NURSERY PRACTICE IN RELATION TO THE CARBOHYDRATE RESOURCES OF LEAFLESS HARDWOOD CUTTINGS

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Hardwood cutting technique. The hardwood cutting technique, as developed at East Malling Research Station, essentially consists of rooting leafless shoot cuttings by applying a synthetic auxin to their bases and placing them in covered bins containing a peat-grit compost where their bases are warmed by heating cables (3). After rooting, the cuttings are transferred to the nursery where shoot growth commences in the following spring; they are dependent on stored carbohydrates until the new leaves produce carbohydrates surplus to their own requirements. If the cuttings do not have adequate carbohydrate reserves to carry them over until this occurs they will die. Experiments investigating this aspect are discussed in this paper.

Problems of clonal and season rooting difference. A period of 4 weeks in heated bins with a basal temperature of 21°C has been recommended to obtain rooting in apple hardwood cuttings (5), but not all rootstocks root with equal facility (3), and rooting may fluctuate depending on when they were collected, being poor in mid-winter (2).

Effect of extended exposure to basal heat on carbohydrate and establishment levels. Improving rooting by extending the period of bottom heat has had varying effects on subsequent establishment (4). In these experiments extending the duration of exposure to basal heat from 4 to 8 weeks increased the rooting percentage of M.25 apple rootstock cuttings collected in mid-winter. However, the proportion of the initial carbohydrate left in the cuttings at the time of planting out in the nursery was significantly lower in the cuttings which had remained in the heated bins over the longer period, and this was correlated with a significantly lower level of establishment than with those heated for 4 weeks (Fig. 1).

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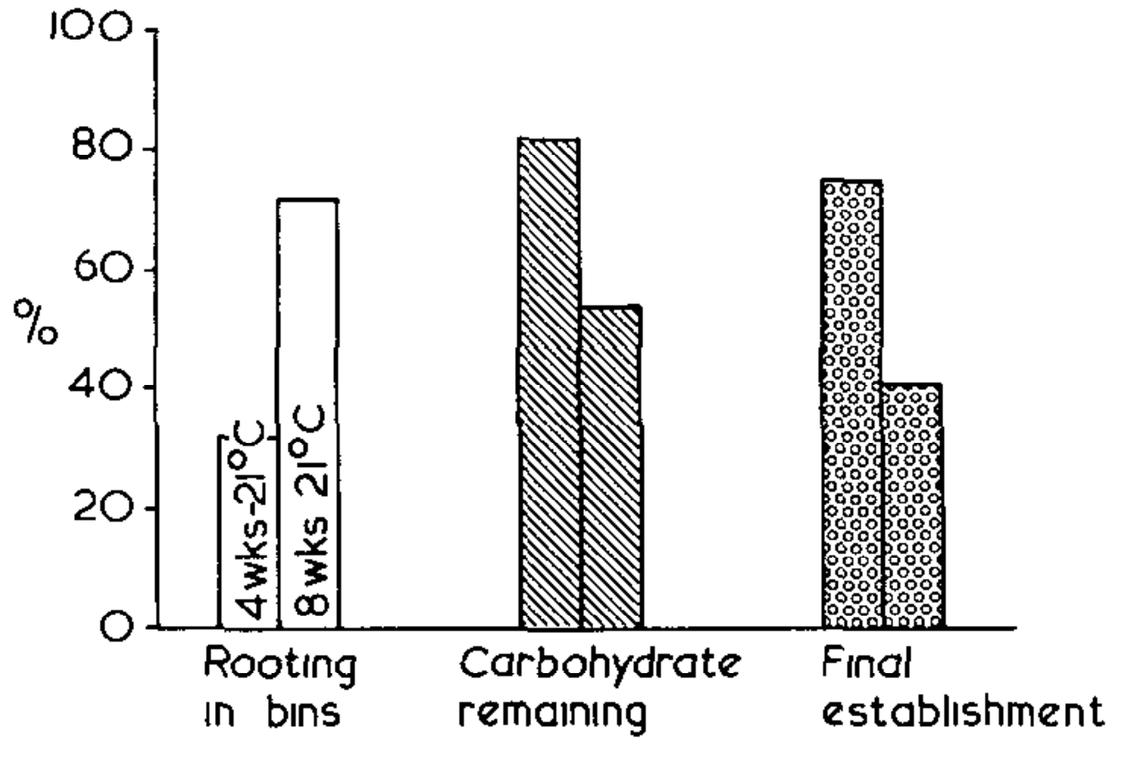

Figure 1. Relationship between rooting, carbohydrate content and establishment of M25 cuttings.

