with some moisture in refrigeration until ready to use.
5. *Disease*. Be careful not to select scion wood from trees suspected of harboring infestation of bacterial, viral, or fungal disease.

NOTE: In grafting the vascular cambium of the scion or bud must be aligned with the vascular cambium of rootstock. In woody plants the cambium is a very thin ribbon of actively dividing cells located just below the bark. The cambium produces conductive tissue for the actively growing plant (Figure 1). This vascular cambium initiates callus tissue at the graft and bud unions in addition to stimulating tissue growth on the basal ends of many vegetative cuttings before they have rooted.

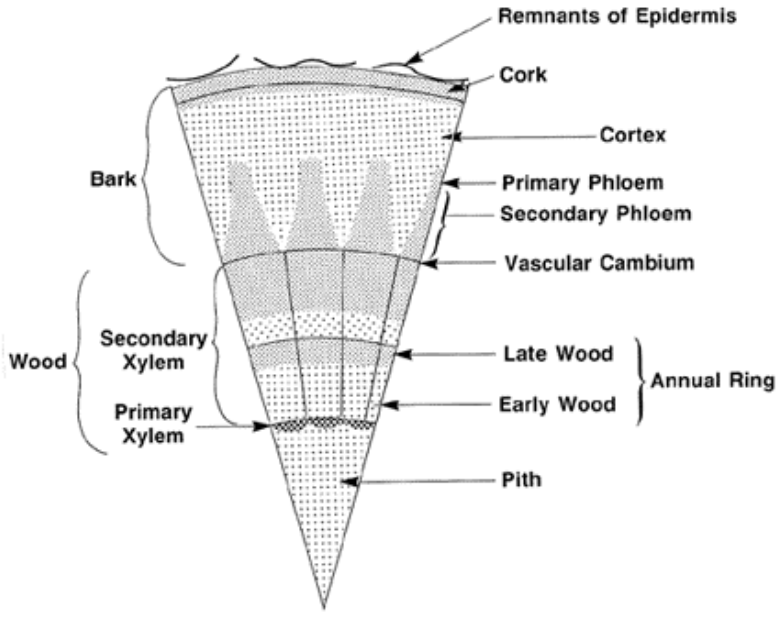


Figure 1 Cross section of a woody plant stem.

Cleft Gı

One of th Figure 2), is a method for top working both flowering and fruiting trees (apples, cherries, pears, and peaches) in order to change varieties. Cleft grafting is also used to propagate varieties of camellias that are difficult to root. This type of grafting is usually done during the winter and early spring while both scion and rootstock are still dormant. Cleft grafting may be performed on main stems or on lateral or scaffold branches.

The rootstock used for cleft grafting should range from 1 to 4 inches in diameter and

should be straight grained. The scion should be about 1/4 inch in diameter, straight, and long enough to have at least three buds. Scions that are between 6 and 8 inches long are usually the easiest to use.

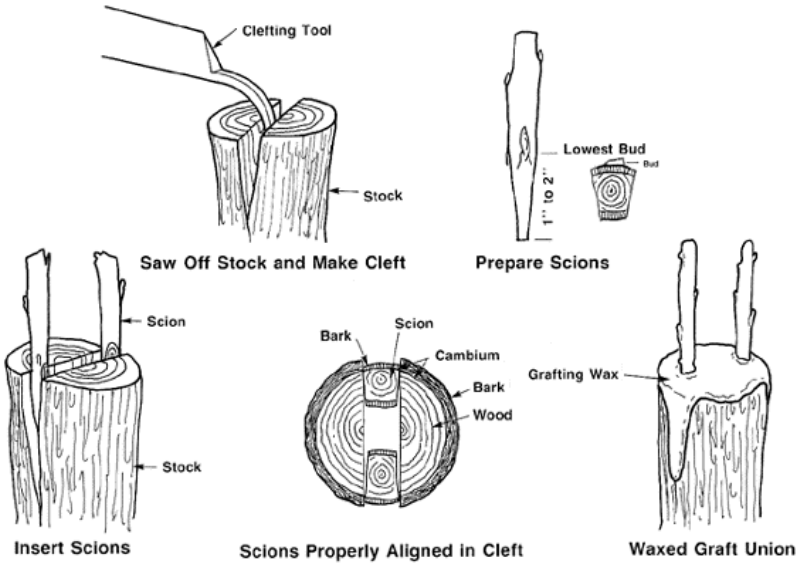


Figure 2. Cleft graft.

