Plant Propagation PLS 3223/5222

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Chapters 11-13

Grafting and Budding
Types of procedures

Types of Grafts

Classification based on the part of the rootstock on which the scion is placed.

- Detached scion grafts
  - apical, side, bark and root grafts
- Approach grafts
  - rootstock and scion of each plant remain intact until a successful union occurs.
- Repair grafts
  - grafts to repair damage on established trees.

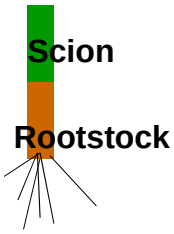
What graft to use?

Depends on:

- Propagators preference
- Plant type, age
- Desired effect
- Production, repairing
- Season
- Materials available

Detached Scion Graft

Apical grafts



The scion is inserted into the top of the severed rootstock shoot.

- Whip and tongue graft
- Splice graft (whip graft)
- Cleft graft (split graft)
- Wedge graft (Saw-Kerf graft)
- Saddle graft
- Four flap graft (Banana graft)
- Hole insertion graft

Cleft graft

Wedge graft

TYPES OF GRAFTS

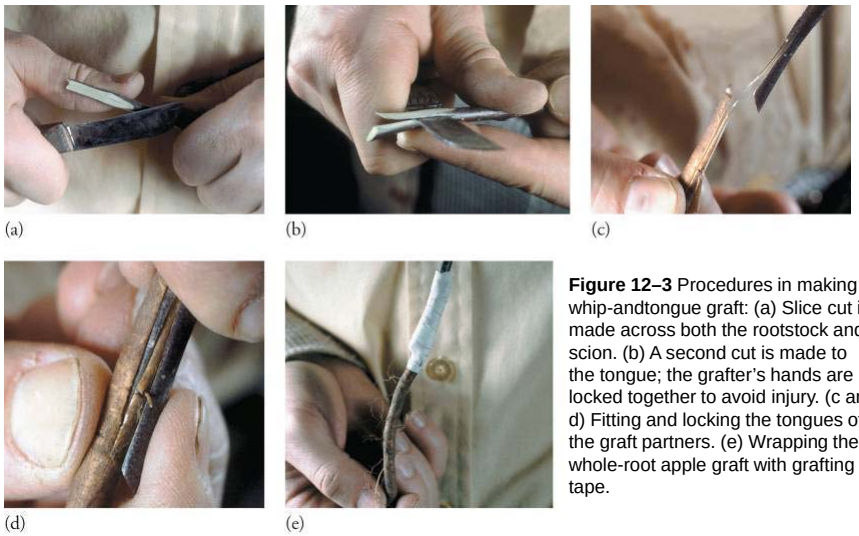


Figure 12–3 Procedures in making a whip-andtongue graft: (a) Slice cut is made across both the rootstock and scion. (b) A second cut is made to the tongue; the grafter's hands are locked together to avoid injury. (c and d) Fitting and locking the tongues of the graft partners. (e) Wrapping the whole-root apple graft with grafting tape.

Hartmann and Kester's Plant Propagation Principles and Practices 8e
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Detached Scion Graft

Apical grafts - Tip grafting of Cactus

TYPES OF GRAFTS

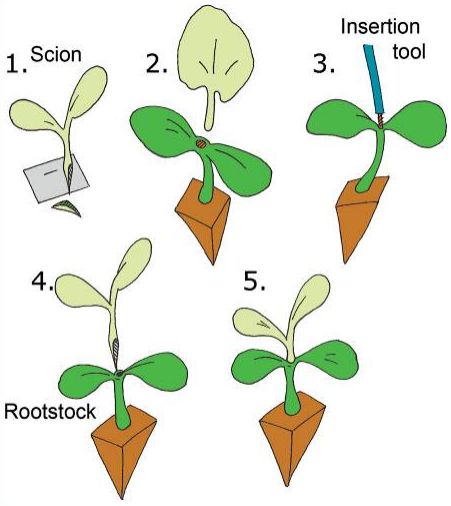

Figure 12–14 Hole insertion graft (HIG) or terminal/top insertion graft (12, 21).

