NEW ADVANCES IN BENCH GRAFTING

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Bench grafting of scions on bare root understocks has long been a mainstay of the production of wine grapes and fruit trees, particularly fruiting apples. It is a slower and more expensive process than budding the same trees on understocks already established in the field. Nevertheless it has several advantages over field budding. It is done at a traditionally "slow" time of the year for northern nurseries when there is little to do outside in the field and extra workers are available. Plants which sprout vigorously from the understocks, like *Hamamelis* and *Corylus*, sucker far less from deeply planted bench grafts than from pot grafts. Similarly budded trees like crab apples and Japanese cherries, which sucker readily from the understock, give far less trouble from grafts because the graft union is more deeply buried. Lilacs and other plants which are grafted on nurse roots with the intention that the scions callus and then put out their own roots produce superior and more permanent plants than when they are budded on the same understocks. In the production of special double-budded or double-grafted fruit trees for orchard production, bench grafting can save a year's production time over trees double-budded in the field.

One criticism of bench-grafted trees is that the first year's growth is noticeably shorter and smaller than that of a budded tree. In the case of orchard trees and small flowering trees like crab apples, where a long smooth stem is not essential, a grafted tree compares favorably with a budded tree in the total production time required. The budded tree requires a season's growth in the field to reach budding size, whereas a bench-grafted tree grows to a respectable size that first season. In the end, after the second season's growth, the bench-grafted tree is saleable as a small branched tree whereas the budded tree has merely produced a lightly branched or unbranched whip. Thus for producing trees for mail order sales or for potting for garden center sales, a bench-grafted tree has distinct advantages in producing a nicely branched medium sized tree much more acceptable to the customer than a mere whip, no matter how vigorous it may be.

In the case of ornamental trees and shrubs, bench grafting has further advantages because it is possible to bench graft many species which are extremely difficult or even virtually impossible to bud. Here, too, the reduction in suckering can be very advantageous in those species which sprout easily from the understock. Grafted wisterias sprout easily from the root crown and it takes a

real expert to recognize the suckers. Ornamental clones of *Corylus avellana* and *Hamamelis* selections are extremely difficult to produce from softwood cuttings. Bench grafts planted with the union well below the surface of the soil sucker much less than pot-grafted plants. While the skilled nurseryman can easily recognize and remove suckers in these species, the home gardener usually does not, and the result is a thicket of sprouts from the rootstocks which crowd out the desired cultivar scion.

All cultivars of woody plants which can be propagated by bench grafting can also be propagated by grafting on potted understock. However, pot grafting is the most expensive and slowest of all forms of propagation. First of all, the understocks must be potted up in durable pots and grown for a season to produce a well-established plant for grafting. Such an understock is already an expensive plant in comparison with a bare root seedling. Handling a potted plant and grafting it is much slower than handling a seedling. If whip and tongue bench grafts are made, the skilled grafter can pass them to a less skilled tier which greatly increases the grafter's daily output. Pot grafts have to be tied by the grafter himself. In the case of really difficult subjects like grafted pines, spruces, firs, true cedars, and other conifers, pot grafting is essential for successful stands, but for many other deciduous plants time and money can be saved by bench grafting.

Many beginning propagators have tried bench grafting with very disappointing results. In almost every case, these poor results or total failures are caused by not permitting the grafts to callus prior to planting out or potting up the grafts in containers. The bare root grafts should be heeled-in in boxes of peat deep enough so that the graft union can be covered. Some apple grafters use boxes of aged sawdust successfully, but peat does seem to have some advantageous fungistatic properties. The boxes of grafts should be placed in a cool but not freezing greenhouse and examined carefully once a week to see how the callusing is progressing. The cool temperatures are necessary to prevent sprouting of the scions into active growth before the graft union has sufficiently callused. Crabapples and cherries are particularly liable to sprout prematurely, while ginkgos, wisterias, parrotias, and, hamamelises are slow. The boxes of grafts should be watered whenever the surface of the peat dries noticeably. However, only a light sprinkling of water should be given. Heavy watering or intermittent mist can cause the lower peat or sawdust in the boxes to become watersoaked and the understock roots will rot. The speed of callusing and the frequency of watering vary from year to year depending upon the late winter temperatures and the amount of sunshine. Like so many other forms of propagation, successfully handling bench grafts is an art more than an exact science, and it is not readily subject to an exact, mechanical regime. The big variable factor is the weather. The time

required for successful callusing is much shorter if the weather is bright and warm than if it is cloudy and cold, even though the grafts are stored in a cool greenhouse. In some nurseries where bench grafting is an important process, the boxes of grafts are stored in a greenhouse with a heated floor. This kind of facility permits rapid callusing of the graft unions while the air above the grafts can be kept quite cold to retard sprouting of the scions. Such a greenhouse with a heated concrete floor is an excellent facility for mist propagation of difficult-to-root softwood cuttings during the rest of the year after the grafts have been put in storage, and it can be put to almost constant use in propagation.

Once the grafts have callused and the scions are showing signs of bud break the boxes of grafts should be removed from the callusing house and put in cold storage. This move has the effect of stopping all further scion growth until the grafts are planted out in the field or potted up in containers. The darkness of cold storage has no adverse effect upon the condition of the grafts during storage. The temperature during this holding period should be cold, between 33 and 36°F if possible. Cold temperature stops the growth of fungi which could otherwise attack the graft unions or the rootstocks. The medium covering the roots and the graft unions should be moist but not wet when the boxes are put into cold storage. Normally, no further watering is necessary until planting time.

