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Sticking the Knife In: Grafted Nursery Stock Production at Yorkshire Plants

Steen Berg
Yorkshire Plants, Carr Lane Thormanby, Nr. Sessay Thirsk, N. Yorkshire, Y07 3NG
United Kingdom

INTRODUCTION

Yorkshire Plants is a wholesale nursery located in the north of England approximately 200 miles north of London. Temperatures range from -10°C in the winter up to about 30°C in the summer. We have rainfall of about 24 inches per year. This is not totally unfamiliar to the climate of the Northwest; just not as cold nor as warm and not as wet. Winds, gales, and spring frosts are our other main climatic challenges. Our main crops (*Cotoneaster, Euonymus, Larix, Photinia, Prunus, Salix*) are top-worked patio trees on an 80- to 150-cm stem. These trees are convenient for retail sales and not too large (they cannot fit into a small family car) but not so small they can still be considered trees. We have tried to search for unusual hard-to-find trees, but with garden appeal (e.g., variegated, purple foliage, large leaves, cut leaves, or contorted forms). Conifers (*Picea, Pinus, Cedrus, Abies, Taxus*) are grafted plants with high value.

SHRUBS

We grown *Hibiscus, Syringa, Wisteria*, and *Corylus* that are propagated by grafting. The U.K. nursery stock industry has largely left this type of product to be grown by continental growers. There is no great tradition in this type of production in the U.K. Our market is retail garden centers/nurseries in the U.K. and Ireland.

GRAFTED NURSERY STOCK PRODUCTION

Grafting. Our grafting is nearly all done in the winter (December to March) using a simple side or whip graft. Only on *Aesculus* and *Gleditsia* do we use the whip and tongue method to help bind the graft union. Bottom-working of trees and shrubs is mainly done on a hot-callus-pipe system where water is heated by a small domestic

boiler, pumped through a 15-mm plastic domestic pipe which in turn is then placed within a 32-mm radiator pipe with static water inside. The static water helps distribute the heat evenly. This is housed within an insulated 75-mm PVC pipe with slots cut out for the grafts to rest in. The roots are covered with damp capillary matting that is watered twice each week. The graft union area is covered with strips of carpet underlay. The area we use for the hot-callus grafting is a modern shed built from steel and concrete blocks. The shed is cool and dark and we find it ideal for this purpose. The main drawback we found with the hot-callus-pipe method of grafting was the amount of space it was taking up in our shed. Our solution was to use second hand supermarket shelving. We have five shelves; however, you could easily use seven to make even better use of your space. In just 40 m^2 we had 5000 grafts on our callusing pipe. This included space to give adequate access to the pipe to work, i.e., placing and taking away grafts. Using this system is very simple. All that's required is that the operator put the grafts so the union is in the warm air pocket and the roots are in a sandwich of damp capillary matting. The management from then on is to monitor the air temperature around the graft union and keep the roots moist. The temperature of the air at the graft union can be 12 to 15°C for *Acer,* 18 to 22°C for *Gleditsia* and *Fagus*. The time taken for stock to callus sufficiently before removal from the callus pipe can be from 13 to 25 days, but 21 days is normal. We can turn our space over in a winter four times, with the use of cold stores and good management. I know of nurseries turning space over seven times in a winter making it possible to callus 35,000 grafts in 40 m^2 from December to April. When the grafts are callused we pot them into containers placing them in polythene tunnels or an unheated glasshouse. The main rule seems to be graft when the stock would usually leaf out. Start with *Acer/Betula* in January and finish with *Robinia, Quercus, Gleditsia*, and *Fagus* in March. If you wish to callus plants in December this can be done, but Iwould say only do Rosaceae subjects such as *Cotoneaster*, *Malus*, *Prunus*, and *Crataegus*. The only reason I would graft in December is to make use of labor to get a chunk of the grafting out of the way and to free up skilled grafters during the main season. Rosaceae subjects are easily grafted by traditional methods, if space on the pipe is limited. I do find that all subjects grow away with more uniformity using the hot-callus-pipe technique.

Top-working. *Cotoneaster*, *Salix*, *Photinia*, *Euonymus*, *Larix*, and *Prunus* are main subjects for top-working. There has been a fashion for these novelties in the U.K. in recent years. However, now most plant retailers have experienced this material and are demanding high quality plants with a purpose. They are looking for straight thick stems, large even heads and large containers that will carry this top-heavy product. Our response as growers has been to take 3 years to grow the plants instead of 2 years. In some cases we double the final pot size and in nearly all cases put two scions on a single stem.

Top working is done on pot-grown and bare-root stems. *Cotoneaster*, *Pyracantha*, *Prunus*, and *Larix* are grafted onto pot-grown stocks, whereas *Euonymus*, *Robinia,* and *Salix* are grafted on bare-root stocks and potted after grafting. In all cases, apart from the willow stems, we buy in understocks from specialist producers. In the case of willows we produce our own, by sticking hardwood cuttings of *S. viminalis* or 'Boles Hybrid' of about 5 to 6 inches long though a polythene mulch with two lines of tape irrigation under the polythene. The cuttings are stuck in March and by

August have reached about 10 ft high. The maintenance has included high levels of water and several times walking through the crop to make sure each plant has only one growth leader. Out of this crop we get three grades; plants for grafting at 120-cm stems and 80-cm stems, and for bottom-working.

