

## 9-10. PLANT PROPAGATION BY GRAFTING

Note: In these labs, you will learn procedures for propagating selected deciduous woody plants by grafting. Turn in lab report on April 29, 2009.

### I. Introduction

Because flowers on trees or shrubs are cross-pollinated, plants grown from seed do not have the same characteristics as the parent. To propagate a particular cultivar, vegetative propagation is necessary. Where propagation by cuttings is not feasible or economical, grafting is done. For fruiting types like apple or pear, scions of several cultivars grafted onto one tree develop into branches that are true to type.

Grafting success requires three elements: a) good technique, b) healthy plant material - both scion and rootstock, and c) a sharp knife. A sharp knife has no substitute. Almost any pocket knife that takes and holds a sharp edge will do but regular grafting knives are recommended.

### II. Grafting Terms

#### A. Scion

A piece of detached twig or shoot (usually from last year's growth) used in propagating the plant from which the twig is taken. The scion usually contains two to four buds. For most kinds of grafting it is the top part of the graft.

#### B. Stock

The portion of the graft to which the scion is attached. It may be a piece of root, a seedling, or a tree with part of the top removed in preparation for grafting.

#### C. Cambium

A very thin layer of living cells lying between the outer sapwood and inner bark. This cambium is the growing region just under the bark. Because cambium cells divide and make new cells, the cambiums of two different but related plants will grow together if they are fixed and held firmly in contact.

### III. Scion Grafting

Scion grafting is normally used in topworking older trees. It is a convenient method for rebuilding or rejuvenating an old tree, or changing one to a better cultivar. Scions may also be bridged grafted to repair damaged trees such as those girdled by mice or rabbits. For a successful graft, the cambium layers of the scion and stock must be brought together and held firmly in place until they unite and grow as one. Scions are generally cut in the late fall or winter when the trees are dormant. Grafting outdoors is usually done in the spring when growth starts and the sap is running.

## **A. Bark Graft**

A simple, rapid grafting method is the bark graft. This type of graft can be readily performed by amateurs, and if properly done, gives a high percentage of "takes". It requires no special equipment and can be done on branches ranging from 1" (2.5 cm) up to 1 foot (30 cm) or more in diameter, although it is not recommended on the larger sizes. Bark grafting can only be done when the stock is actively growing since it depends on the bark separating readily from the wood. Usually this takes place in the spring when active growth of the stock occurs. Dormant scions must be used, necessitating the collection of scionwood for deciduous species during the dormant season and holding it in cold storage until the grafting is done. With this method, scions are not as securely attached to the stock (as in some of the other methods) and are more susceptible to wind breakage during the first year. New shoots arising from the scions should be staked or cut back to half their length in windy sites.

For small diameter branches, one scion is used. For larger stocks, several scions may be inserted. Cut the stock or branch where the scion is to be attached to form a stub. A vertical knife cut 1" to 2" (2.5-5 cm) long is made at the top end of the cut stub through the bark to the wood. The bark is then lifted slightly along both sides of this cut, in preparation for insertion of the scion. Select a dormant scion 4-5" long containing two to three buds. Make a slanting cut 1.5" to 2" (3.8 to 5 cm) long at the base of the scion. On the side of the scion opposite the long cut, a second shorter cut is made which forms a wedge at the basal end of the scion. The scion is then inserted between the bark and wood of the stock with the long cut towards the wood.

The finished graft should be wrapped with grafting rubbers, rubber tape or clear grafting tape. When bark grafting outdoors, the scions are often fastened to the stock using small flat-headed nails (0.5" to 1" long). After the stub has been grafted and the scions fastened by nailing or tying, all cut surfaces, including the end of the scions, should be covered thoroughly with grafting wax.

## **B. Cleft Graft**

One method commonly used is the cleft graft. This type of graft is the most important method used to topwork a tree, changing it from one variety to another. Branches which range from 1 to 3 inches (2.5-7.6 cm) in diameter should be selected for cleft grafting. Smaller diameter branches do not provide adequate pressure to hold the scions in position during the healing process. Select the branch to be grafted and cut it back to a smooth, knot-free, straight-grained section of the branch. A knife is used to remove any ragged edges of bark around the diameter of the wound. Make a vertical cut, 1.5" to 2" (3.8 cm to 5.0 cm) deep, down through the center of the stock piece with your knife (use the cleft tool for larger branches).

The cleft graft scion should be about 0.25" (0.6 cm) in diameter. Cut a wedge on the butt end of the scion stick, starting about 2" (5 cm) from the end and making a long smooth cut toward you that is about 1 to 1.5" (2.5-3.8 cm) long. Turn the scion 180° and make a similar cut on the opposite side. These two cuts make a two-sided wedge. When making the second cut, hold the knife so that you make one side of the wedge slightly thicker than the other. The wedge is usually cut so that the bottom bud is on the thick side. Open the crack in the stock wide enough to insert the scion without much force. Insert the scion so the thick side of the wedge is toward the outside and its cambium is in contact with the cambium of the stock. Be sure to push the scion wedge down into the crack far enough to hide nearly all its cut surface. Slant the scion slightly to insure contact. Cambiums must touch where the stock is tight against the scion. Two scions of equal size are usually inserted in each cleft. Wrap the graft with clear plastic tape or rubber electrician's tape.