A number of different materials have been used successfully for tying bench grafts. The oldest method was to tie the graft with string and then paint the finished graft union with grafting wax. Millions of successful grafts have been made with this method, but it is especially slow and cumbersome, requiring a heated pot of wax and an extra worker. The wax temperature is critical. If it is too hot it will penetrate the cuts and inhibit or prevent callusing. If it is too cold, it will not seal well. In the case of nurse grafts, it will inhibit rooting from the scion.

A second method is to use special grafting adhesive tape. This is much quicker than using string and waxing, but it does not give as tightly tied a union as does string. It inhibits scion rooting if this is desired, but the progress of callusing is more difficult to observe.

A third method is to tie the union with grafting string which has been previously soaked on the spool with melted grafting wax. This waxed string is quick to apply and does not need to be tied at the end of the graft as does unwaxed string. It lasts long enough to plant or pot the graft without dislodging the graft union and then rots as the graft begins to grow and the ground or the planting medium warms up. Care must be used to wrap the graft evenly and not too thickly with the string. A wad of wraps in one place will not rot easily in the ground and the resulting constriction can girdle the graft and kill the scion.

A new material which is especially useful for difficult subjects

is to use strips of 12 × 1 in. thin clear polyethylene tape, 1½ mil in thickness. It is perfect for grafts in which the union will be above the ground. It is not good for grafts with buried unions because polyethylene does not rot in the ground. The union must be tied with a rubber budding strip prior to wrapping with the poly strip because the latter is too weak to make a tight union. The poly holds in the moisture produced by the cut surfaces of the graft, while permitting normal gas exchanges. This method is too slow for mass produced grafts like fruiting apples and ornamental crabapples and cherries. It is very valuable for topworked specialty grafts like weeping elms, weeping mulberry, and other ornamentals and it is excellent for deciduous grafts on potted understocks such as oak, beech, *Hamamelis, Aesculus,* and *Parrotia.* The old method of treating such grafts was to plunge the unions in beds of peat or to lay them on peat under double glass, both being slow and cumbersome. Using the poly strips, such grafts can be set up on the open greenhouse bench with great savings in space and labor and also avoiding attacks of mold fungi on the new foliage which are always a danger in grafting cases.

Once above-ground grafts tied with rubber and polyethylene strips have united and the scion is growing vigorously, the ties must be cut or they will constrict the graft. This can be very quickly done with a single-edged razor blade cutting down one side of the union. As previously stated, grafts tied with waxed string or grafting tape and planted with the graft union below the surface of the soil or the container medium do not need to have the ties cut, as they decay prior to causing any constriction of the scion.

It is possible in future years that micropropagation of difficult plants like oaks, beeches, and horse chestnuts by means of tissue culture will be worked out. Formerly very challenging trees like the purple-leafed, weeping, and fastigiate forms of the European birch (*Betula pendula*) are now easily grown in tissue culture. However, the others mentioned have been extremely resistant to micropropagation so far. In addition, working out the correct biochemical manipulation of a given woody tree or shrub is very costly, commercial laboratories quoting tens of thousands of dollars for a single plant. Therefore, for choice but rare plants like those named above, for which the commercial demand is limited, grafting is likely to remain the preferred method of propagation. Bench grafting, with the addition of new tying materials, is sure to be with us for many years to come.

The following woody trees, shrubs, and vines can be successfully propagated by bench grafting on bareroot understocks.

Acer palmatum clones. Grafts must be carefully callused to prevent premature bud break. Plant in shaded beds or in poly covered container houses.
Aesculus × *carnea* and *A. hippocastanum* clones. Graft on *A. hippocastanum*

seedlings. Use poly wrapped above ground grafts to retain sufficient root area on the understocks of these tap-rooted trees.

Amelanchier clones. Deep-planted bench grafts sucker far less than budded trees.

Betula pendula clones. Quickly branching clones like 'Fastigiata' produce little or no useable bud wood but are easy to graft.

Campsis clones. Grafted plants produce blooming size plants in one growing season.

Carpinus betulus clones. Large seedlings grafted with thick scions produce a saleable tree much more quickly than thin pot grafts.

Corylus avellana clones. Bench grafts sucker much less than pot grafts. Plant deeply in shaded beds or in containers in a poly house.

Ginkgo biloba clones. Ginkgos are difficult to bud and rooted cuttings grow much more slowly than bench grafts.

Hamamelis clones. Deeply planted bench grafts sucker less than pot grafts. *H. virginiana* suckers far less than *H. vernalis*.

Malus clones. Bench grafts sucker less than budded trees.

Prunus flowering clones. Thin-barked species like *P. subhirtella* are difficult to bud but graft easily.

Syringa vulgaris clones. Some choice lilacs are very difficult to root. Bench grafted shrubs on nurse roots are superior to budded plants.

Ulmus species and clones. Thin-wooded, twiggy species like *U. parvifolia* produce little useable bud wood but are easy to graft.

Wisteria clones. Softwood cuttings are difficult to root in wet summers and less vigorous than grafts. Deeply-planted grafts do not give suckering problems.

JOHN BAKKER: In your cold storage of the bare root grafts, how long can you hold them in storage and at what temperatures?

BILL FLEMER: We try to hold the temperature above freezing but below 40°F. We put them in from mid-February on and plant in early April. We have had no problem keeping them in storage if they have no leaf growth.

SAM JONES: Did I understand that you bare-root graft *Hamamelis*?

BILL FLEMER: We do them both ways.