

Grafting and Budding



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Plantsman and Grower

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1 - Introduction

Grafting is the act of joining two plants together. The upper part of the graft (the scion) becomes the top of the plant or tree, the lower portion (the understock or rootstock) becomes the root system or the bottom part of the trunk. Although grafting usually refers to joining only two plants, it may be a combination of several. A third plant added between two others becomes the trunk or a portion of it. This is called an interstem. Multiple grafts may produce an apple tree with several varieties or a Rose-of-Sharon shrub with several different colours of flowers.

Budding is a method of grafting in which the scion (upper portion of the graft) is a single bud rather than a piece of stem or twig. Many of the same conditions and materials used for other forms of grafting also apply to budding

Budding is most frequently used where there is a limited amount of grafting scion wood available, or where other forms of grafting do not take on a particular species.

Interesting novelties can be developed by grafting several cultivars on one tree. It also is a means of producing a dwarf plant.

For practical purpose, I would recommend whip and tongue grafting for beginners, as it provides maximum length of contact of the cambium.

Before you start doing any 'real' grafting or budding, practice on some willow which is a soft wood. Then progress onto some hazel which is a slightly harder wood, and then go onto the 'real' stuff.

2 - Why Graft or Bud

Some cultivars (varieties) of plants do not come true from seeds. Others are difficult or impossible to reproduce from cuttings or other propagation techniques. Grafting is a way to change a large tree from an old to a new variety. It is also a method of using a root system better adapted to soil or climate than that produced naturally by an un-grafted plant.

Budding, particularly "T" budding, is faster than any other grafting technique. With a little practice, the right conditions and compatible plants, the percentage of successful unions can be high. Experienced budders may get 90 to 100 percent take. Even for the beginner, the percentage of successful unions is usually greater than with other forms of grafting. Budding is also well adapted to rootstocks from 6mm to 25mm in diameter. In larger branches, buds may be inserted in vigorously growing branches near the upper part of the plant, this is called top working.

Besides ease and success, a stronger union is formed with budding than those made with other grafting techniques. Because only a single bud is inserted, you can produce a large quantity of new plants even when scion wood is scarce.

3 - What can be Budded or Grafted

Not all plants can be budded or grafted. Generally, only plants closely related botanically form a good graft union, but not always true thou. Budding or grafting is not a means of developing new cultivars. The rootstock and scion must be compatible. Incompatible grafts may not form a union, or the union may be weak. A poor union results in plants that either grow poorly, break off or eventually die.

The compatibility of plants has been determined through many years of trial. There is no other way to determine whether or not two plants will produce a good graft union.

4 - When is the Right Time

Most grafting is done in late winter or early spring before new growth begins. The best time is after the chance of severe cold has passed but well before the plant breaks bud. Scion wood should be collected during the winter. Store it in a cold, moist place at temperatures close to but above freezing. At home, a few scions could be stored in a plastic bag in the refrigerator wrapped with moist (but not damp) paper towels. Any cut ends need to be sealed so they retain moisture.

"T" budding can be done almost any time that the bark of the stock slips (easily separates from the wood) and buds are fully developed. Most budding is done from early June (June budding) to early September (autumn budding). Buds set during this period normally remain dormant until the following spring. In cold climates, bud growth in autumn is undesirable because young shoots are subject to winter injury. Autumn budding is the most common technique for producing fruit trees. Spring budding (in March and April) is possible but is less desirable than autumn budding. June budding is best suited to climates with relatively long growing seasons. Beginners should select autumn budding.



INCOMPATIBLE SADDLE GRAFT WITH INDIAN CHESTNUT (*Aesculus indica*) ONTO A HORSE CHESTNUT (*Aesculus hippocastanum*) ROOTSTOCK

5 - What Tools are Required

Knife

A good-quality knife, able to hold a sharp edge, is the key to good grafting. Although special grafting and budding knives are desirable, you can use almost any good pocket knife, Stanley knife etc. Keep a hone of some sort handy to sharpen the knife.

