TOMATO GRAFTING

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Crop producers worldwide are constantly searching for cultivars with resistance or tolerance to pests and diseases. Plant breeding has always been the most common method of producing such cultivars with techniques ranging from simple hybridisation to the more complex genetic engineering processes of today. All these methods are relatively slow and pests and diseases often mutate and develop different strains faster than plant breeders can produce resistant or tolerant cultivars.

Chemical control of pests and diseases is being questioned increasingly as people pay more attention to their health and the environment. Previously accepted chemicals for the control of particular problems are now being questioned, re-tested, and withdrawn from usage in many instances.

Consequently there is a growing need to find—or return to—alternative methods of protecting plants against pests and diseases.

Grafting scion cultivars onto rootstocks has been a common practice in fruit and ornamental horticulture for many years. Clonally propagated and seedling rootstocks are used to influence overall plant growth, to induce uniformity, to affect flowering or fruiting and to confer resistance or tolerance to certain pests, diseases and soil conditions.

The use of grafted plants in vegetable crop production is very limited but there are examples where the technique is used to allow tomatoes and cucumbers to be grown where soil-borne pests and diseases are difficult to control by any other means.

The technique of grafting tomatoes was developed in Holland during the 1950's when there were severe problems with crops being damaged by nematodes, corky root fungus, *Fusarium* wilt, *Verticillium* wilt, and tobacco mosaic virus. Resistant cultivars had not been developed at that time and the standard method of eliminating soil-borne pathogens was to pasteurise or sterilise soils using steam or chemicals, respectively. Neither method was totally satisfactory and there was always a carry-over of pathogenic material from one season to the next in dead and decaying plant material in the soil.

It was shown that several wild species in the genus *Lycopersicon—L.pimpinellifolium, L.hirsutum, L.peruvianum* and *L.glandulosum*—had resistance to the pathogens in question

but it was a very slow process to transfer this resistance into acceptable cultivars of the commercial tomato—*Lycopersicon esculentum.*

F_1 hybrid rootstocks were produced by crossing long established greenhouse cultivars—'Ailsa Craig' or 'Moneymaker'—with a wild sub-species—*L. hirsutum* ssp. *glabratum.* A number of rootstocks were produced by this means so that resistance was avilable to one, some, or all of the pathogens. Rootstock resistances were given code letters as shown:

K—Corky root: N—nematodes: V—Verticillium wilt.
F—*Fusarium* wilt: Tm—tobacco mosaic virus.

An appropriate rootstock could then be used for each situation; for example, rootstock KN gave protection against corky root and nematodes, while KVFN was used against everything apart from tobacco mosaic virus.

The tomato rootstock used today in Australia is TmKNVF Hires which gives protection against all five pathogens.

Plant breeders have produced many new fruiting tomato cultivars over the last 30 years, most of which have resistance or tolerance to tobacco mosaic virus and *Verticillium* and *Fusarium* wilts. Problems still exist in this country with nematodes and the susceptibility of old, traditional cultivars to virus and wilts. Consequently there is only a limited place today for the use of grafted tomatoes by commercial growers. Grafted plants are produced, however for sale in garden centres. Garden soils are often heavily contaminated with the pathogens in question and home gardeners do not have access to most of the crop protection materials used by commercial growers. Most people would not want to use them anyway especially in the enclosed environment of a home garden.

THE METHOD OF PRODUCING GRAFTED TOMATO PLANTS

Sowing. Poor germination can occur with rootstock seed and it is also slow to emerge. Consequently the rootstock seed should be sown ahead of the cultivar that is to be grafted. A time lag of 10 to 14 days may be needed in late winter but that can be reduced to 6 to 8 days later in the year, or when temperatures are higher. It is important to have rootstock and scion cultivar seedlings with stems of similar diameter at the time of grafting.

Seedling culture prior to grafting. Scion and rootstock seedlings should be pricked out as soon as they are large enough to handle. An ideal method is to transfer them to plastic or polystyrene cell trays. Seedlings should be set towards the edge of the cells since this makes the grafting process easier.

Seedlings are generally ready for grafting at a height of 10 to 13 cm and a stem diameter of 3.5 to 5.0 mm. The plants should not be too soft although it is better for them to be a little soft rather than too hard.

