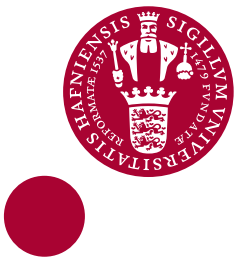

# Grafting and budding of fruit trees

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# Grafting and Budding of Fruit Trees

**Introduction**

Grafting is a type of vegetative propagation where a shoot (scion) of one plant is transplanted onto and united with another plant, often a root stock. The properties of the shoot e.g. its flowers and fruits are the same as the ones of the tree, from which it was taken (the ortet). Budding is principally the same as grafting except that in budding only a single bud attached to a small piece of bark and sometimes wood is transplanted. The role of the root stock is to provide nutrient and support to the new plant. Grafting is used for different purposes in fruit tree propagation:

- To shorten the juvenile growth phase of the tree. A grafted plant typically flowers several years earlier (2-5 years after planting) than a tree raised from a seed.
- To maintain properties of the mother tree. In fruit trees this is often the size, taste and yield of fruits, resulting from a previous intensive selection and breeding
- To produce fruiting trees of convenient size. Grafted trees have shorter stems and thereby lower crowns, which eases intercropping and collection of fruits.

**Conditions of the root stock**

Root stock is usually raised from seed. Seedlings should be of the same species as the scion or a compatible variety. Compatibility is usually best when the two parts are closely related (same species), but there are cases where scions can be grafted onto different species usually, however, only between species within the same genus. Wild varieties of a fruit tree can be suitable as root stock since they often maintain a very high adaptability to soil conditions and resistance to soil pests. The root stocks must be grown to a size so that their diameter fits with the diameter of the scions. The root stock should be hard (lignified, not soft and succulent) at the site of grafting. Root stocks for budding must be larger, often > 1 cm diameter, to avoid the root stock being girdled, when cutting out the slice for bud insertion. Root stocks are usually grown as container / potted plants. Grafting can also be done after out-planting on several-year old plants, or on coppice shoots from stumps of mature trees.

**Conditions of the scion**

The purpose of grafting, e.g. taste or yield of fruits will determine selection of the mother trees (ortet) of the scions. Although grafted scions are usually not more than 10-15 cm, they are usually cut with extra length, so that a fresh cut can be made for the actual grafting. For bud grafting the buds of the pieces of branch can be removed immediately before uniting. Scions must have fresh vegetative and preferably no flower buds (the two types of buds can easily be distinguished). The lower ⅓ of the scion must be woody or hard. Time of collection is crucial; scions must be collected when there are mature dormant buds which, under tropical conditions, are best after fruiting just before the rainy season. Bud development can be encouraged by pruning i.e. removing leaves from the scions 2-3 weeks before harvesting. In species with strong apical dominance, e.g. oranges, side bud formation for budding is encouraged by removing the terminal bud.

For a number of species with tendency to plagiotropic growth (branches maintaining a branchlike growth habit), the place of collection from the tree is critical. Branches should preferably be collected from the upper part of the canopy and close to the stem. Some species produce upright coppice shoots from the upper side of branches or from epicormic shoots. These shoots usually maintain their upright (orthotropic) growth habit. Scions should be used as fast as possible after harvesting. During short term storage, desiccation may be prevented by removing leaves and keeping them under moist cool conditions.

**Tools and accessories used in grafting**
The simplest and easiest type of grafting can be accomplished with an ordinary knife and some wrapping tape. However, special designed tools are generally an advantage for a special job:

a. Grafting knife. The 'normal' grafting knife has a straight cutting edge of the blade, which allows a straight cut. Budding knives have curved blades and usually a small leverage device to split open the root stock

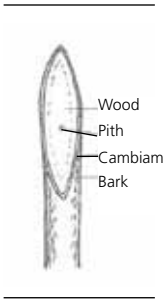
*Grafting knife*

*Budding knife*

b. Grafting tape. Polythene sheeting in strips 10-15 cm long and 1-2 cm wide are good for several species. Rubber bands, about 7-12 cm long and 5-8 mm wide are good to keep the two parts tight together. Special grafting tape, e.g. stretchable parafilm used e.g. together with rubber bands can make unions very stable and water tight.

