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Propagation by Grafting and Budding

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Grafting is a term which covers many propagation techniques. It includes the scion or the above ground part of the plant.

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 type of grafting is called budding.

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.

The rootstock or lower portion of the grafted plant. The rootstock provides the root system for the new plant.

Rootstock (also stock or understock) This term means the part of the graft that produces the root system of the grafted plant. It must be related to the scion and often has dwarfing or other desirable characteristics.

Interstem on fruit trees helps dwarfing or incompatibility. Interstock (also interstem) This is a piece of plant (to form part of the trunk) grafted between the scion and understock.

Grafting with interstocks is double working. Interstocks are not normally needed with ornamental plants.

Grafting Tools; Usually simple but some machines are complex and expensive.

When grafting, make clean cuts in the tissue of the two pieces. The cambium tissues must match together. Cambium is the meristematic tissue layer in woody plants. It is a layer of tissue immediately under the bark in stem and roots.

The botanical limits of grafting
Grafting within species, Grafting of species within the same genus
Grafting of different genera within the same family *Pyrus communis* (Pear) with *Cydonia oblonga* (Quince)

Grafting between families: Plants of different families cannot be grafted successfully Reports of relatively short-lived grafts of herbaceous plants of different families have been made but there is no successful commercial or home grafting of different woody plant families

Reasons for grafting plants
Propagate plants not economically done other ways

Cultivars of ornamental shrubs and trees
To control tree growth and performance
Malling series and other dwarf rootstocks
To control grape phylloxera, fire blight and other pathogens
To bring fruiting plants into production earlier
Add a pollinator
All fruit crops are commercially grafted
Fruit at 2-3 years
Grafting to obtain special effects in plants
Weeping standards
Multiple cultivars on the same tree
Preserve old cultivars
Grafting as an orchard management technique
Top working of fruit trees to change varieties
Frame working of fruit trees to assist pollination

Successful grafting needs the right time of year
Active growing stock + Dormant scion
Scion material at correct stage of growth

Growing environment Healthy, growing trees without pest problems

Maintain correct polarity of stock and scion. The proximal scion end is fitted to the stock distal end.

Incompatibility in grafting
Graft compatibility means two closely related plants will graft if there is no physiological or morphological reason for a union to fail.

Graft incompatibility occurs when morphological or physiological reasons can prevent related rootstock / scion combination from forming a strong union. Incompatibility is not common with ornamental plants.

Most rootstocks used for grafting are closely related to the scion
Vegetative propagation can transmit diseases

There are two basic grafting systems
Field Grafting –rootstocks are grown and grafted in the field
Selection of suitable rootstocks
Ornamental rootstocks used are closely related species to the scion
Seeds are easy to propagate and fast growing
The rootstock vigor determine size and vigor of the grafted plant
This controls the size of fruit trees and shrubs

Bud grafting
The scion is a single bud It uses scarce scion material economically

Simple to learn
Fast to do

High success rates (95-100% common)
Budding produces a strong union

T-budding
Chip budding
Patch budding

Plants that are budded

Deciduous fruit trees
Nut trees
Citrus

Roses
Roses
Ornamental trees

Top grafting
In top grafting the top is removed from the rootstock. The scion shoot is grafted in to the top end of the rootstock stem. Used both in the field and in bench grafting. Top grafting is much slower than budding. Many styles are complicated to carry out. Used in spring when t-budding is not possible.

Cleft grafting
Bark Grafting
Bark grafting of walnuts
Bridge grafting

Examples of top grafted plants. Many species do not respond well to top grafting. Once the top is removed from the rootstock, uptake of water and mineral nutrients is restricted. This prevents a graft union from forming.

Graft the scion onto the side of the rootstock in side grafting. The top stays on the rootstock for moisture and nutrient uptake. Side grafting is only done on container grown rootstocks The grafted rootstock is grown on in a greenhouse. Collect dormant scion material in winter and cold store until use.

Approach grafting is an old fashioned horticultural curiosity. Usually considered to be the last resort in grafting. Other grafting systems are detached scion grafting. In approach grafting the scion remains attached to the mother plant until the graft union forms. It is used to graft tomato varieties onto disease resistant rootstocks.