Preparing the Rootstock. The stock should be sawed off with a clean, smooth cut perpendicular to the main axis of the stem to be grafted. Using a clefting tool wedge and a mallet, make a split or "cleft" through the center of the stock and down 2 to 3 inches. Remove the clefting tool wedge and drive the pick end of the tool into the center of the newly made cleft so that the stock can be held open while inserting the scion.

Preparing the Scion. In cleft grafting, one scion is usually inserted at each end of the cleft, so prepare two scions for each graft. Select scions that have three or four good buds. Using a sharp, clean grafting knife, start near the base of the lowest bud and make two opposing smooth-tapered cuts 1 to 2 inches long toward the basal end of the scion. Cut the side with the lowest bud slightly thicker than the opposite side. Be sure the basal end of the scion gradually tapers off along both sides.

Inserting the Scion. Insert a scion on each end of the cleft, with the wider side of the wedge facing outward. *The cambium of each scion should contact the cambium of the rootstock.*

Securing the Graft. Remove the clefting tool from the cleft so that the rootstock can close. Pressure from the rootstock will hold the scions in place. Thoroughly seal all cut surfaces with grafting wax or grafting paint to keep out water and prevent drying. If both scions in the cleft "take," one will usually grow more rapidly than the other. After the first growing season, choose the stronger scion and prune out the weaker.

NOTE: The temperature of grafting wax is critical. It must be hot enough to flow but not so hot as to kill plant tissue. Recently, paint-like sealants have replaced wax in many areas because they are easier to use and require no heating.

Side-Veneer Graft

At one time the side-veneer graft (Figure 3) was a popular technique for grafting varieties of camellias and rhododendrons that are difficult to root. Currently, it is the most popular way to graft conifers, especially those having a compact or dwarf form. Side-veneer grafting is usually done on potted rootstock.

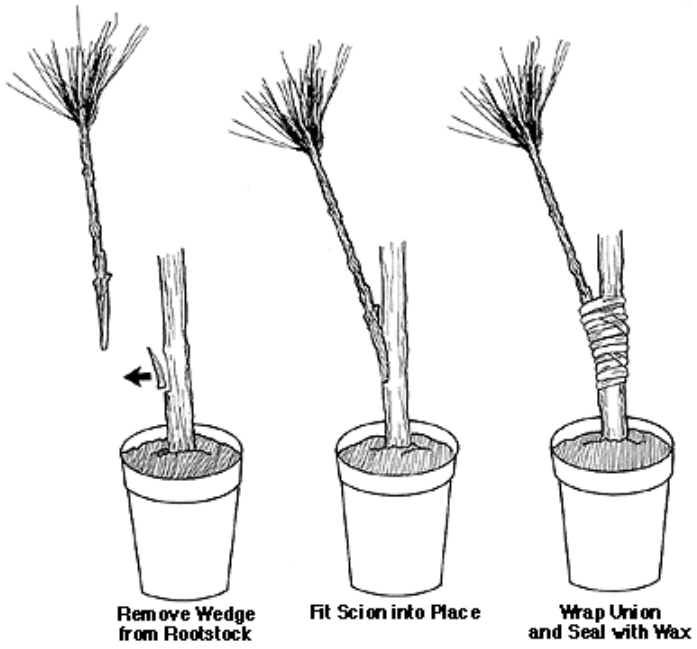


Figure 3. Side veneer graft

Preparing the Stock. Rootstock is grown in pots the season before grafting, allowed to go dormant, and then stored as with other container nursery stock. After exposure to cold weather for at least six weeks, the rootstock is brought into a cool greenhouse for a few days before grafting takes place to encourage renewed root growth. The plant should not be watered at this time.

Make a shallow downward cut about 3/4 inch to 1 inch long at the base of the stem on the potted rootstock to expose a flap of bark with some wood still attached. Make an inward cut at the base so that the flap of bark and wood can be removed from the rootstock.

Preparing the Scion. Choose a scion with a diameter the same as or slightly smaller than the rootstock. Make a sloping cut 3/4 to 1 inch long at the base of the scion.

Inserting the Scion. Insert the cut surface of the scion against the cut surface of the rootstock. Be certain that the cambia contact each other.

