

BENCH GRAFTING COLORADO BLUE SPRUCE— CRITERIA FOR SUCCESS

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Picea pungens (Colorado blue spruce) cultivars are one of the most important bench-grafted crops in both North America and Europe. A number of superior, glaucous, blue forms have been selected and named during the last few decades, including *P. pungens* 'Hoopsii', 'Thomsen', and 'Baby Blue Eyes'. There have also been selections based on their varied growth habit, e.g., the weeping 'Glauca Pendula', and the compact 'Glauca Compacta'. The aim of this paper is to summarize a number of the important criteria necessary for successful bench grafting of this crop.

Rootstock Production. A quality rootstock should have a pencil-thickness caliper (6mm; 1/4in.), a straight stem, and a well-developed rootball. These are major criteria for success. The production or purchase of under-sized rootstocks with a poor root system results not only in low grafting success but also in poor subsequent scion growth. Quality rootstocks can be produced by using 2-year, graded, transplanted, or undercut open-ground seedlings of *Picea abies*, which are then potted into 10 cm (4 in.) containers. Attention to control of red spider mite, spruce aphid, and root aphid, together with adequate nutrition and irrigation, is particularly important after potting. Mulching the pot-grown rootstocks with peat moss reduces weed germination and also reduces the need for irrigation.

Time of Year. There are two optimum periods for grafting blue spruce. The first is in late July to early August, when there is a natural lowering of growth processes, and the second is during December to early February, when the rootstocks are still fully dormant. One advantage of late summer grafting is that the vascular tissue between scion and rootstock unites prior to the winter and this subsequently often results in improved scion growth the following season, as compared to winter grafting. The majority of propagators prefer winter grafting. It is important not to graft late, particularly after a mild winter.

Rootstock Preparation. Correct preparation of the rootstocks just prior to grafting is often overlooked. Inspect the rootstock

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plants 2 to 3 weeks prior to grafting and bring them into a greenhouse with an optimum air temperature of 10 to 12 °C (50 to 54 °F) to reduce the rootball moisture level to 50 to 60% in order to initiate physiological activity. Less drying-off is required for late summer grafting. A small amount of white root growth should be visible after this procedure. Excessive moisture in the rootball at grafting time will encourage "flooding of the union" (excessive sap accumulating around the union following grafting) and results in poor success. Conversely, excessive drying-out kills the newly formed roots, resulting in little or no subsequent scion growth.

Selection and Collection of Scionwood. The propagator must collect 1-year, vigorous, terminal scions, 10 to 15 cm (4 to 6 in.) long, with a dominant terminal bud and not less than three radial buds. Scions prepared from non-vigorous wood lacking dominant terminal buds result in plants with lack of symmetry in whorls and in reduced vigour. The slower growing cultivars often require scions prepared by cutting into 2- or 3-year old wood and these normally have side shoots. Collection of scionwood should be geared to having sufficient scions available to supply one-half to one full day of grafting. If storage is necessary, the scions should be placed in a polyethylene bag and put in a refrigerator at 4 °C (39 °F).

Method of Grafting and Tying-in. Blue spruce must be side-grafted because a considerable degree of control of the sap rise is required during the aftercare procedures. The two methods principally used are the side veneer and the apical wedge grafts. The key points for success, apart from developing a proficient skill by continuous practice, are:—

1. Use a sharp knife. I like the pointed blade of the Tina 606 because I find that it allows greater precision.
2. Clean the knife blade after each graft to remove the resin. Wipe the blade on a pad dampened with white or methylated spirits.
3. Do not tear the stem tissue when removing the needles from the scion at the point where the cuts will be made.
4. Ensure the cuts on the scion are shallow to expose the cambium—the wood is often relatively pithy so good knife control is important.
5. Make sure that the cut surfaces are in close contact when matching the scion and rootstock. Smaller caliper scions should be matched on one side only of the cut surfaces.
6. Tying-in should be firm, begin above the upper cut surface and end well below the base of the cut on the rootstock. The base of the veneer on a side veneer graft must be left uncovered by the tie. One common fault of beginners is to pay insufficient attention to tying-in—particularly at the start and end of the operation.

Waxing. Waxing of the cut surfaces is necessary when humidity and air temperatures are low and movement of air is encouraged, e.g., on an open bench or in a polyethylene tent facility. Waxing is not necessary if the unions are covered with moist peat moss in a grafting case. It is better to wax the unions if in any doubt. The best types of waxes are either the cold latex waxes (e.g., Farwells Tree Doc® —Yellow or Green Cap), or the hot waxes that cool rapidly when brushed onto the cut surfaces of the grafts.

Aftercare. Correct aftercare procedures for the grafts are essential. Perfect carpentry is useless if the principles of aftercare are neglected.

A heated aftercare facility, grafting or closed case, is normally designed as a tent, drape, or tunnel. An open bench in the greenhouse is used sometimes providing there is limited air movement. A shaded coldframe is a very effective aftercare facility for summer grafting.

Very accurate temperature control is not vital, but a useful guide to optimum temperatures is to have a base temperature of 18 to 20°C (65 to 68°F) and an air temperature of 15.5 to 18°C (60 to 65°F), combined with a minimum humidity of 80%. It is important to provide sufficient shading to reduce temperature build-up and retain sufficient humidity—a rise in temperature will reduce the humidity unless precautions are taken. Excessive extremes of temperature and humidity cause severe stress to the rootstocks and result in poor success. A guideline is to have 50 to 70% shading for winter grafting and 80% for summer grafting.

Watering is another important consideration. The commencement of watering depends on the moisture level of the rootball at the time of grafting and on the environment within the grafting facility. The rootballs *must* be inspected regularly for excessive dryness and root development. The first thorough watering should take place when callus tissue has formed between the scion and rootstock, although some propagators prefer to wait until the terminal bud on the scion begins to swell. Excessive watering during the first 2 to 3 weeks after grafting leads to excessive sap rise and results in lost grafts due to “flooding of the union”. Stress or loss of newly developing roots caused by either over- or under-watering will also cause poor results. Watering should be increased gradually as the grafts are hardened-off.

The application of a fine spray of water over the grafts is beneficial in several circumstances, e.g., the morning after the polyethylene cover was removed overnight, when the grafts have been left uncovered on a dull day to encourage some air movement, and during hardening-off. Such spraying helps to reduce stress by quickly raising the humidity levels around the needles.

Ventilation of the grafts begins 3 to 6 weeks after grafting to start the hardening-off process and is normally concluded by 8 to 12 weeks after grafting. Shade cloth should replace the polyethylene at this point.

Attention to pest and disease control is very important. The major pests for blue spruce are red spider mite, spruce aphid and root aphid. *Botrytis cinerea* infection of the soft growth results from infection of the scion buds.

Heading-back (snagging back) of the rootstock to the apex of the union is best done in three stages. Reduce the rootstock ("sap drawer") to half its length 6 to 8 weeks after grafting. Repeat 6 weeks later to 2.5 cm (1 in.) above the union. The third stage is the final removal of the snag in the following August for winter grafting and in early March for summer grafting. Earlier removal of this final snag, particularly for winter grafting, results in poor scion growth.

CONCLUSIONS

In this paper I have attempted to relate the major criteria for successful grafting of blue spruce. Successful bench grafting should result from adherence to these principles, especially if the propagator is willing to adapt his/her technique in response to experience with successes and failures. As in many aspects of propagation, observation, dedication, and enthusiasm are essential, and bench grafting of *Picea pungens* cvs. will challenge all three of these powers.

REFERENCES

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