Top-working is done in the case of the pot-grown stocks *in situ* within a double-skin poly tunnel or within a cold house. Bare-root stocks are grafted in our shed then potted and taken to a double-skin tunnel or cold glasshouse. When using two scions we use a whip graft for the top scion and a side graft for the bottom scion, putting the scions at opposite sides of the stem. The grafted union area is then dipped into melted paraffin wax. Tying is done with rubber strips. Cotoneasters are usually the first plants to be top-worked in January with *Robinia* being the last in March. Plants are maintained through spring routinely suckered and heads pruned to shape them. They are then transplanted into their saleable pots in May and June or an intermediate pot should the plant require the extra time to make sale. Due to us putting a lot of work into the plants prior to going into their final container, little more than light pruning is done to the plants. We do have a windy climate in the U.K. and these plants have to be tied to some kind of support when grown outside. All plants are staked and tied, the stake itself is tied to their support. We use drip irrigation for all our trees and patio standards. This is an expensive method of delivering water to the plant, but it does use water efficiently, we pay 80 pence or $1.25 for 1000 liters of water. I have to use mains water as there is no viable underground supply and the capital costs for collecting roof water is, as yet, prohibitive. The storage of this water would take up a large amount of valuable growing space.

Conifers have recently dropped off in popularity in recent years in the U.K. in favor of more fashionable herbaceous, grasses, and bamboo. We do grow some of the more high-value conifers such as *Pinus*, *Cedrus*, *Abies*, and *Taxus*. Our method of propagation is a very traditional side graft onto a pot-grown stock during February to March and placed under a polythene tent within a cold glasshouse. Successful grafts are planted out into the open ground during June and remain there for 2 years, transplanted into containers and sold in or planted out for an additional 2 years.

Stock Plants. We have planted stock plants for all the subjects we are growing; they act as a valuable source of material for grafting and as trial grounds for the plants we are growing.Showing customers semi-mature plants is a great way to educate and to give them confidence to buy. We have planted conifers through woven plastic matting to act as a mulch on our very sandy soil and to suppress weeds so reducing the need for spraying herbicide. Great care is taken over our stock plants with pruning and feeding. During spring they are as important as our saleable crop. Without our stock plants in good condition the whole business will suffer over a period of time.

GENERAL NURSERY OPERATIONS

Our stock is moved around our site with compact tractors. We have an automatic irrigation system using a mixture of drip irrigation and overhead sprinkler system. Generally we have our main program come on about 3 AM and a secondary program will top tip about 5 PM in the early evening. Although when the weather is very hot

we find ourselves putting on the drip irrigation three times a day. Working on the theory of a little and often. If we give them just one long blast of water then we find the water just runs out of the bottom of the pot and is wasted. Staff personnel include a mixture of full-time college-educated nursery people, students, part-time labor, and press-ganged family.

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Control of Botrytis During Plant Propagation

Walter Mahaffee
Horticulture Crops Research Laboratory, 3420 NW Orchard Avenue, Corvallis, Oregon 97330

INTRODUCTION

Diseases caused by species of *Botrytis* (Table 1) are probably the most frequent and widely distributed diseases of nursery plants, with *B. cinerea* being the most common. Symptoms of *Botrytis* diseases generally appear as blights or rots of various plant tissues. Under humid conditions the characteristic gray cottony sporulating mycelia appears, thus the common name of gray mold. In addition, symptoms can consist of leaf spots and cankers. Diseases caused by *B. cinerea*. are also some of the most difficult diseases to control due to the pathogen's prolific asexual reproduction, ability to survive as a saprophyte, and the continuos susceptibility of plants to infection.

PATHOGEN BIOLOGY

Botrytis spp. have an extremely complex life cycle (Fig. 1) that involves sexual and asexual reproduction, and the abilities to survive indefinitely as a saprophyte on organic material, to remain latent on infected plants, and sporulate at any point in its life cycle. In addition, *Botrytis* spp. are extremely genetically variable due to multinucleate hyphae and spores, the heterokaryotic (both male and female) nature of some strains, and sexual recombination. However, *Botrytis* spp. tend to be weak pathogens, usually requiring an exogenous nutrient source (e.g., insect frass, senescent tissue, wounds, etc.) or a compromised host for successful infection.

Dispersal is mainly through the dissemination of airborne conidia from sporulating mycelia. Dispersal can also occur through ascospores, dispersion of infected debris, insects, and mechanical transmission. Conidia are released during rapid changes in relative humidity accompanied by air movement or water splashing. Generally, peak spore release is associated with activity in the greenhouse (e.g., watering plants, moving plants, leaf removal, etc.). Once released, conidia land on plant tissues where they can remain dormant or germinate if conditions are favorable. They require RH > 93% or free water and an exogenous nutrient source to germinate. Germination can occur between 32 and 79°F, with an optimum of 68°F for *B. cinerea*. Infection and disease development can occur at 32 to 95°F.