Grafting wax/sealers

After the graft is made, some covering must be used to not only keep the graft from drying out, but also any cuts. Either hand wax or brush wax may be used. A hand wax is most commonly used for home grafting. It is softened by the heat of the hand and can be easily applied. Heated waxes may be brushed on, but make sure the wax is not too hot. Heat could damage the tender cambial tissue. There is a tendency to use brush on sealers that are fluid at normal temperatures, but then gradually dry out.

Grafting tape

Now a days the most common grafting and budding tape used is called 'Parafilm'. It stretches, and also sticks to each other forming a sealed covering. The other beauty of this over many of the others is that you do not need to remove it when joint has taken, as it breaks down and then falls off. You can also wrap it over buds, as the buds will force there way through the tape.



6 - Scions and Bud Sticks

Scions

Scions are selected from the previous season's growth, while they are dormant, but before growth begins in the spring. It is best to try and get scion the same diameter as the rootstock. If the scions are left on the tree until spring, however, there is some danger that the buds will start to grow or be injured during winter.

The scions should be cut and kept in the longest pieces possible and be tied securely, carefully labelled and kept moist. They should be kept cool, where they will remain fresh and dormant until spring.

Budsticks?

The budstick is a twig, usually from the current season's growth. It is taken from the plant of the desirable variety to be increased. It should have average vigour, be healthy and have plump, well-developed buds. Buds on the centre of the twig are generally better than those near the tip or the base (where the twig may have branched from another limb).

As soon as you cut the budstick from the tree or shrub, clip off the leaves, allowing about 12mm of the leafstalk to remain as a handle. This will fall off after a few weeks. Use budsticks as soon as they are taken from the tree, but if necessary, they may be stored in cool, moist conditions for a few days maximum. But preferably use as fresh as possible.

7 - Rootstocks

The following list is just an example of the most common rootstocks found in the UK

Rootstock	Habit	Scion	Soil and training preference	Notes
Colt	Semi-vigorous	Cherry	Fan trained or large tree	Root pruning maybe necessary if tree over vigorous and not fruiting
Gisela 5	Semi-dwarfing	Cherry	Bush, pyramid or fan	
M26	Semi-dwarfing	Apple	Most soils. Recommended for containers. Suits bush trees, cordons and dwarf pyramid trees	Support free standing trees for one or two years.
M27	Very dwarfing	Apple	Fertile soil.	Good for cordons. Always require support.
MM106	Semi-vigorous	Apple	Poor soils.	Bush trees, spindebushes, cordons, espaliers and fans. Support for first year or two
Pixy	Semi-dwarfing	Plums, damson	Good as small pyramid or medium tree	Requires generous feeding
St Julien A	Semi-vigorous	Peaches, nectarines, plums, apricot	Fan trees for nectarines and peaches. For plums a bush or half standard.	
Quince A	Semi-vigorous	Pear	Ideal for most forms	Can tolerate poorer soil than Quince C
Quince C	Semi-dwarfing	Pear	Suitable for fertile soils and vigorous cultivars	Fruits earlier than Quince A

It should be noted that some pears cultivars are incompatible directly being grafted onto quince rootstocks, therefore an interstock is used. Typically 'Beurre Hardy' is the most widely used interstock.

8 - Grafting Technique

Grafting techniques are largely determined by the size of the rootstock. But we will limit ourselves to whip & tongue and splice grafting.

8.1 - Whip & Tongue Grafting



It is preferable to have the rootstock and scion wood of the same diameter. Some grafters use a calliper to pick the best matching diameter on rootstock and scion.

Both rootstock and scion are cut on the same angle and are placed together so the growing layers are in perfect contact. A notch is placed in the centre of both pieces so that they lock together. The graft is then wrapped tightly with 2 layers of grafting tape. The tape does give some strength to the graft, but protection from accidental damage to dislodge the joint is required.

You must ensure that the cambium layers of both scion and rootstock are in line and touching.

Where there is a difference in diameters, you must ensure that one side of the scion and rootstock are in line and touching, or you can do a side graft (see photo further on).

I would strongly advise not to do an offset whip and tongue graft. This is where just one side of the scion and rootstock has the cambium layers lined up, the other side is not lined up. The only time to ever use this, is if there is a strong requirement to keep the scion growing till next year, and re graft.

