TOP FRUIT CULTIVARS ON THEIR OWN ROOTS

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At Long Ashton Research Station we have become interested in growing top fruit cultivars on their own roots for two main reasons:

(a) Highly intensive systems of plantings such as the "meadow" orchard use of up to 30,000 trees per acre and, if such a system is to be economically viable, then the cost of establishment must be reduced.

(b) It has recently been found that many of the apple rootstock cultivars in use produce heavy crops of apples suitable for use by the cider industry. A project is at present screening fruits from rootstocks for their juice characteristics and there has been much interest from the major cider companies, who have been quick to realise the potential savings from growing trees that do not require budding or grafting.

Several techniques have been used to obtain cultivars on their own roots:

Layerbed technique. Seeds of the apomictic *Malus toringoides* collected in autumn and stratified in cold storage were sown under glass to obtain strong seedlings. The following summer the seedlings were established in the open 2 feet apart in rows. The following March, 'Cox's Orange Pippin' was grafted onto the seedlings and the resultant shoots allowed to grow for 1 year before layering in the normal fashion. The shoots from the layered material were earthed up on three occasions during the growing season.

Because the shoots from the *M. toringoides* stock can be easily identified, rogueing of the layerbeds is a simple matter. Shoots of clonal rootstocks can prove difficult to rogue out and, if left until after leaf fall, prove almost impossible to identify.

Rooting is lower than expected in clonal rootstock layerbeds but has been giving 62% over the last 4 years. Unrooted shoots have been used successfully as hardwood cuttings where the etiolated stems have proved easier to root.

Rooting of some stoolbeds has been increased by using softwood sawdust to earth up the stoolbeds.

Softwood cuttings under mist. Several research workers have attempted to root apple and pear cultivars from softwood cuttings under mist. Although cherry and peach cultivars have rooted with

differing degrees of success, very little success has been claimed on apples and pears. The cuttings tend to callus within a matter of days and look very promising, then the leaves drop off after about 2 weeks, and the cuttings collapse.

This technique may receive more attention over the next few years as it is felt that the greater range of root promoting substances and fungicides available today could lead to better results.

Root cuttings. This technique has received considerable attention in the past at Nottingham University, where it has been used to bulk up new breeding lines of raspberries. More recently Wye College has been producing self-rooted apple cultivars using roots from trees raised from hardwood cuttings.

At Long Ashton we were able to obtain roots of 'Cox's Orange Pippin' from trees that had scion-rooted naturally in an orchard belonging to one of our members. Our first attempts at the technique were not successful. Whereas the root cuttings produced a proliferation of shoots it proved difficult to root the shoots under mist. Temperature and time of taking root cuttings has been shown to vary according to cultivar.

We have achieved considerable success by giving treatment to the shoots whilst still attached to the root cutting. We aim to repeat the treatment again this season before giving any recommendations.

Irradiation. For several years we have been interested in obtaining mutations of our commercial top fruit cultivars by treatment with gamma rays. Visitors to the Research Station see some of the compact forms of cultivars such as 'Bramley's Seedling'' and 'Cox's Orange Pippin' obtained by this technique. We are at present screening material from such mutations for their rooting performance as hardwood cuttings.

Direct irradiation of softwood and hardwood cuttings prior to insertion in a rooting medium has proved beneficial in some species such as *Populus*, *Salix*, *Hebe* and *Escallonia* and work is underway at present to discover whether top fruit cultivars will respond in a similar manner.

Tissue culture. Tissue culture has become a widely used research technique for rapid propagation and for production of virus-tested material.

There are facilities at Twyford Laboratories where tissue culture is used on a commercial scale for the propagation of orchids and other ornamentals.

Little success has been reported in the use of this technique on top fruit cultivars, although two years ago I saw plants of cherry, plum and apple rootstock raised from meristems growing in Belgium and research workers in Angers, France, claim to have rooted apple material.

At Long Ashton tissue culture research is being continued but in general woody plants such as apples and pears prove very difficult to root. More promising lines of research are the use of juvenile shoots and pollen culture.

Hardwood cuttings. The technique of propagation by hardwood cuttings is well known and papers have been presented at previous I.P.P.S. Conferences by Dr. B.H. Howard of East Malling Research Station and Mr. D.N. Whalley of Glasshouse Crops Research Institute.

I wish to outline some of our experiences at Long Ashton Research Station and give some indication of the way we are progressing. We have mother trees of over 250 virus-tested cultivars of apples and pears suitable as a source of hardwood cutting material. We have screened many of the more interesting cultivars for their response to the East Malling Cutting Bin technique: i.e.,

> Apple hardwood cuttings 24'' long are given a basal dip of 2500 ppm IBA and are inserted into heated bins for a period of 4-5 weeks at 20°C. The majority of apple and pear cultivars do not root given this treatment, but if given a total of 8-10 weeks at 20°C, some cultivars have given over 40% rooting: e.g.,

'Blenheim Orange'	'Egremont Russet'
'Cox's Orange Pippin'	'Rosemary Russet'
'Golden Delicious'	'Ingrid Marie'
'Cheddar Cross'	'Winston'

It has been found that foliar application of SADH (B-Nine) during the growing season has increased the rooting of 'Cox's Orange Pippin,' 'Golden Delicious' and 'Egremont Russet' by up to 80%. Further experiments should enable us to obtain the correct concentration and timing to obtain maximum results.

Because apple and pear cultivars do not respond readily to this technique we have taken a new look at the rooting medium, temperature, root promoting substances and establishment techniques. We have found that cultivars differ widely in their requirements; conditions under which 'MM 106' will give over 90% rooting are not those that give optimum results with 'Cox's Orange Pippin'. Other cultivars have individual requirements; e.g., 'Cox's Orange Pippin' roots more readily at 25°C than at the more conventional 20°C.

Over 18 different phenolic compounds have been screened for their properties as root promoting substances and several cytokinins have given rooting increases of between 5% and 20%.

Because of the requirements of a longer period at higher temperatures we do not consider the standard 1 to 1 mix of peat and coarse sand suitable for rooting scion cultivars. We have ex-

perimented with several new mixtures and have obtained some interesting results from incorporating polystyrene granules into the rooting medium.

For three years now we have obtained more accurate control of temperature in the rooting medium by using thermistor probes connected to a proportional temperature controller instead of the thermostat rods more conventionally used.

Poor establishment in the field has been overcome by the use of anti-dessicants and rooting directly into containers such as Nisula rolls. We have been encouraged by the performance of scion cultivars on their own roots planted at Long Ashton. The trees have proved comparable to those worked on 'MM 106' and respond well to growth regulants such as SADH (B-Nine).

We have not ignored the fact that in our search for a cheaper fruit tree the answer may well lie in reducing costs associated with conventional tree production. We have designed our own Bench Grafting Machine and Stoolbed Earthing-Up Machine, which reduce costs considerably.

In a report recently published by Mr. C.J. Patt of Bath University it is stated that . . . "the costs directly attributable to production (of Maiden fruit trees) amount to less than 25% of the wholesale price currently asked". If this is true then perhaps we need look no further than improved nursery management and costings to obtain cheaper planting material.

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