The Use Of Hot Pipe Callusing For Bench Grafting

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The use of hot pipe callusing of subjects usually difficult to bench graft is described. The technique allows the use of bareroot rootstocks for ease of handling and the subsequent economic raising of the trees in line with the majority of bench grafting of fruit and ornamental trees on the author's nursery. The application of the technique to *Aesculus, Betula, Carpinus, Corylus, Fagus, Juglans*, and *Quercus* is described.

INTRODUCTION

Two papers in previous *I.P.P.S. Proceedings* have dealt with this subject very well with references dating back to the 1930s. The principles described in these papers have changed little in our application of the technique.

MATERIALS AND METHODS

Principle. Most grafted subjects of deciduous fruit and ornamental trees survive the initial critical growth phase well enough not to need hot pipe callusing. However, certain subjects, even with special attention, such as the use of pot-grown rootstocks and protected growing environments fail to survive in economic numbers. This is because the grafted tree cannot meet initial demands to make root, callus, and begin scion growth all at the same time. The precallusing of the graft union, using the hot-pipe technique—in advance of root and shoot activity, is a logical step to increase the survival rate.

Seasonal Timing. Our experiences show that this technique can be used at any time from mid-December to April, enabling a succession of batches to make full use of a limited facility. The use of a coldstore for extending dormancy of rootstock and scion wood, and of the grafts themselves during and after the callusing period, extends this window of opportunity to 5 months.

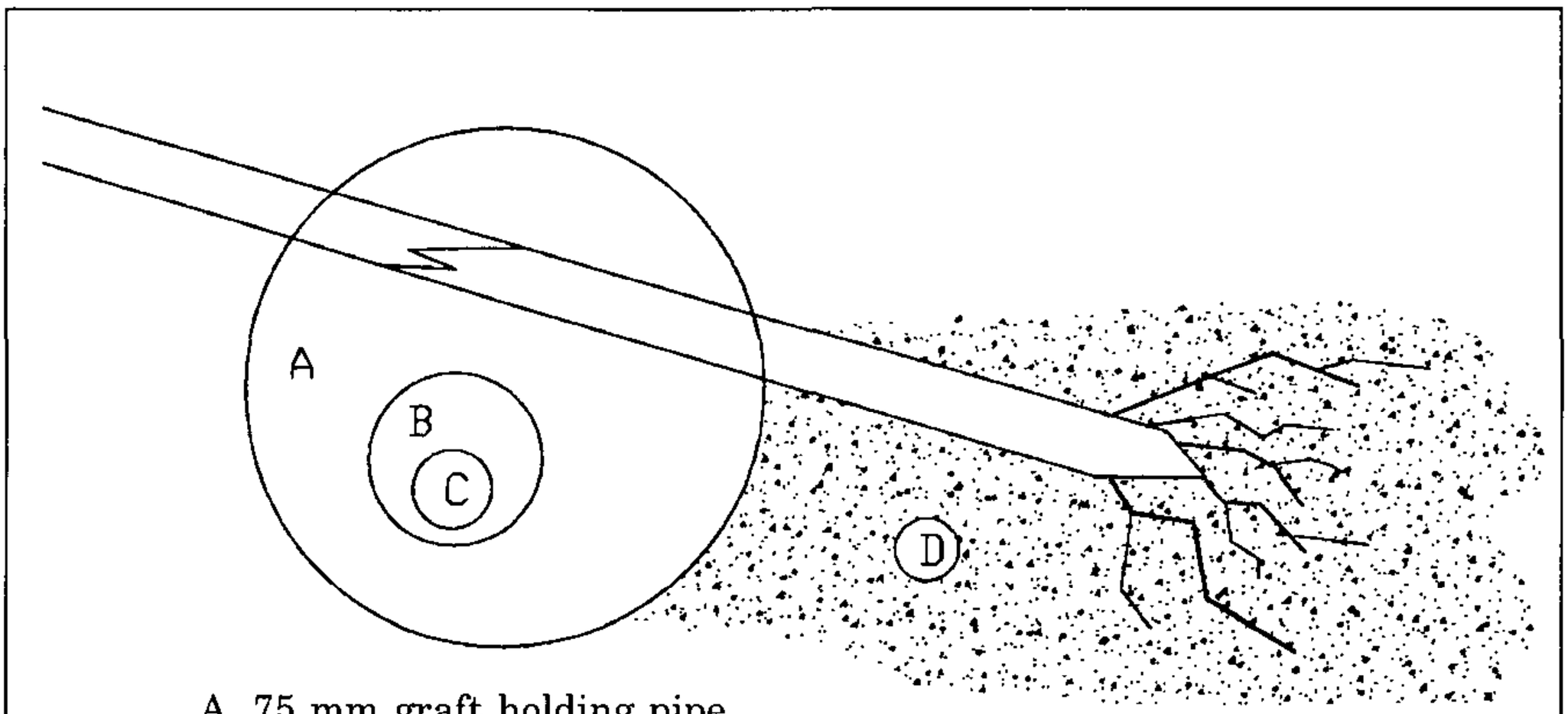
Grafting. Most forms of grafting would be suitable and we have used whip, whip and tongue, and side veneer with varying success including use with various grafting machines. Whip and tongue is our preferred method because it enables the matching of unequal sizes of rootstock and scion. This is an especially significant consideration with *Betula* and *Fagus* as it is preferential to use large well rooted (often transplanted) rootstocks whose reserves are critical to the successful promotion of callus.