The effect of this can be seen in the below photo, whereby the side where cambium is in contact has callused, it has acted as a hinge and opened up the graft joint faces.



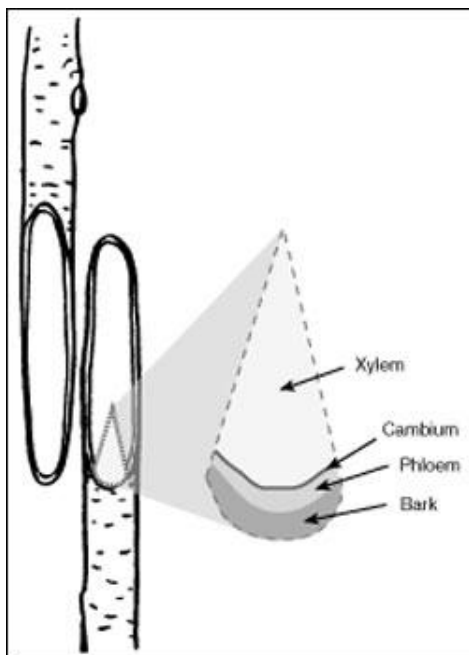
OFFSET WHIP GRAFT

I prefer to pot up the rootstock a few months / weeks before grafting and keep above 5 deg C, so as to enable the roots to get going. I then graft at about 10cm from the soil level. This is so should there be a grafting failure I can then keep the rootstock and do autumn budding later the same year. As the spring temperatures increase the rate of callusing at the union increases. I leave them in their pots until I know that they have taken and then plant out in open ground.

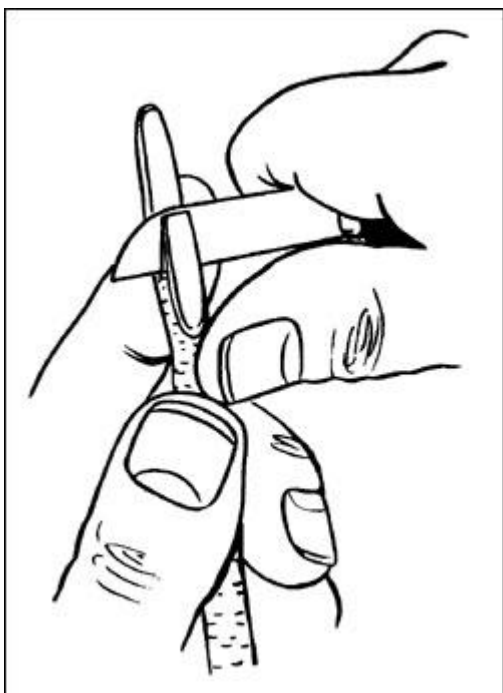
This is OK for plants that callus readily, like apple (malus) etc, but some need a bit more attention. This is when I use the 'hot tube callusing' method (see photo). This where the rootstock and scion are kept at 5 deg C, and the union / graft is kept at an elevated temperature for 2 or 3 weeks. The temperature is very dependant on the plant being grafted, but can typically range from 20 to 25 deg C. After that period of time the whole plant is stored at 5 deg C until spring.



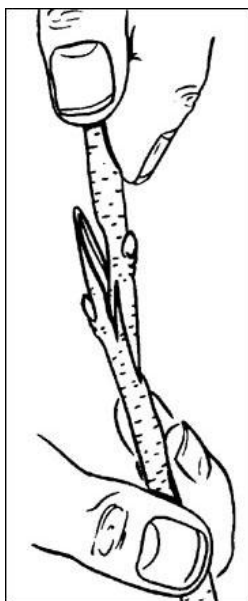
ROOTSTOCK ALL POTTED READY FOR GRAFTING



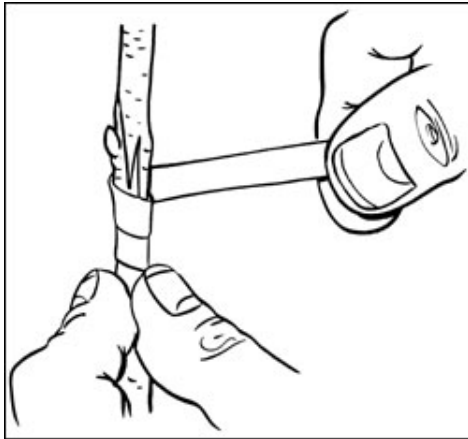
Cuts must be smooth and straight on the scion and on the rootstock and be of approx 30mm in length.



