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GRAFTING AND BUDDING

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**GRAFTING AND BUDDING**

Grafting and budding are methods used to join various plant parts to form one plant. These techniques are used principally in the fruit tree and rose industries as a means of perpetuating cultivars and for plant improvement.

The main reason for grafting and budding is for propagation but it is also used in obtaining disease resistance, dwarfing and repairing the plant.

**WHAT PLANTS CAN BE GRAFTED**

Dicotyledonous (broad-leaved) and coniferous plants are the only plants that can be grafted. Monocotyledonous plants such as lilies, bamboo and grasses can't be grafted.

Dicots and conifers both have a continuous cambium layer just beneath the bark which is necessary for the graft union. Monocots, on the other hand, have vascular bundles instead of continuous cambium which makes matching of the two plant parts impossible.

**GRAFT COMPATIBILITY**

Not all plants can be grafted easily even if they are dicots or conifers. There are limitations when you try to graft between genera of the same family and it is usually impossible to graft between families. Some plants are simply hard to graft. Beeches and oaks are examples of these.

Following is a list of grafting limits:

1. Within a variety - good
2. Between varieties - good
3. Between species but in the same genus - good
4. Between genera - remote. The following are compatible Pears on hawthorn, pears on quince, and pears on mountain ash, Lilacs on privit. Most often the reverse will not work.
5. Between families - impossible. Birch can't be grafted on elm.

Other causes of incompatibility are low humidity, too cold, poor technique, contamination and the scion grafted upside down.

**FORMATION OF THE GRAFT UNION**

When a graft is made two plant pieces are needed. The portion with roots is called the root stock when a root graft is done or the understock when a shoot portion is grafted. The portion to be attached to the root or understock is called the scion.

The plant tissue that makes grafting possible is called the cambium. This layer of cells separates the xylem (structural cells that conduct water and minerals in the plant) from the phloem (the outer vascular tissue that serves as a pathway of food in the plant). (Fig. 1)

![Diagram of Plant Vascular System](image)

**FIGURE 1 - PLANT VASCULAR SYSTEM**

The cambial region is an area of rapid cell division as it produces new tissue (cells) for both the xylem and the phloem. For a graft to be successful, it is imperative that the cambium of the scion and the cambium of the understock match up. (Fig. 2)

![Diagram of Cambium Matchup](image)

**FIGURE 2 - CAMBIUM MATCHUP**
The growing together of the cambium and consequent union of the xylem and phloem takes place best at a temperature of 70-80 degrees F. in the presence of high humidity.

**SCION PREPARATION**

The scion must be dormant or at least not as advanced as the understock when it is grafted. To assure this, cut off scion wood in January or at least by early February. The scion wood should be healthy 1-year-old wood with well developed vegetative buds. Avoid wood with flower buds, it does not graft. Generally, vegetative buds are narrow and pointed and flower buds are rounded and plump. Vigorous water sprouts make good scion wood and should be between 1/4 and 1/2-inch in diameter. Suckers or water sprouts coming from the base of the tree should not be used as they may be coming from the root stock. Also, avoid water sprout tips for they are generally soft and low in carbohydrates (energy).

Scion wood can be wrapped in bundles of 25 to 100, put in a plastic bag and stored in the refrigerator at 40-50 degrees Farenheit if they are used within three weeks. If longer storage is desired, scion wood should be stored at about 32 degrees Farenheit and they will keep for up to three months. They can also be buried 12-18 inches deep in shaded soil and kept for several weeks.

**GRAFTING TECHNIQUES**

The most common grafting techniques include the whip graft, cleft, bridge and approach graft.

The whip graft is used on seedlings. (Fig. 3). Both the understock and the scion have to be the same diameter. They should be at least 1/4-inch and at most 1/2-inch in diameter. The cut on both the understock and the scion should be a slant about 1 1/2-inches long. A tongue is made on the understock and scion by cutting downward into the slant. No wood is removed.