**Unification**
To avoid excess evaporation, leaves of the scions are usually pruned prior to grafting. Grafting technique consists of two simple procedures:

a. Cutting and fitting. Cutting exposes the cambium of the scion and the stock, the two sensitive parts that will form the union. The cut of the scion / bud and the cut of the root stock must fit so that union can be done with maximum contact between the cambium, and minimum exposure of the cambium on either part. In grafting we use one or two straight cuts of the scion fitting into one or two straight cuts of the root stock. Scion and root stock should preferably have the same diameter, so that best possible contact is established between the cambium at both sides. If the scion is thinner than the stock diameter, then the cambium must be made to fit at one side. In budding a piece of bark with a bud is removed from the donor tree and inserted into a cut in the stock.

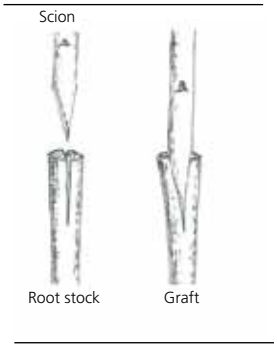



b. Wrapping. The purpose of wrapping is to stabilise the graft until the two parts have united, and to prevent any entrance of water to the graft union. Wrapping starts from below, where one end of the tape is fixed by the subsequent coil; the tape is coiled around the two parts and tied at the upper end by putting the end under the last coil.

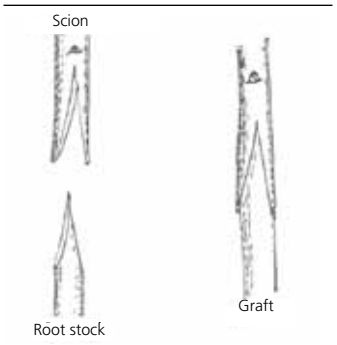
Timing of grafting is often crucial for success. Best result is almost always the period just before normal bud burst. At that time evaporation is relatively low and hormone levels high.

**Different types of grafting and budding**
Different types of grafting and budding are all variation over the same concept: How to make an effective union between a growing plant joined to a piece of plant material from a different mother plant. The resulting plant should perform a normal growth and crown form. Different types of techniques are employed to different species and conditions.

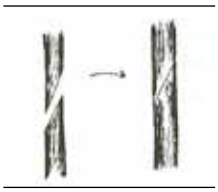
**Top cleft grafting.**
The 'standard' grafting method. The wedge-shaped scion is inserted into a vertical split in the root stock. Top cleft grafting is often preferred as it is easy, and the graft is mechanically stable. It can also be used when the stock has larger diameter than the scion. The root stock must possess some flexibility so that the cleft can be opened easily without breaking and can make a smooth contact to the inserted scion.



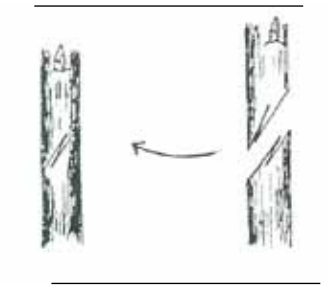

**Saddle grafting.** The grafting looks like an inverse top cleft grafting in that the wedge is cut in the root stock and the scion is shaped to fit. This method gives good cambial contact and is easier to make water-proof. The scion and the stock should be the same diameter.



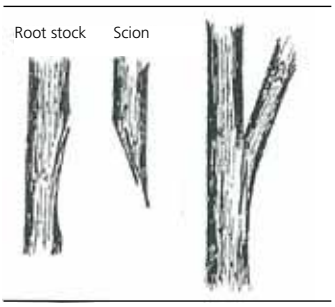

**Slice grafting** consists of a slant cut in scion and in the root stock. This fitting ensures minimum wood exposure but scions are, however, prone to mechanical dislocation. Often used for relatively large size material including coppice shoots and branches on standing trees in the field. Can also be used when the size of the scion is smaller than that of the root stock.

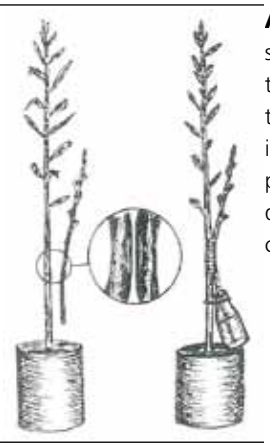


**Slice tongue grafting**.
Similar to slice grafting but a small, about ½ of the first slice, additional parallel slice is cut in both root stock and scion. The second slice helps locking the two parts together and thus stabilises the joint.