Cut again to form the tongue in both scion and rootstock.



Push rootstock and scion tightly together. The aim is not to see any air gaps in the joint.



Wrap with parafilm grafting tape as tight as you can, to keep cuts tight and to prevent drying.



ALL TAGGED WITH NAMES AND READY FOR THE
SPRING



HOT TUBE CALLUSING

8.2 - Splice Grafting



This method of grafting is identical to the whip and tongue, but it does not have the tongue part. I very often use this method when the diameter of scion and rootstock is quite small, and physically impossible to cut the tongue. But the graft is very delicate and additional protection is required against damage.

Other types of grafting include the following



SIDE GRAFTING



CLEFT GRAFTING

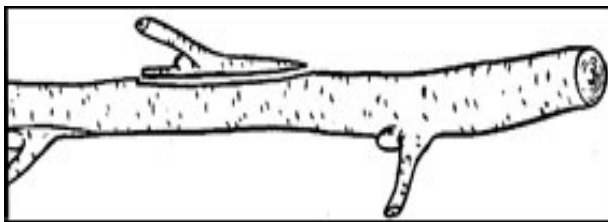


4 FLAP GRAFTING

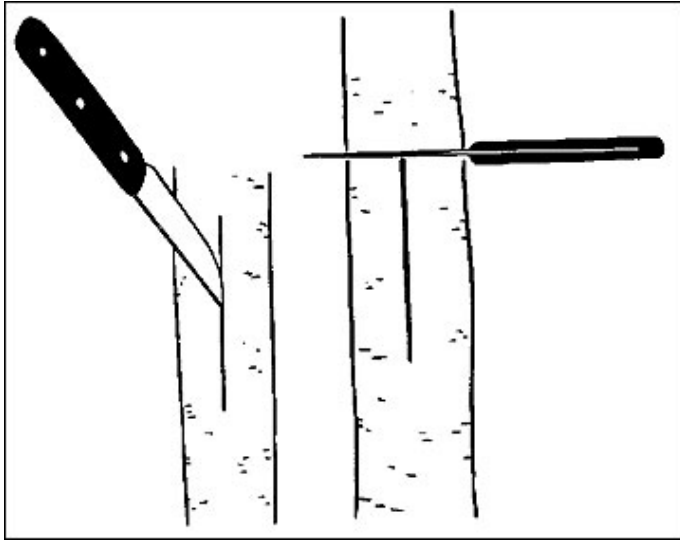
9 - Budding Technique

The most common budding techniques is known as 'T' budding. The technique is detailed in the below pictures.

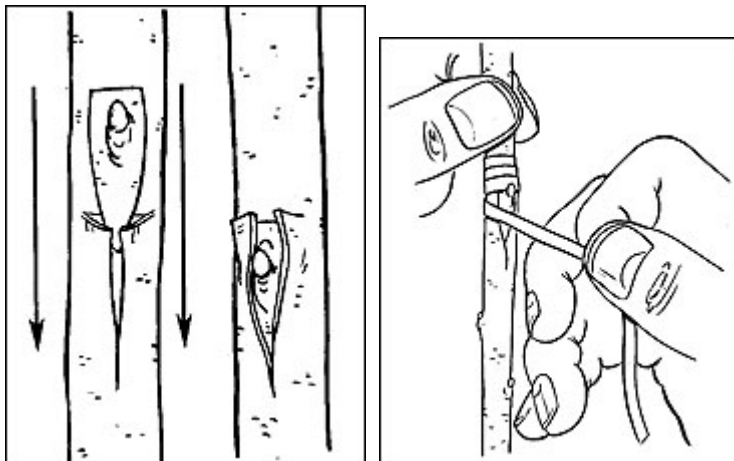
'T' Budding



Cut the bud from the budstick.
The sliver of wood can be left
on the back of the bud.