Effect of premature bud activity during root induction upon carbohydrate content and establishment. It has been shown that carbohydrate levels in one-year-old stoolbed shoots decrease during bud break in the spring (7). Prolonged periods in the heated bins can cause buds to resume active growth and this might be expected to further deplete carbohydrate reserves of hardwood cuttings and affect establishment. To investigate this, cuttings of M.25 and M.26 rootstocks were collected in either autumn, mid-winter or early spring, of the 1972-1973 propagation season, treated with auxin and placed in the heated bins at a basal temperature of 21°C. To stimulate shoot growth the air temperature above the compost was raised from 4.5°C to 14.5°C. Cuttings in the mid-winter and early spring samples had experienced sufficient winter chilling for their buds to resume active growth which was associated with large decreases in carbohydrate levels during root induction compared to autumn cuttings. Although the new shoots were removed before planting in the nursery to minimise the dangers of desiccation, the final levels of establishment were exceedingly low where active buds had been present, as shown for M.25 (Fig. 2).

A similar situation was encountered in the 1973-1974 propagation season with hardwood cuttings which had been held in cold storage at 3°C prior to root induction. The cold-stored cuttings were treated with auxin and placed in the heated bins for 8 weeks, again using a basal temperature of 21°C but with the normal air temperature of 4.5°C. Cold storage of cuttings before or after root stimulation has been shown to be a viable technique for apple, plum and quince rootstocks (6), but bud activity occurred in cuttings given 8 weeks cold storage, and more so in cuttings which had been cold-stored for 16 weeks. As before, the occurrence of bud activity was associated with subsequent low levels of establishment (Fig. 3). These results are similar to those reported following the use of pre-rooting cold storage of pear cuttings (1).

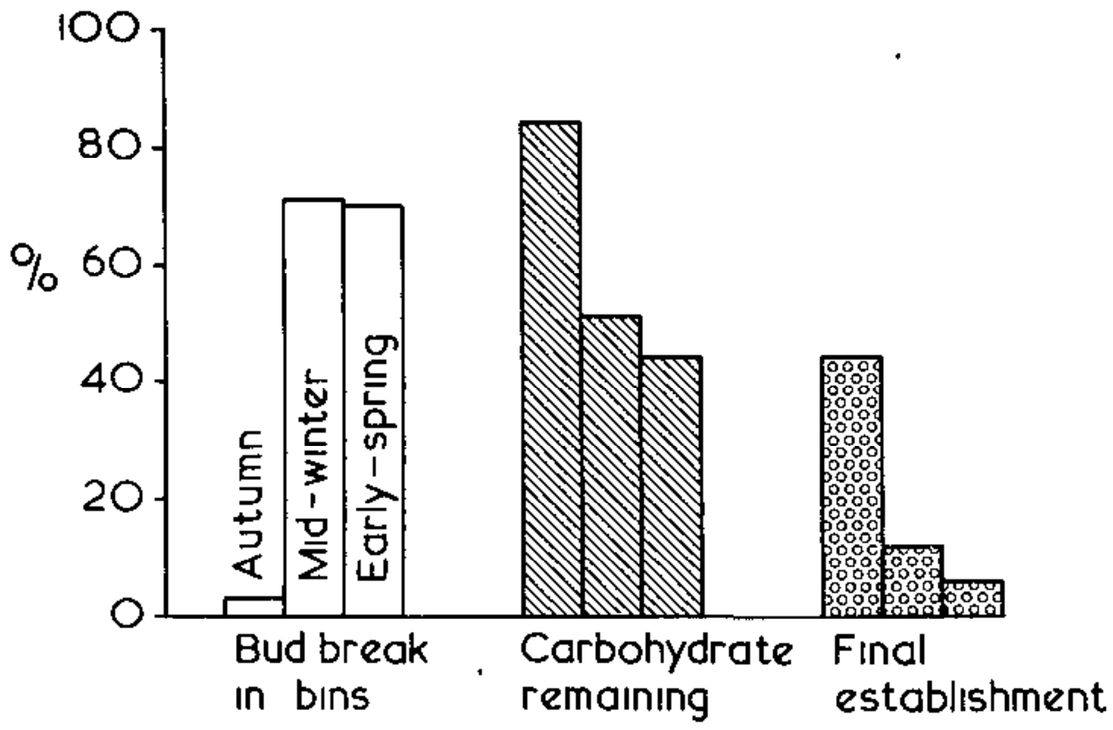

Figure 2. Effect of premature bud break and growth in autumn, winter and spring-collected M25 cuttings.