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TYPES OF GRAFTS

(a) (b)

Figure 12–15 (a and b) Hole insertion graft (HIG) for grafting watermelon to squash rootstock. This is the most popular graft used in China because it is suitable for Lagenaria (Cucurbita) and interspecific squash as rootstocks, requires few materials, has high efficiency, 1500+ plants/day/worker, and simpler management techniques (34).

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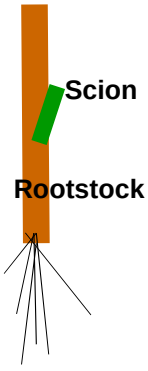
Detached Scion Graft

Side grafts

The scion is inserted into the side of the rootstock, which is generally larger in diameter than the scion.



Side-stub graft

Side-tongue graft

Side-veneer graft

Side Insertion Graft

Side veneer graft

Side graft

Ulmus alata ‘Lace Parasol’
Side veneer graft

TYPES OF GRAFTS

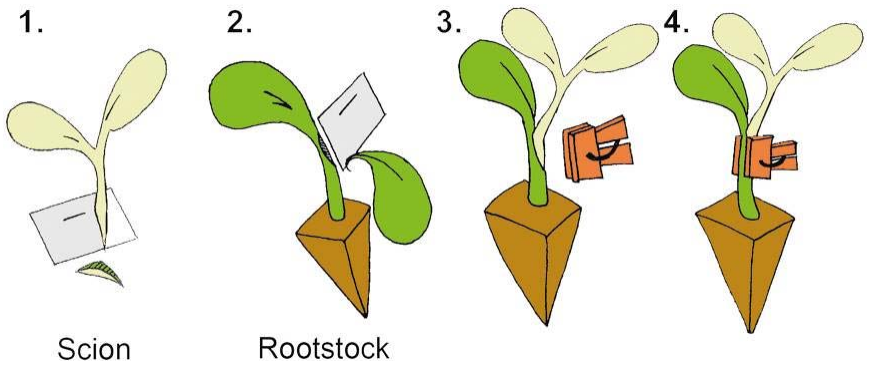


Figure 12–6 One cotyledon grafting (OCG), which is a form of the splice graft used with cucurbit vegetable crops; also called the slant graft and Japanese tube graft (12, 21).

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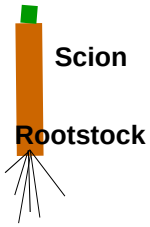
Detached Scion Graft

Bark grafts



The scion is inserted between the bark and wood of the rootstock.

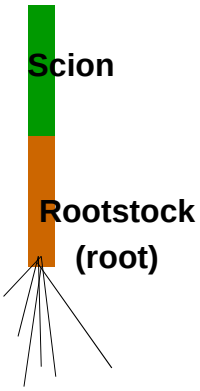
Bark graft (Rind graft)

Inlay bark graft

Detached Scion Graft

Root grafts

An entire root system or pieces of root serve as the rootstock for the graft.



Whole root grafting

Piece root grafting

Nurse root grafting

The whip and tongue graft is often used.

TYPES OF GRAFTS

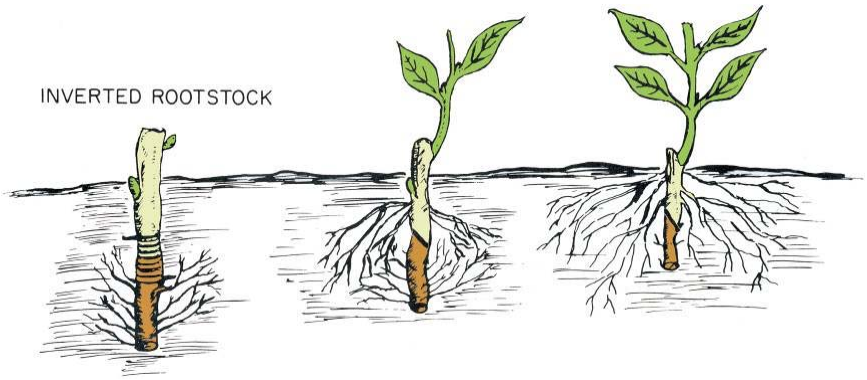


Figure 12–26 Reversing the polarity of the rootstock piece of the root graft is one method of "nurse-root" grafting. The nurseroot graft is a temporary graft used to induce the scion to develop its own roots. The nurse root sustains the plant until the scion roots form, then it dies. In the method shown, the rootstock piece is inverted, so the distal of the rootstock is temporarily joined to the proximal of the scion.