Tying materials include polythene and degradable materials such as rubber and masking tape. All grafts are dipped in a specially prepared low melting point wax, essential to avoid loss of moisture during and after hot pipe callusing.

Construction of Hot Pipes. The Mark One model used self-regulating heating cable immersed in a static water pipe. This resulted in reasonable but often unreliable results because undesirable fluctuations of temperature led to variable callus

formation. The Mark Two has been designed to prevent such problems (Fig 1).

The unit consists of three different diameter pipes. The 75-mm pipe has 25-mm slots cut to hold individual grafts in place to allow heated air to completely circulate the graft union. The 35-mm pipe contains static water to act as a radiator. The 16-mm pipe circulates hot water. The 75-mm pipe is wrapped on the lower half with 25-mm Armaflex insulation (not shown in Fig. 1).



A. 75 mm graft holding pipe
B. 35 mm static water pipe
C. 16 mm circulating hot water pipe.
D. Moist peat for roots

Figure 1. Hot pipe profile.

The heating system provides circulating hot water the temperature of which is controlled precisely using a mixing valve. The water temperature on leaving the oil fired boiler is 75C. This is reduced by the port mixing valve to 10C above the required air temperature at the time, being the estimated heat loss of the system. A return valve sensor monitors the returning water temperature allowing for fluctuations in the ambient temperature of the building.

A 40,000 BTU boiler operates a 160-m pipe run allowing 3800 grafts per batch. Heating cost is low at an estimated 75 gal of oil per season for four batches.

Batch Timing. The use of a coldstore allows batches to be callused irrespective of seasonal restrictions and the pipe itself is housed in an old coldstore to reduce ambient temperatures to approximately 5C when necessary to cool the rootstock and scion. However, in keeping with the natural order of leaf emergence the earlier bud developers are callused first. We run our batches in the following order:*Corylus, Betula, Carpinus, Aesculus, Quercus, Fagus,* and *Juglans*.

Temperatures and Duration. It has taken various experiments to determine the correct temperature and length of time that certain species prefer. The following general observations have been made.

- Maximum temperature thresholds are critical and variable according to subject.
- If callus is not produced within 3 weeks grafts deteriorate quickly.

- Roots must be kept moist with a suitable mulch at all times.
- Minimum 8-mm preferably 10-mm calibre rootstocks should be used. No pretreatment, such as drying off, is necessary.
- Some development of suckers or lower buds of grafts during the latter part of callusing is not harmful provided grafts are potted and retained in a frost-free growing area.
- Early batches of grafts, i.e. *Corylus* and *Betula*, can be safely cold-stored prior to potting or after callusing.
- Whip and tongue grafting has been the most successful with equal success using side veneer on *Betula* but not on other subjects.
- Experience will determine the minimum amount of callus necessary, however, some subjects naturally produce more than others.

The list below gives the optimum times and temperatures for each subject. Degrees of callus do not necessarily reflect the best results.

	Days	Temperature	Take (%)	Callus
Aesculus	21	80	95-99	Average
Betula	18	75	85-95	Average
Carpinus	16	70	95-99	High
Corylus	14	65	95-99	High
Fagus	21	75	75-85	Average
Juglans	21	75	55-75	Low
Quercus	17	75	95-99	Average

AFTER-CARE

Batches that are callused before 1 February are coldstored after callusing to delay growth. After this date all batches are immediately potted up and held in a frost-free structure to develop slowly. The first 3 to 4 weeks growth is the most critical after which they generally grow rapidly with little problem.

LITERATURE CITED

Strametz, J.R. 1983. Hot-callus grafting of filbert trees. Comb. Proc. Intl. Plant Prop. Soc. 33:52.