Preparation of seedlings for grafting. The cotyledons and true leaves are removed up the stem to a height of about 6 to 8 cm. Some authorities favour cutting the stem of the rootstock about 5cm above the point at which it will be grafted. Our experience is that plants are easier to handle if they are kept intact until after the graft has taken.

Grafting. A simplified tongued approach graft is used and it works very well with tomatoes. Razor blades or scalpels are ideal tools for cutting into the soft stems.

Rootstock and cultivar seedlings are moved into adjacent cells in a tray and can then be grafted *in situ*. The cuts are made on the sides of the stems nearest to the edge of the cell so that the two seedlings can be brought together.

A *downwards* sloping cut is made into the rootstock seedling at the point of graft. The cut should be about 10 to 12 mm long and pass just over half way through the stem. An *upward* cut of the same dimensions is made into the fruiting cultivar seedling. The cuts must match each other, being an equal height above the original soil level and of similar length and depth.

The stems and cuts must be accurately matched so that a close fit is obtained.

Grafting should not be done in direct sunlight as the soft tomato plants are likely to collapse or wilt.

Hold the two joined seedlings together carefully and bind them together around the graft using adhesive tape or a special grafting clip. Self-adhesive medical tape, such as Micropore® , works very well. Grafting clips are also satisfactory but are much more expensive. The tape should be wrapped around all edges of the graft and a small amount should overlap to form a handle with which to pick up the grafted seedlings.

The grafted seedlings should remain in the trays in the growing house and be watered carefully to avoid wetting the graft area.

After-care of the grafted plants. Initially the plants should be kept out of direct sunlight to reduce stress. The humidity should be high with the temperature maintained around 20 to 25 °C. Plants must be watered as necessary and misted over if they show any signs of wilting. During the first two weeks from grafting the plants can be gradually introduced into direct sunlight.

Tomatoes are very easy to graft and they unite quickly. The grafts should take in about 14 days and the plants should then be potted up. Since the rootstock and scion cultivar are growing in adjacent

cells it is easy to take them out and pot them into a single pot. The grafting clip or adhesive tape can be removed as soon as the graft has taken and strengthened.

The root of the scion cultivar can be severed any time after the graft has securely taken Simply make a cut through the stem between the graft union and the base of the cultivar stem. When the plants are destined for soils known to be infected with tobacco mosaic virus, *Verticillium* or *Fusarium* and the fruiting cultivar is susceptible to these diseases then the scion root must be severed otherwise the diseases may be transmitted up to the cultivar via the scion roots. After the scion root system is severed the plant may suffer a temprorary setback. It may be preferable to postpone the severing until just after planting out so that plants retain both root systems during propagation and sale and are accordingly more robust.

A slight hardening of the plant occurs due to a grafting check but it should be remembered that grafted plants have a vigorous, spreading root system in conditions where nongrafted plants have limited roots. Consequently the grafted plants should grow vigorously after planting.

Associated problems:

Virus: Grafting is an ideal method of spreading sap-transmitted viruses and attention to hygiene is very important. Washing hands and tools in a 3% solution of tri-sodium orthophosphate between grafts is a sensible precaution.

Magnesium deficiency: Grafted plants may show magnesium deficiency symptoms in some soils where nongrafted plants remain quite green. In such cases foliar applications of magnesium sulphate can help to correct the problem.

The steps in producing grafted tomato plants are shown in Figure 1.

CUCUMBERS

Grafting fruiting cucumber cultivars onto rootstocks of the Malabar gourd (*Cucurbita ficifolia*) is a control measure for *Fusarium* wilt and also allows crops to be grown in soils infected with black root rot (*Phomopsis sclerotioides*). This technique is particularly important when cucumbers are to be grown in infected greenhouse or polyhouse soils where pasteurisation using steam is not possible since *Phomopsis* is not controlled by any other method.

The grafting method is very much the same as that described for tomatoes.