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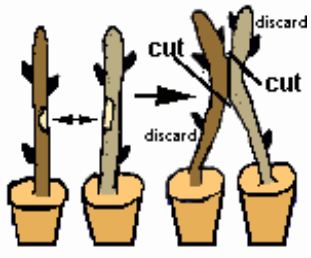
Approach Graft

- Two independent, self-sustaining plants are grafted together.

Spliced Approach Graft

Tongued Approach Graft

Inlay approach Graft



Grafting terminology

- Stenting - simultaneous grafting and rooting of the rootstock.

  Roses
  Citrus
  Conifers

- Micrografts – grafting of tiny plant parts using micropropagation techniques.

Production Processes

- Preparation 45%
- Craftsmanship 10%
- Aftercare 45%

100% success

Preparation

– Proper tools and accessories
– Selection and handling of the scion and rootstock

Aftercare of grafted plants

Root grafts

Refrigeration

- Temperatures from 45 to 75°F are the most satisfactory for callusing
- 2 months at 45°F

Aftercare of grafted plants

Hot Pipe callusing system

- The graft union is placed in a slot in a large plastic pipe
- Hot water passes through a smaller pipe inside the pipe with the slots, thereby warming the graft union
- Roots and shoots remain protected in a cooler environment to retard shoot & root development.

AFTERCARE OF GRAFTED PLANTS

Figure 12–48 Hot-pipe callusing system for bench grafting difficult plants. The graft union is placed in a slot in a large plastic pipe. Inside the large pipe is a smaller pipe through which thermostatically controlled hot water circulates. Insulating material laid over this pipe retains the heat. The protected roots and scions protrude into areas of cooler temperatures, which retards their development.

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Aftercare of grafted plants

Non-waxed grafts may be placed in a moist environment long enough to form a callus bridge

Closed Case

- Closed box with moist peat (bare-root)
- Polytent inside a greenhouse (potted)

Open Case

- Placing potted plants in moist peat
- Outplanting of bare-root grafts in spring

Field Grafting Systems

- Crown Grafting – several scions inserted at the base (crown) of an existing tree
- Topworking – several scions placed on the major scaffold branches
- Frameworking – several scions placed on the secondary scaffold branches
  - These procedures usually retain temporary nurse branches

TYPES OF GRAFTS

Figure 12–24 Topworking an existing orchard using the inlay bark graft for (a) citrus, (b) pecan and (c, d, and e) peaches. (b) For topworking pecans in Texas, the inlay bark graft is covered with aluminum foil to reduce the heat load and polyethylene to retain moisture; conditions are too hot for using grafting wax. (c, d, and e) Topworked peach orchard in Israel using an inlay bark graft. (c and d) The grafts have aluminum covers to reduce heat buildup.

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PRODUCTION PROCESSES OF GRAFTAGE

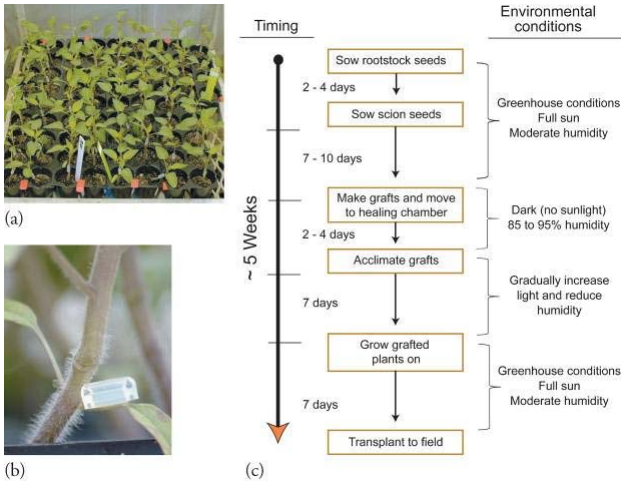

Figure 12–46 Grafting timeline for heirloom tomatoes. (a) Grafts in healing chamber. (b) Hardened-off grafted plant, with grafting clip falling off—ready for transplanting (52).