Securing the Graft. Hold the scion in place using a rubber grafting strip, tape, or grafting twine. Seal the entire graft area with warm grafting wax or grafting paint. Remove the rubber or twine shortly after the union has healed. Never allow the binding material to girdle the stem.

Whip and Tongue Graft

The whip and tongue technique (Figure 4) is most commonly used to graft nursery crops or woody ornamentals. Both the rootstock and scion should be of equal size and preferably no more than 1/2 inch in diameter. The technique is similar to splice grafting except that the whip on the rootstock holds the tongue of the scion in place (and vice versa). This leaves both hands free to wrap the joint.

For the whip and tongue graft, make similar cuts on both the stock and scion. These cuts should be made with a single draw of the knife and should have a smooth surface so that the two can develop a good graft union. Up to this point, rootstock and scion are cut the same as for a splice graft.

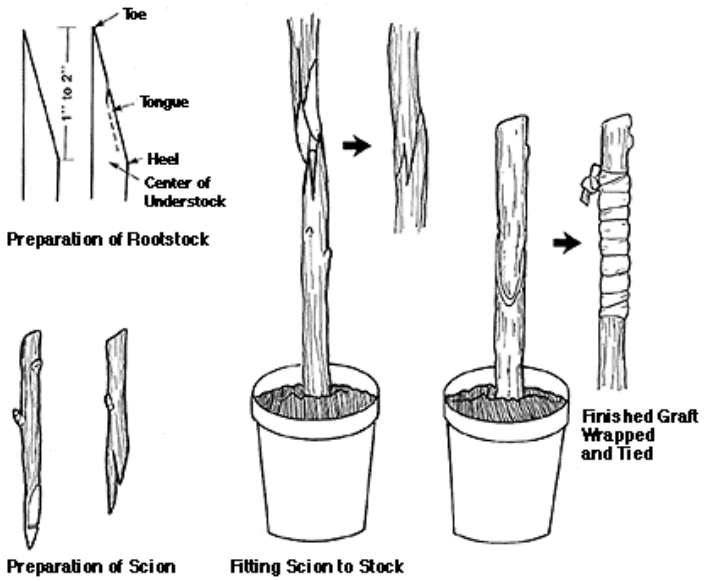


Figure 4. Whip and tongue graft.

Preparing the Stock and Scion. Cut off the stock using a diagonal cut. The cut should be four to five times longer than the diameter of the stock to be grafted. Make the same kind of cut at the base of the scion.

Next, place the blade of the knife across the cut end of the stock, halfway between the bark and pith (on the upper part of the cut surface). Use a single knife stroke to draw the blade down at an angle through the wood and pith. Stop at the base of the initial diagonal cut. *This second cut must not follow the grain of the wood but should run parallel to the first cut.*

Inserting the Scion. Prepare the scion in the same way. Fit the scion into the rootstock so that they interlock whip and tongue. Be certain that the cambia are aligned.

Securing the Graft. Wrap the junction with a grafting strip or twine, and seal it with grafting wax or grafting paint. Never allow the binding material to girdle the stem.

Restoration use

Grafting techniques can be extremely useful in restoration work. Grafting can substantially increase the speed of growth and multiplication among various woody plants. Through the use of these techniques, a native plant production facility can quickly grow several seedlings for restoration use. Grafting can also increase the hardiness and disease resistance of trees, and other woody plants that may struggle in a particular area or are just difficult to grow. If a tree is damaged during restoration work, grafting can help rehabilitate and repair the damage to the tree.

Sources:

Hartmann, Hudsun T., Plant Propagation: Principles and Practices. Upper Saddle River: Prentice Hall, 2002.

Kruckaberg, Artheur R., Gardening with Native Plants of the Pacific Northwest. Seattle: University of Washington Press, 1996.

http://ag.arizona.edu/pubs/garden/mg/propagation/asexual.html

http://www.ces.ncsu.edu/depts/hort/hil/hil-8701.html

http://www.ces.ncsu.edu/depts/hort/hil/grafting.html

http://www.ces.ncsu.edu/depts/hort/hil/ag396.html

http://www.homeorchardsociety.org/article/3/

http://en.wikipedia.org/wiki/Grafting

By: Charlie Delius and Patrick Keegan