

Top-working of citrus

The origin of the technique of grafting or budding of trees is unknown. However, this technique is of great horticultural significance and has enabled rapid and uniform multiplication of various fruit crops. By Werner Swiegers, Johan Joubert and Paul Cronjé (Citrus Research international)



Budding is the plant propagation practice of cutting buds from a desired scion and inserting them into a cut made in the bark of a compatible rootstock to vascular cambium layers of each line-up. Cell division occurs at the bud-insertion site joining the vascular tissue of the bud and rootstock. Under ideal growing conditions, the bud grows out and within 2 - 3 years develops into a productive tree.

Reasons for budding and top-working citrus

- Ensuring cultivar uniformity by vegetative reproduction (true-to-type status). Propagation fruit trees from seed is problematic if seeds are not nucellar (genetically identical to parent plant). However, in citriculture, scion multiplication by means of seed is impossible due to the production of zygotic seedlings (sexually produced and dissimilar to parent).
- Replacement of a cultivar in an orchard to rapidly adapt to market demands for new or improved selections and cultivars and introducing new ones.

- Avoiding juvenility: Top-working of a scion to an established rootstock with a strong root system, accelerates the time a tree takes to come into bearing. Thereby obtaining better quality fruit sooner compared to newly-planted trees. The yield (kg/tree) of top worked trees can recover within 2 - 3 years, compared to new trees that can take up to 4 years for the first fruit set.

Importance of disease-free budwood and clean equipment

New cultivars are introduced into the South African citrus industry through discoveries of mutations in orchards, or are developed by international breeding programmes. During the propagation process, it is important to understand that citrus species are susceptible to various graft transmissible pathogens such as viruses, viroids and bacteria. Graft transmissible diseases can negatively affect vigour, the longevity of trees, yield and fruit quality, and some instances can potentially destroy thousands of hectares of citrus. Thus, it is of utmost importance to use budwood that is free of harmful pathogens. The supply of healthy budwood is based on a phytosanitary programme that includes



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diagnosis, detection and elimination of pathogens and assures maintenance and distribution of healthy propagation material. The Citrus Foundation Block (CFB) is responsible for multiplying and supplying disease-free budwood. Cultivars supplied from the CFB are additionally evaluated to be "true-to-type".

Equipment and procedures required for successful budding

Equipment used

Budding knife: A budding knife has a thin, sharp blade that allows you to make the cut in one clean stroke. Pocket knife blades are normally too thick for budding. Budding knives also have a "bump" on the back edge of the blade, which is used to split the bark open at the T-cut on the shoot, exposing a "pocket" into which the bud is easily slid.

Budding tape: A clear, thin polyethylene tape is used to add extra pressure on the inserted bud, to enable good contact between the bud and rootstocks cambium. It also keeps out extra moisture and protects the bud while it makes callouses.

Saw/chainsaw: To cut the tree below the graft union for top-working to the rootstock or if an interstock is to be used, 10 - 15 cm

of the old scion should be left.

Pruning scissors: To cut the shoots shorter for wind protection and to reduce the shoot length after successful budding.

Sodium hydroxide (household bleach): An important disinfectant used to clean all the equipment. A 30% solution with water is the most effective.

100 ml measuring jug: Used to mix the 30 ml household bleach with 70 ml water for the 30% solution.

Cotton pads/a spray can: To wipe the equipment clean with the bleach solution.

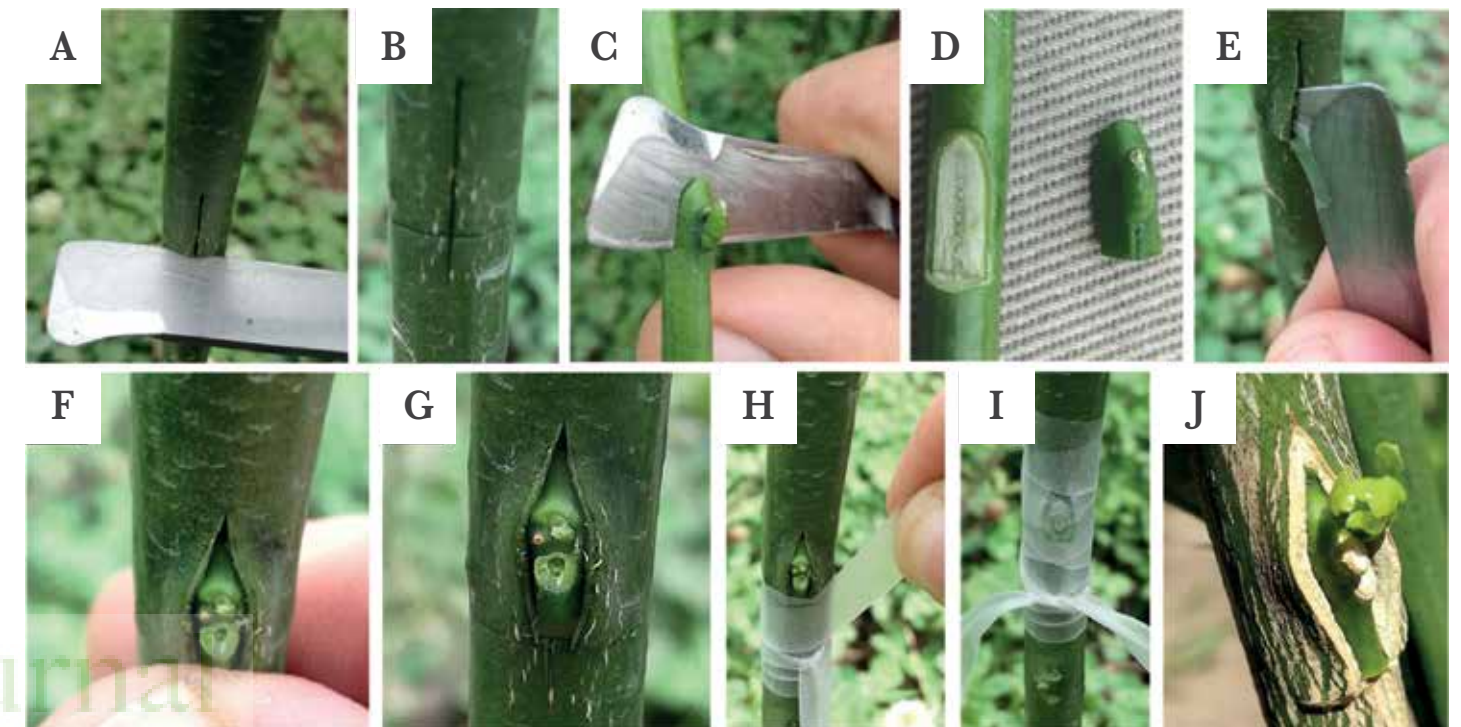
Paint and tree seal: White PVA paint should be used to protect the stem from sunburn and tree sealant is applied to seal the wound to prevent pathogen entry. These measures improve bud-take percentage.