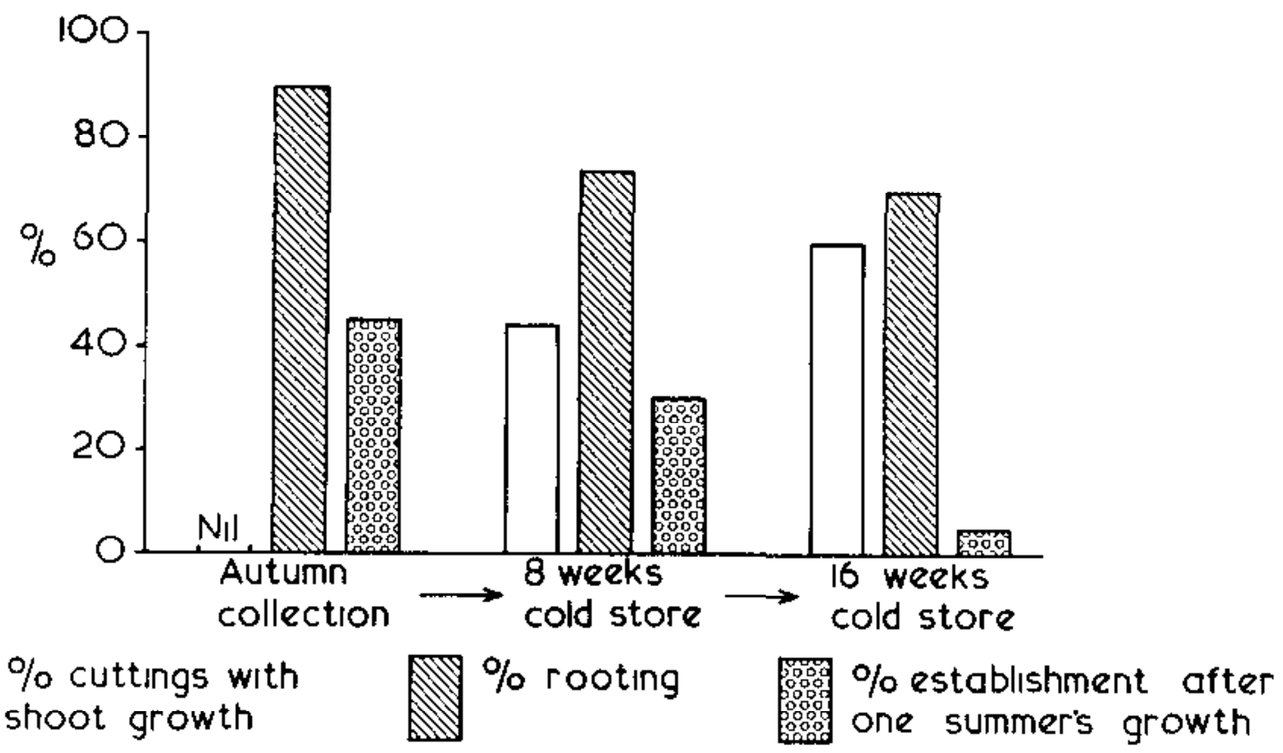

Figure 3. The effect of premature bud break and shoot growth following cold storage of M25 cuttings.

Discussion. Rooting of hardwood cuttings in heated bins clearly causes a depletion of stored carbohydrate reserves. The use of extended periods of basal heat improved the visible level of root production but also increased carbohydrate depletion, which in turn was associated with reduced establishment. It has been demonstrated that high levels of establishment can be obtained after relatively short periods of bottom heat (Howard unpublished) and it would therefore seem preferable to provide only sufficient stimulation to encourage root initiation and *limited* visible root production in the heated bins. When the propagator is satisfied that his conditions are conducive to survival and rooting, two weeks in the heated bins giving a few rooted and many well callused cuttings should prove satisfactory for the handling of subjects which have been shown to respond well to the hardwood cutting technique.

There is a clear need to avoid premature bud activity in the heated bins as shoot growth appeared to create a significant additional drain on carbohydrate reserves. Further, the carbohydrate utilized in shoot growth was totally lost because new shoots were

removed to minimise initial water losses in the nursery, and the low levels of establishment that ensued indicated that insufficient reserves remained to support any renewal of growth.

Recommendations. (1) Cutting collections should be timed to coincide with periods of most rapid rooting, so as to minimise exposure to basal heat and still obtain satisfactory stimulation. For many subjects this is generally towards the end of the winter rest period, i.e. February (3, 8).

(2) To minimise bud activity during rooting, the air temperature around the buds must be kept cool, either by siting the bins in a nursery stock cold store, or in a ventilated north-facing building.

(3) If cuttings must be left for longer than 2 weeks in the heated bins due to pressure upon labor, nursery space, or because of unsuitable soil conditions, the basal temperature should be lowered from 21℃ to 10℃.

(4) There is insufficient experience of cold storage for hardwood cuttings for it to be recommended other than on a trial basis, but nurserymen wishing to use it as an alternative to prolonged periods in heated bins should ensure that buds are restrained from active growth until planting in the nursery (see recommendation No. 2).

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