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Types of Budding

- Chip budding
- T-budding
- Inverted T-budding
- Patch budding
  - Fall patch budding
  - Spring patch budding
- I-budding
- Flute budding and Ring budding

TIME OF BUDDING—SUMMER, SPRING, OR JUNE

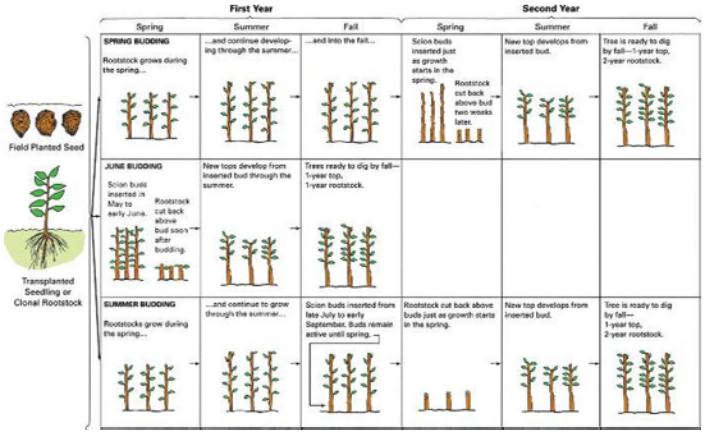

Figure 13–1 Comparison of the steps in spring, June, and summer budding for nursery production. The actual techniques in budding are not difficult, but it is very important that the various operations be done at the proper time. Rootstocks are field propagated from fall-planted or early spring-planted stratified seeds, seedling transplants, rooted cuttings or layers, or micropropagated plantlets.

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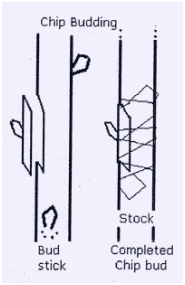
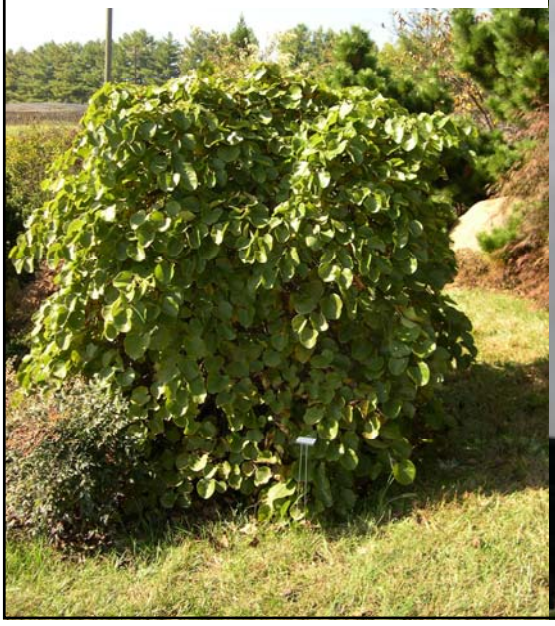
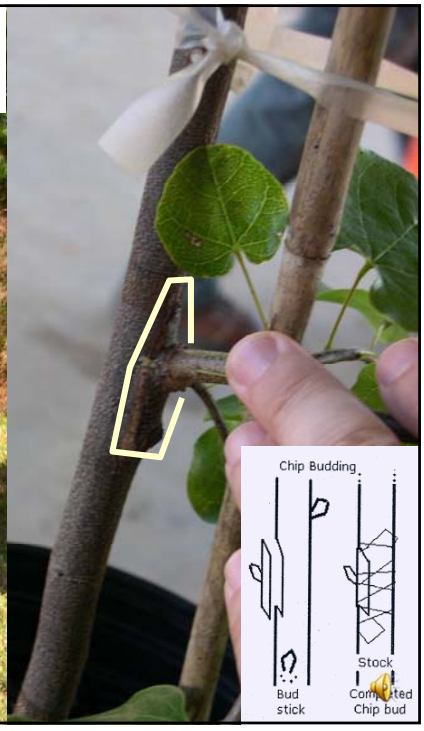
Chip budding