Grafting unrooted cuttings eliminates rootstock production. The unrooted cutting roots develop as the graft union heals. Both processes need the same greenhouse environment. Grafting machines speed up the grafting process. It also enables the grafting to be carried out by less skilled staff. Scions and rootstocks must match in diameter

Several materials are used for securing the graft union. It depends on grafting technique and post-grafting environment. Tie or wax the union is to keep it from drying out.

Tying materials for grafting

Grafting Wax	Silicon Seal	Others?
Toilet Bowl Wax	Plastic Roofing Cement	

With t-budding, use rubber bands that disintegrate. PVC tape is used but must be cut off after the graft forms. Use laboratory "Parafilm". This thin, stretchable tape keeps the graft union from drying out. It degrades rapidly so it does not need to be removed.

Reasons 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
Reasons for failure
Scions were dried out or injured by cold
Scions were not dormant
Stock and scion were not compatible
The scion was displaced by storm, birds or other means

Reasons for failure
The graft was not properly covered with grafting wax
The graft was shaded too much by other growth
The graft was attacked by insects or disease
The graft union was girdled because tape was not cut or released in time

Rootstock nursery

Rootstocks are produced in specialized nurseries
Clonal rootstocks are produced with mound layerage
Seedlings are produced from seed sown in the nursery row

Plant Propagation:

Mound layering: Strong root systems are developed in rows The shoots that arise are cut back close to the root each year to force plants As the plants grow media is mounded around the shoot base for rooting.

Layering: Layering is the rooting of the scion while it is attached to the mother plant

Tip	Mound
Simple	Air

Mound Layering Media

Sawdust or sawdust with added ingredients is added several times during the summer to induce ideal rooting conditions at and above the crown of the growing rootstocks

APPLE ROOTSTOCKS

M 27 – 20-25% SDLG
M 9 – 25% SDLG
M 26 – 33% SDLG
M106 – 50% SDLG
M 7 – 50-60% SDLG
M 111 – 66% SDLG

EMLA = VIRUS FREE STOCKS
GENEVA 65
BUDAGOVSKI 9
GENEVA 26
GENEVA 30

Propagation by budding:

T-bud	Fruit trees, roses
Patch bud	Walnut, pecan
Chip bud	Fruit trees, grapes

Budding:
"T" budding
Cuts in rootstock: 1 ¼" vertical cut ¼" cross cut 6" above soil
Scion: shield 1" long ¾" below to 1/4" above the bud
Chip and patch budding
Newly budded trees

Summer Bud in August
North side, Petiole abscises on good buds, Petiole dries and remains on dead buds

Top pruning The rootstock tree top is cut off in the spring. The cultivar tree grows during the year and is dug in the fall.

Time-line for trees
Liners planted spring , Budded August, Cut rootstock off spring, Grow cultivar summer, Dig trees fall, Plant trees spring. Interstems – add one year

Propagation by grafting:
Whip/bench/tongue graft was used long ago for tree production. A root and a scion were joined with an elaborate graft in a root cellar in winter.

Top grafting: crown of the root, trunk, and on limbs

Grafting: Whip, bench, piece root, or tongue graft. Graftage: When plants are difficult to root or wanted on another root than their own, grafts of the desired scion and a rootstock are made
Graft = scion + root Bud = root + 1 bud

Cleft graft: A scion of 4-5 buds is cut to form a double tapering (top to bottom, and out to in) wedge It is placed in the cleft of the rootstock so that cambium layers line up. The union and tip of the scions are covered with grafting wax.

Bark graft: Scions are placed when cambium is slipping. The bark is cut to accommodate the scion and the scion (cut with a sloping cut) is nailed to the stock.

When to graft? **When to bud?**

Graft in the spring
Collect scions in mid- to late-winter
Store scions in cool - 2-4 °C, moist conditions
Graft just as cambium begins to divide!
Bud in August in cool climates
Collect scions just before budding
Store scions in cool - 2-4 °C, moist conditions
Bud while cambium is still dividing!