The scion should have four good buds. Fit the scion onto the understock as snug as possible taking care that the cambium layer of each is matched up. Bind in place with a 1/4-inch wide rubber band strip (1/4-inch wide rubber band cut once to make a strip), and seal the graft union with grafting wax to make the union airtight. (Fig. 3)

![Diagram of Whip Graft](image)

**FIGURE 3 - WHIP GRAFT**

The cleft graft is done to graft shoots onto old trees to help rejuvenate them and/or add another variety. Limbs to be grafted should be cut back to about 2 feet from the trunk. If the resulting stump is 2 inches in diameter, one scion is used. If the stump is 6 inches or larger in diameter, two and sometimes three scions are used. Split the branch stump across with a chisel. The base of the scion (1/4-inch in diameter with four good buds) is cut in a wedge shape slightly wider in proportion to the outside of the graft. (Fig. 4) The scion is wedged into the split and positioned so that the cambial layers of each match up tightly. (Fig. 5) Cover the union with grafting wax to make it airtight.

![Diagram of Cleft Graft](image)

**FIGURE 4 - CLEFT GRAFT**

![Diagram of Cleft Graft Union](image)

**FIGURE 5 - CLEFT GRAFT UNION**
The bridge graft is used to repair a girdled tree or limb. In this case the scions form a bridge between the understock, over the damaged area to the healthy wood above. Cut both ends of the scion on a slant so as to have a flat surface at least 2-inches long. Cut through the bark and into the cambium to form a pocket below and above the wound. The prepared scion should fit snugly into the pockets as diagramed. Or, if done in the spring, clean up the edges of the wound and make a slit in the bark as long as the slant on the scion. Lift the bark carefully and slip the scion under the flaps of bark so the cambium of each is next to each other. Then nail in place and cover with grafting wax. (Fig. 6)

![Bridge Graft Diagram](image)

**FIGURE 6 - BRIDGE GRAFT**

The approach graft is used to save a tree that was girdled or has damaged roots. In this situation the scion is a rooted cutting or seedling which is planted (roots not removed) beside the injured tree. The top end of the scion is cut at a slant and fitted into a pocket or slit in the bark above the wound so the cambium of the scion and tree are in contact. Cover with grafting wax. (Fig. 7)

![Approach Graft Diagram](image)

**FIGURE 7 - APPROACH GRAFT**

**BUDDING**

Budding is a form of grafting but instead of using a scion, only a small portion of the stem tissue with a bud or buds is used. Budding is generally done on immature plants or small twigs and is used on fruit and ornamental plants. The most common example of budding would be on hybrid roses (this is how they are created). The hybrid is budded to the understock to provide a hardier root system for the hybrid rose.

Budding limitations are similar to those for grafting.
An actively growing plant may be budded indoors at any time. For outdoor plants, the budding season runs from March through April when budding last season's wood, and begins in late June for budding on current-season wood.

The three main types of budding are T budding, patch budding and chip budding. Of these, T budding is the most common and is done when the bark will slip. Patch budding is done in later summer and chip budding is done when the bark doesn't slip.

The materials needed for budding are a good sharp knife (budding knife best) and raffia or rubber bands.

To prepare budwood cut off the leaves so that the leaf petiole can act as a handle for holding the buds. (Fig. 8)

T budding is done by cutting a T in the rootstock. The leg of the T should be 1-inch long; the cross should be 1/2-inch long. Carefully lift the corners so that the bark is pulled away from the wood leaving a pocket in which to place the bud. Cut a bud so that a small shield of bark and a sliver of wood come with it. Check the back side of the bud after cutting to make sure the eye of the bud is there. A hole in the back of the shield tells you the eye didn't come and you need to cut a new bud. Slip the bud between the flaps of the T so that the bud is pointed up and then trim the top of the shield so it fits flush with the top of the T. Carefully wrap the bud so that only it is exposed and is held securely in place. Periodically check the bud to see if it remains plump. It will start growing next season. If the bud dries, the bud union failed. (Fig. 9)

FIGURE 9 – T BUDDING

The patch bud is done by removing a square patch of bark from the understock and placing an identical patch containing a bud in its place. The bud is wrapped to secure it in place. A special, double-bladed knife is useful so a perfect, parallel-sided patch can be made. (Fig. 10)

FIGURE 10 – PATCH BUDDING

Chip budding is used when the plants are dormant or at a time when the bark will not slip. A wedge-shaped chip is cut out of the stock leaving a notch. An identical chip is cut from the bud wood and the bud chip is placed in the notch on the stock and wrapped. (Fig. 11)

FIGURE 11 – CHIP BUDDING

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