### **C. Whip-and-Tongue Graft**

The method of grafting probably used the most in this country is the whip-and-tongue. It is a common method used to propagate nursery stock and is primarily designed to join together plant parts which are under 1" (2.5 cm) in size. When selecting the scion, choose dormant one-year old wood, preferably the same size as the stock. You get contact only on one side when the stock and scion are of different sizes.

First prepare the stock. Starting about 2" (5 cm) from the butt of the stock, make a smooth, straight cut about 1.5" (3.8 cm) long. Try to make this cut with one good sweeping movement. Position the one-sided wedge so the cut surface faces you and support the wedge on the back side with your index finger. Starting about one-third of the way down from the tip of the exposed wedge and with the knife perpendicular to the wedge cut, make a downward cut about 0.5" (1.3 cm) long. Make the cut approximately parallel with the grain of the wood. Prepare the scion in the same way, leaving two to three buds. Fit the scion and stock together, pushing them together far enough so the cut surfaces match. The toe of the scion then just comes to the heel of the stock. If the scion and stock are not the same size, be sure to match the cambiums on one side only.

Grafts must be wrapped to maintain contact. When wrapping, see that the scion does not move out of position. The tips of both wedges should be bound tightly against matching cut surfaces. When using non-elastic binding material that may girdle or wraps that will not disintegrate as the graft grows, you will need to slit the material a few weeks later after the graft union has healed.

### **D. Side Grafts**

With this method, the scion is inserted into the side of the stock. Large-scale propagation of both coniferous and deciduous nursery trees and shrubs is done using numerous variations of this method. One variation is the side-veneer graft which works well for grafting named evergreen cultivars unto small potted evergreen liners. To prepare the stock, a 1 - 1 ½" shallow downward and inward cut is made to a smooth area of the stock just above the soil line. A second short inward and downward cut is made at the base of the first cut to remove the piece of wood and bark. A 1 - 1 ½" long diagonal cut is made to one side of the scion and a short cut is made at the base of the scion on the opposite side. The cuts on both rootstock and scion should be about the same length & width to facilitate good cambium contact. After the scion is inserted, the graft should be tightly wrapped with paraffined string or budding rubbers. A common practice is to plunge the grafted plants into a grafting case containing damp media such as peatmoss or a blend of peat-perlite (coarse grade) to cover the graft union and provide high humidity during the healing process. The case is kept closed for the first week and then gradually opened over several weeks to acclimate the grafts. Once the union has healed, the stock can be cut back above the scion in gradual steps or all at once.

## **Recommendations for Finished Grafted Juniper**

by Don Cross, Cross Nurseries, Lakeville, MN

1. Provide under bench heat at a minimum of 60 °F to 70 °F.
2. Build a 2 mill poly tent over the grafting bench. Build with 1" x 2" lumber or use 1/2" metal conduit. For example, build the tent at least 2 1/2' above the grafts covering with 2 mil poly, tape down the three sides and leaving the one side open, so the grafter can get access for watering, working on the grafts by lifting up the side and most important for accessing air to the grafts.
3. Put 1 inch of Canadian peat moss in the bottom of the bench for the finished graft to sit on. This moss is to be wet just before grafts are set on it. This will help create high humidity.
4. Use sphagnum peat moss to cover. This is the best method we have used. Take a bale of sphagnum moss, break up in a bushel basket or tub and wet thoroughly. When you take a handful of the wet moss and wring out the excess moisture so the water just runs out of the moss, the optimum level of moisture is obtained.
5. The finished graft: Both the whip and tongue and veneer grafts have been successful. We use the rubber strip for tying our grafts to the understocks. Then we wax the wound with a paraffin wax. The wax is not necessary if the rubber strip is tied tightly. Holding the graft in one hand take a small handful of the wet moss and wrap around the graft wound, squeeze gently and set the graft into the tent in neat rows. Stand the grafts straight up. Some books say to tilt the graft a bit, but we feel this is unnecessary. When you are finished grafting the plants for the day, mist them down moderately. Pin the open side of the tent tight. Water this moss lightly after one to two weeks and then every time it appears a little dry. After the first three weeks, water the entire graft moderately and then once every week to assure the potted understock has enough water to survive.
6. Watch the tent for heat and humidity. Mount a thermometer inside tent. After the first couple of days watch the condensation build up within your tent, if it looks good, no need to open the tent unless the inside temperature gets above 74 °F. Then we must open the side of the tent for some air circulation. Beginning week two, open the side of the tent each day until 4 p.m. then close it tight for the night. It's very important to give the grafts air and necessary heat to callus.
7. Growth on grafts. After 5 to 6 weeks most grafts will show some new growth. When the growth gets to a length of 3/4" to 1" long, remove the moss from around the graft wound. Set the grafts back into the bench with no moss around the graft. Continue to cover the tent in the same method as before, leave inside the tent for another 10 days to 2 weeks then remove the poly tent. Do not cut back the understock until the time when they are in the open bench and beginning to harden off some.
8. Cutting off the understocks. Try not to be in a big hurry to cut off the understock top. The longer it stays the better chances the graft will grow. Sometimes there is too much foliage growing into the scion. If this is the case cut the understock top 1/2 off, wait 10 days then cut the rest of the top off.
9. We stake all the upright junipers with a 10" steel stake and tie with whatever is best for you. We leave the steel stakes on for the first year or two in the container or in the field. Then we remove the stake and reuse them on the next grafts.
10. Blight spores. After the grafts have been in the tent for about two weeks, some blight or dying pieces of the scion may show disease. When this appears we want to remove it. Sometimes we must take all the plants out of the bench and hand pick out the problem. Keep these grafts clean and spray with a fungicide to help control problems. We suggest spraying with a good fungicide once every 10 days or two weeks to insure control.