- A chip of wood containing replaces a chip of wood from the stem of the rootstock.
  - More takes, straighter, more uniform tree growth
  - Greater production window than T-bud
  - Better union than with T-bud
  - Allows budding of smaller diameter wood than T-bud

Cercis 'Traveler'
Chip bud





TIME OF BUDDING—SUMMER, SPRING, OR JUNE

Figure 13–4 (a) Spring budded Acer platanoides using a chip-bud system. (b) A chip-budded crab apple is being wrapped with poly tape (arrow), which will be removed after the graft has taken to prevent girdling the plant. (c) Grow Straight metal shield (arrow) to produce straight, upright growth from the scion bud. The top of the rootstock has been cut off to force out the scion bud. (d) The metal shield system with 'Crimson King' maple T-budded to a seedling rootstock.

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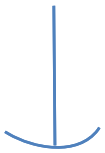
T-budding (Shield budding)

- Limited to rootstocks that range from ¼ to 1 inch in diameter
- Rootstocks must be actively growing so the bark will slip
- Wood in or Wood out?
  - The wood under the bark of the scion may be removed or retained.
  - Removal is necessary for certain species and when June budding.

Inverted T-bud



Same operation as the T-bud but the horizontal cut of the T is inverted to allow better drainage.

- Used in times of excessive rainfall
- Used for species with excessive bleeding
- The scion wood is inserted with *normal* polarity

Patch Budding

A rectangular patch of bark is removed from the rootstock and replaced by a patch of bark from the scion that contains a quiescent bud.

- Slower than other methods
- Widely used for species with thick bark (nut crops)
- I-budding method used when the bark of the rootstock is exceptionally thick

Budding Terminology

- Top-budding (Topworking)
  - Several (15 to 20) buds are placed in the upper portions of an established tree
  - Pruning the previous year may be necessary to provide vigorous branches
  - T-bud or chip bud may be used

Budding Terminology

- Double working
  - An interstock is budded the first year
  - A cultivar is budded the following year
  - Production may be reduced by one year by first grafting the interstock and then budding the cultivar
- Microbudding
  - Basically T-budding with a very small scion – used in Australia for Citrus

Time of Budding

Budding is accomplished during the active growing season.

Rely on actively growing rootstocks.

Depends on location in U.S. (heat)

Spring (March to early May)

June (May to early June)

Summer (mid-July to early September)

Timing of Budding

Budding techniques also rely on the availability of scionwood

- Spring budding relies on scion buds from dormant, stored budwood.
- June budding and Summer budding rely on quiescent (nonelongating) buds from the current season's wood.

Post-graft bud-forcing methods

- 'Crippling'
  - bending or cutting halfway through the the rootstock stem above the bud union
- Girdling
  - cutting through the bark and cambium completely around the rootstock stem
- Totally removing the rootstock above the scion

Removal of Rootstock

- Successful unions may contain buds in a state of physiological dormancy.
  - Removal of the rootstock should occur only after physiological dormancy requirements have been met.
- Quiescent buds will remain quiescent until apical dominance is disturbed.

Advantages of Budding Compared with Grafting

- Very efficient use of scion or budwood
- May result in a stronger union
- Simple and fast
- Sometimes easier for the amateur
- Provides Flexibility - Spring grafting may be used as a backup for budded plants that do not take

Requirements for Successful Grafting and Budding

- The Rootstock and Scion must be compatible.
- The vascular cambium of the scion must be placed in direct contact with that of the rootstock.
- Timing must consider the correct physiological stage for the rootstock and scion.
- All cut surfaces must be protected from disease and desiccation.
- After graft care is essential for success.

Automation ?

- Grafting machines (manual)
  - Wedge graft
  - Saddle graft
  - Notch or groove type grafts
- Robotics
  - Prototypes developed for vegetables
  - Korea - 81% of commercial production
  - Japan – 54% outdoor & 81% indoor

Record keeping

- Source and identity of rootstock
- Source and identity of scion