Tool spray lubricant: To spray the tools after use, to extend tool longevity.



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Plant material

Rootstocks: Adequate number of high-quality nursery supplied rootstocks or existing, mature trees for top-working.

Budwood: The CFB supplies disease-free budwood. Budwood shoots are about 15 - 20 cm long with five to six buds on each. All leaves are removed from shoots to prevent them from drying out and to improve the take percentage.

Handling of plant material

- Budwood needs to be stored between 5 - 10°C in a fridge for cool storage when received from the CFB, and can be stored for up to two months at this temperature.
- For transporting to the orchard, place material in a cooler box with ice packs and wrap budwood shoots in newspaper to protect the budwood against cold damage (due to direct contact with ice pack).

Guidelines for budding new wood (scion buds) to old wood (rootstock) with the T-bud procedure

1. Clean all cutting equipment with the 30% sodium hydroxide solution.
2. The best time of the year to do top-work is from September to February, during the growing season when vascular tissue development occurs (meristematic activity). If top-works need to be done directly onto the rootstock, cut the trees below the graft union at a slight angle, to allow water to run off, as this could lead to infection. If the new scion requires an inter-stock, cut the tree about 10 - 15 cm above the graft union, at a slight angle.
3. After removing the scion, paint all the rootstock stumps with white PVA paint to prevent sunburn and heat damage to the vascular tissue. In addition, seal the cut with tree seal.
4. Wait 6 - 8 weeks for strong shoot regrowth (pencil thickness) before budding. During this time, it is very important to remove unnecessary shoots as soon as possible and to spare only 3 - 4 strong shoots. Before removing shoots, sterilise the pruning shears or tool used to remove excess shoots for each tree/rootstock. Cut long shoots back to 1 m in length and support them by binding them together with twine/rope, as protection against bending and breaking off in the wind. **See images 1, 2 and 3**
5. Order budwood two weeks before planned budding and remember to place material in the fridge.
6. Sterilise the budding equipment. Prior to starting the budding process, clear the budding area (30 - 70 cm) of thorns and leaves to make budding easier.
7. Between 20 - 30 cm above the ground, make an upside-down T-cut and open up the two flaps with the back of the grafting knife (**Images A, B and E**) on the shoots.
8. Cut the bud from the budwood. This is a very important step, as it will mean the difference between a successful or failed budding. Place the knife about 1 cm

above the bud and hold the blade at a 45° angle, facing towards you. Slide the sharp blade below the bud until it is about 1 cm past the bud and cut the bud loose (**Image C and D**) from the shoot.

9. Insert the top sharp part of the bud into the flaps of the upside-down T-cut. Use your thumb to gently slide the bud into place (hands should be sanitised with alcohol or bleach solution during budding). Make sure both sides of the bud are under the bark flaps (**Image F and G**).
10. Begin below the bud and use the budding tape to wrap the bud to the shoot, then move up to the top of the bud. Come back down again and bind it in a knot. Make sure the budding tape binds the bud firmly onto the rootstock, but not too tightly. This will ensure that there is good contact between the cambial layers of the bud and the rootstock, and it will protect the bud from drying out (**Image H and I**). If there are 3 - 4 shoots, top-work 2 - 3 shoots and keep one shoot as backup (**Image 3 and 4**). If budding was a failure, repeat step 12 below on the additional shoot.
11. Leave the budding tape on for about three weeks, to allow a callus to develop between bud and rootstock. This will allow the bud to receive nutrients and water from the rootstock for growth. Open up the budding tape carefully in order not to damage the new bud, which should be green if it is still alive (**Image J**).
12. With clean pruning shears cut the rootstock shoot off, about two fingers above the green bud. Seal the wound with tree seal. If the bud is not green, it is dead, in which case steps 6 - 12 should be repeated on the back-up shoot. However, do keep the extra shoot as backup even if your graft was successful. But remove all the newly developed rootstock shoots, as they will be competing for nutrients.
13. As soon as the bud grows strong and the wood starts to harden off (round

and not angular), all the extra rootstock shoots can be removed and a tree can be allowed to develop (**Image 4**). It will be preferable if the new shoots are supported with a wooden stake.

Conclusion

The main advantage of top-working an existing rootstock is that the well-established root system of the existing tree will help with strong new growth. Full production could be achieved 2 - 3 years earlier compared to four years for a newly planted tree, in addition, no orchard preparation is required.

The disadvantages of this technique are that the success of the top-works will be determined by the age and health of the rootstocks and the virus status in the existing tree. And follow-up top-works can be time-consuming and expensive. 🍷