Grafting tomatoes or cucumbers onto disease-resistant rootstocks is unlikely to be a technique for field producers since many of today's commercial cultivars—especially of tomatoes—have been

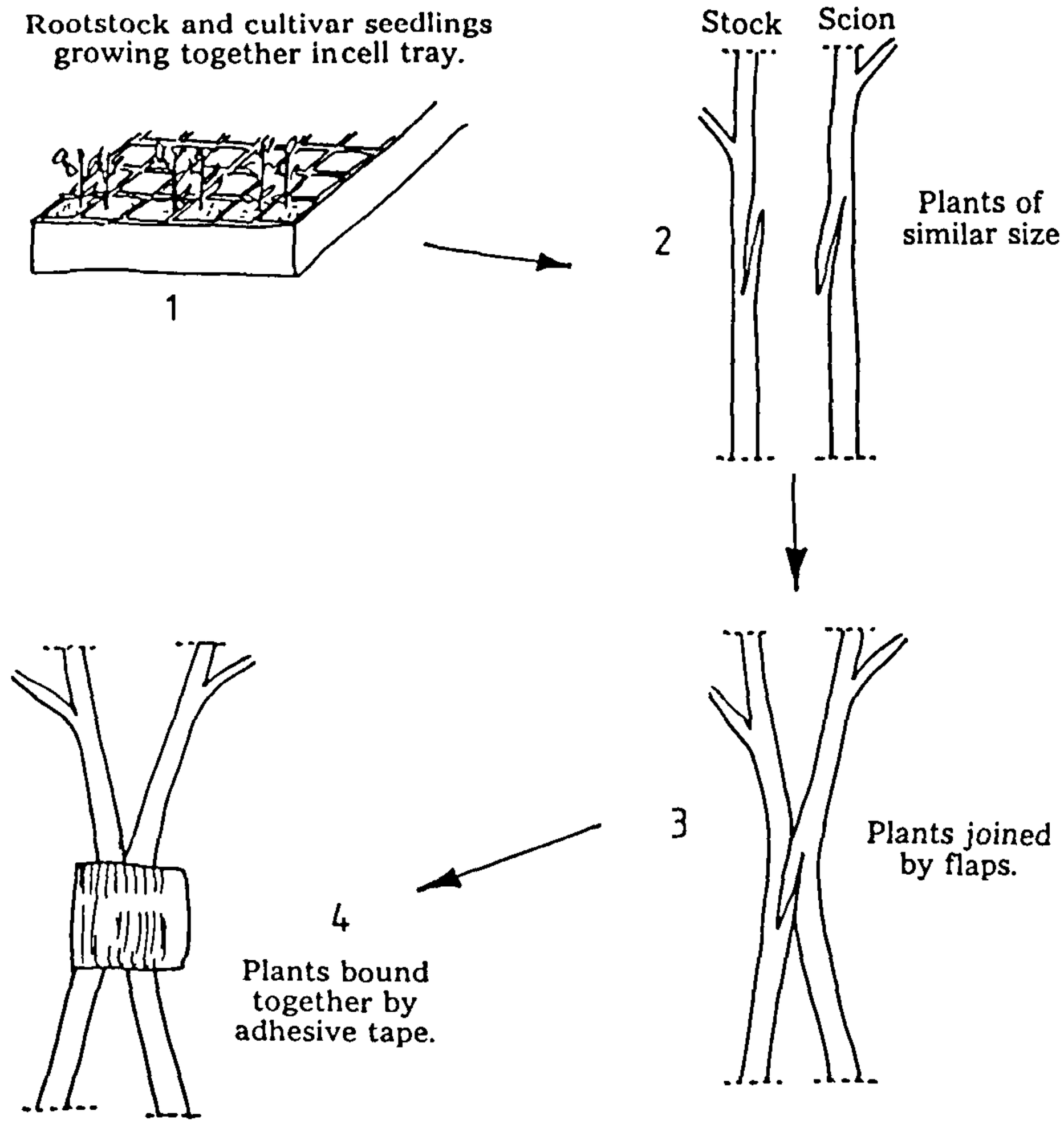

Figure 1. Stages in grafting tomatoes

bred with resistance to soil-borne problems The situation may change, however, and new strains of the pathogens may appear to which the cultivars are susceptible Legislation and/or public opinion may not permit the use of chemical treatments in this new situation and growers may need to resort to alternative methods of growing healthy crops.

With greenhouse or polyhouse crops the situation is different since growers do not have the option of rotating their plantings onto other areas of land. Consequently the use of grafted plants may become a very important method.

The production of grafted plants for the domestic market will continue and it is important that the general public is given full and accurate information on the use of these plants