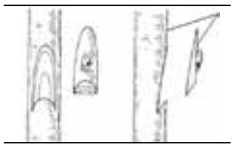
**Side whip (tongue) grafing**.
Scions are inserted on the side of the root stock. The whip / tongue stabilises the fitting. This type allows grafting of more than one scion on each root stock, e.g. different varieties / clones ('family tree'). It also allows continuous growth of the root stock until the grafts have united. Unsuccessful grafting can thus be re-done.





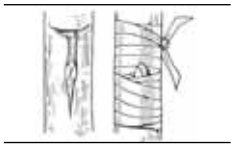
**Approach grafting**. Scion and root stock are connected sideways by removing a slice of bark from each side. This type is used if graft union tends to form very slowly. A water bottle may provide the scion with adequate water until it receives water from the stock. In very difficult species the potted root stock may be hung up in the canopy of the donor tree, where the grafting takes place. Hence, in this case the scion is only cut after graft union has formed.

**Budding** is used as an alternative to grafting if 1. grafting material is scarce, 2. there are problems with plagiotropism or 3. if grafting gives poor success. Budding is a type of side grafting, but since the bud is level with the root stock bark it is easier to make water proof wrapping. There are different types of budding.

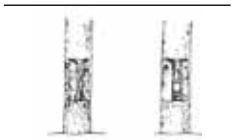


***Chip budding***. *The most common type of budding for most plants. A small piece of wood is left attached to the bark which prevents the bud from falling off.*

***Patch budding***. *A square piece of bark with the bud is inserted into a fitting patch in the root stock. This is used when the thickness of the bark of both root stock and bud patch is about equal.*



***T-budding***. *A T-form is sliced into the coot stock where the bud, attached to a small piece of bark, is inserted. T-budding is used if the bark of root stock is significantly thicker than that of the bud insert.*



***I-Budding***. *Similar to T-budding except that the root stock bark is opened also at the lower part. Used in a similar way as T-budding*

Success or failure of grafting will normally show after 1-2 weeks; - in successful unions the inserted scion or bud material remains fresh and may already start to grow. In unsuccessful grafting the material fades and dries out. Sometimes failure may be re-done by a new grafting or budding at a fresh site on the root stock.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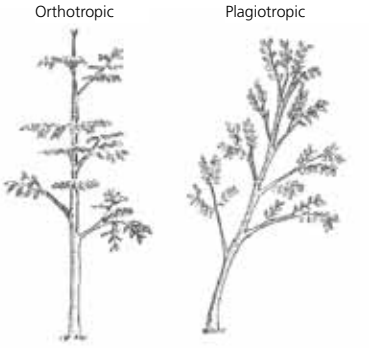
**7. Frequent problems encountered in grafting**

Unsuccessful grafting can often be ascribed to one or more of following reasons:

a. Poor growth conditions. Healthy, vigorous plants always heal faster than slow growing ones. Poor growth media with poor root respiration or water-stressed plants is one of the most frequent causes of graft failure.
b. Damage to scion or buds. Buds are quite sensitive and especially prone to damage. Careful handling of scions from collection to grafting is essential. During some types of budding the buds are attached only to a small piece of bark and can easily fall out.
c. Incompatibility. Some species are generalists while others have difficulties uniting with even their own variety. Incompatibility should not be confused with technical problems of unification. Where this is not evident, one can try to graft on the same individual; since possible failure of survival in this case cannot be ascribed to incompatibility, it must be technical or environmental.
d. Desiccation of scion. This is a general problem outside optimal grafting time for most species. A number of species take a long time to form a graft union, and until the union forms, the water transport from stock to scion is inadequate to support the evaporation demand. Evaporation can be reduced by removing possible leaves on the scion. If desiccation is still a problem, special grafting procedures may be necessary e.g. bottle approach grafting
e. Water enters the graft union. Probably one of the most frequent causes of mortality. Side grafting is particularly prone to water entrance at the upper side of the the graft union.
f. Contamination of graft union. Occurs e.g. when touching exposed slices or leaving cuts exposed for too long before uniting
g. Plagiotropic growth. The phenomenon where scions tend to maintain a branchlike growth habit. Plagiotropism is quite species specific and much influenced by the place on the tree where scions are harvested.

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