## E. Lab Exercises

### 1. Plant Materials

- a. Root stocks: *Malus* species (Siberian crabapple seedlings)  
*Fraxinus pennsylvanica* (green ash seedlings)  
*Pyrus ussuriensis* (Ussurian pear seedlings)  
*Juniperus chinensis* 'Hetzii'
- b. Scionwood: Cultivars of apple, ash (green, Manchurian, black), pear, and juniper

### 2. Procedures

- a. Perform bark grafts on 2 crabapple rootstocks and 2 green ash or 2 pear root stocks for a total of four bark grafts.
- b. Perform cleft grafts on 2 crabapple rootstocks and 2 green ash rootstocks for a total of four.
- c. Make four (4) whip-and-tongue grafts using 2 crabapple root stocks and 2 green ash (or 2 pear) rootstocks.
- d. Perform side grafts on 2 junipers

Note: Make sure to label type of graft, scion cultivar name, date and your name on all grafted plants.

### 3. Observation

Place your grafted plants inside a high humidity tent and observe the shoot growth from the scion. Your lab grade will reflect the success of your grafts.

**Remember to check your grafts each lab period and remove any new sprouts that might develop on the rootstock below the grafts.**

## **Grafting and Budding Fruit Trees**

### **How to Protect the Graft**

Immediately after completion of the graft the scions should be protected from drying out. Use a grafting compound on the graft unions and other cut surfaces.

### **Some Reasons Why a Graft Fails**

The scion and stock were incompatible; apple will not unite with plum, for example.

The grafting was done at the wrong season.

The understock was not healthy.

The scions were not vigorous.

The scions were dry or injured by cold temperatures.

The scions were not dormant.

The cambium of scion and stock were not meeting properly.

The scions were upside down.

The graft was improperly covered with grafting compound.

The scions were displaced by wind, birds or storms.

The graft was shaded too much after growth began.

New growth was damaged by aphids or other insects.

New growth was killed by fire blight.

The union girdled because the bindings or label were not released in time.

### **What If Grafts Fail?**

One hundred percent success in grafting is rare. The failure of one or two scions is not serious, since usually more scions are inserted than are necessary for the completed tree. On branches where the scions fail let the shoots grow. These can be budded the same summer or grafted later. Some shoot growth is needed for regrafting, but don't let them become so dense that they crowd the scions.

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Follow the links: Publications/Grafting and Budding Fruit Trees/How to Protect the Graft

### 9. PLANT PROPAGATION BY GRAFTING

1. Illustrate the four different types of grafting that you performed.

**a. *Bark graft***

**b. *Cleft graft***

**c. *Whip-and-Tongue graft***

**d. *Side-Veneer graft***

2. Present the result of your grafting exercises.

Graft type	<u>Cultivar</u> Scion / Stock	Results and comments
<b>a. Bark Graft</b>		
Apple 1	_____	_____
Apple 2	_____	_____
Ash 1	_____	_____
Ash 2	_____	_____
Pear 1	_____	_____
Pear 2	_____	_____
		% Success _____
<b>b. Cleft Graft</b>		
Apple 1	_____	_____
Apple 2	_____	_____
Ash 1	_____	_____
Ash 2	_____	_____
Pear 1	_____	_____
Pear 2	_____	_____
		% Success _____
<b>c. Whip-and-Tongue Graft</b>		
Apple 1	_____	_____
Apple 2	_____	_____
Ash 1	_____	_____
Ash 2	_____	_____
Pear 1	_____	_____
Pear 2	_____	_____
		% Success _____
<b>d. Side Graft</b>		
Juniper 1	_____	_____
Juniper 2	_____	_____
		% Success _____

3. Summarize the outcome of your graft exercises showing the percentage of successful grafts. For those grafts that failed, indicate possible reasons why your grafts did not take and suggest what improvements can be made.