Preparing the rootstock for T-budding. Cutting into the bark, and then prise up the bark.



Inserting the bud for a T-bud graft. Then wrapping the bud with parafilm grafting tape.

10 - Aftercare

In all cases you need a leader shoot. This invariably needs to be trained.

If it's a graft from a shoot tip, all is well and all it needs is support against winds etc.

However if it's a budding or a non shoot tip graft, the shoot would come out at 45 deg to the main stem. In this case when the graft has taken and the shoot starts growing, in the following spring. The existing top of the rootstock is cut off, approx 75mm from the graft. This enables the shoot to be tied to it, to try to attain the vertical leader. After a period of time the tie is cut off with the remaining top 75mm.

Any side shoots from the rootstock must be rubbed or cut off. If you use parafilm there is no problem, but other tape may need cutting off to prevent girdling of the rootstock.



ALL SIDE SHOOTS FROM ROOTSTOCK MUST BE RUBBED OFF. NOTE THAT SHOOTS HAVE PUSHED THRU THE PARAFILM GRAFTING TAPE.

11 - Tips

Scion

Scion wood should always be dormant. Scion wood should be made from previous season's growth and have a diameter of 6mm to 10mm to match the same diameter of the rootstock. Store the scion in moist cool place.

Scion wood should be made of twig sections with two to three buds each, but store in longest lengths possible. Discard the tip of scion wood and re-cut the base before grafting.

Timing

The best time for grafting is in the spring just as growth starts. When necessary, grafting can start several weeks before growth is expected and can continue a few weeks after growth has started, if you have dormant scion wood in storage and if weather is not exceptionally warm.

Other suggestions

The rootstock and scion must have cambial contact for union, callusing and growth to take place. All cut surfaces must be covered and kept covered with grafting wax or tape until complete healing has occurred. In a few techniques, alternate methods for maintaining moisture in the union are used. But if you are grafting only a few plants, you will find taping the graft most satisfactory.

After the graft has taken and growth has started, cut off any side shoots or competing twigs that would shade or compete with the development of the new graft.

12 - Common Terms

Budstick – A shoot of the current season's growth used for budding. Leaves are removed, leaving 12mm of leaf stem for a handle to each bud.

Cambium – This is a single layer of cells between the wood and bark of a tree or shrub that produces new cells. In grafting, the cambium of the scion must line up as closely as possible with the cambium of the stock for a good union.

Callus – This is the actual plant tissue that is created that joins the cambium layers of the scion to the rootstock.

Cultivar – This is a term now used in place of variety. It means cultivated variety and differentiates a plant from a botanical or natural variety.

Dormant—The condition of live trees at rest—as in winter.

Interstock (also interstem) – This is a piece of plant (usually to form trunk or a portion of it) grafted between the scion and rootstock.

Rootstock – Also understock. This is a term applied to the part of the graft that produces the root system of the grafted plant.

Union – This is the actual joint between the scion and the rootstock

Scion – A piece of detached twig or shoot. The scion usually contains two or three buds, although it may contain more. When the scion is only a single bud, the form of grafting is known as budding.

13 - Reason for Failure

Stock and scion were not compatible.

The cambiums were not meeting properly.

Scions were upside down.

Grafting was done at the wrong time of the year.

Rootstock or scions were not healthy.

Scions were dried out or injured by cold.

Scions were not dormant.

The graft was not properly sealed or covered with grafting tape / wax or sealer

The scion was displaced by storm, birds or other means.

The graft was shaded too much by other growth.

The graft was attacked by insects or disease.



HERE IS A GRAFT WITH 2 PROBLEMS.

1 – SIDE SHOOT GROWING FROM THE
ROOTSTOCK HAS NOT BEEN CUT OFF

2 – THE MAIN SCION HAS DIED OFF WITH ONLY
ONE BUD ADJACENT TO THE UNION THAT IS
GROWING.