PROSPECTS FOR THE WIDER USE OF CLONAL ROOTSTOCKS FOR DECIDUOUS ORNAMENTAL TREES

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Trees of cultivars whose cuttings cannot be rooted, or which grow poorly on their own roots, are commonly grafted onto seedlings of the same or a related species. This doubtless contributes to the variable bud-take and tree growth experienced in many nurseries.

Sixty years of research into the use of clonal rootstocks for fruit trees has shown how they influence many important tree characters, of which tree size has been studied more than any other. It has been suggested, largely on the basis of observation, that rootstock influence extends to at least 53 genera of woody plants (9). Clonal rootstock attributes of particular interest to nurserymen include the following:

1. Uniform and rapid plant establishment associated with a fibrous root system.
2. High level of bud-take based on specific compatibility tests.
3. Uniform growth because all the stocks are of the same genetic make-up.
4. Known performance in relation to soil-borne diseases.

These important advantages noted for fruit must be considered in the context of raising ornamental trees.

Clonal rootstocks must be propagated vegetatively, preferably by cuttings. Therefore, the nurseryman is faced with a new job because, previously, seedling rootstocks were probably purchased from a specialist raiser. Although many plants are propagated from cuttings in the everyday work of nurseries, the dependence of the future tree nursery on the success of the rootstock raising stage makes it doubly important to carry out this work with technical precision and good management. Most cuttings will need to be grown-on for one season before lining-out, so transferring the requirement for land and management from the seedling raiser to the general nurseryman. These specialized requirements may lead to those specializing in clonal rootstocks supplying other nurserymen in the future.

A good stand of clonal rootstocks growing well when budded will lead to a full crop of uniform trees with maximum return on investment in land, labor, agrochemicals and fuel. In addition to these visible improvements, the selection of clones resistant to important diseases such as verticillium wilt would

remove a serious constraint on land use, and lead to increased productivity. Resistance to the fungus causing specific replant disease in cherries and plums has been found in easy-to-propagate hybrid cherry clones (8).

But will the consumer want trees of identical shape and size, however well grown? In many cases not, especially in the landscaping context, but relatively few grafted trees are used for this purpose. It is in the production of standard trees of named cultivars that quality and uniformity are required especially when precise grades are stipulated in tender documents by public authorities. It is in this area that clonal rootstocks will make their impact.

Fruit-related species. Because of the very specific role projected for clonal rootstocks in ornamental tree production and the limit to available R and D resources it is very important to identify clearly those species most suitable for this approach. Immediate progress can be made with fruit-related species where clonal rootstocks for apple, cherry and plum are available.

Their limited use to date is probably determined by the higher price commanded by clonal stocks compared to seedlings, which is controlled by the closely matched supply and demand situation in fruit tree nurseries. Nurserymen raising flowering cherries and crabapples should reflect that fruit nurserymen justify a cost of about 20p per rootstock against a finished tree price of 120p after a two-year cropping cycle. Such an initial cost would seem more than justified for ornamental trees when the final tree price may be double or triple that of a maiden fruit tree and where the land is occupied for twice the time. The opportunity to clear the land completely rather than to allow the poorer plants to remain for a further year is a significant factor in itself.

Ornamental cherries can now be produced on the freerooting 'Colt' rootstock (*Prunus avium* × *P. pseudocerasus*). A clone (No. 17, now named 'Cob'), almost as easily propagated as 'Colt', has produced trees with particularly thick trunks and good blossom characteristics (Table 1).

It was particularly interesting when comparing a range of interspecific hybrid cherry rootstocks that a statistically significant correlation was obtained between the growth habit of the unworked rootstocks in the nursery and the shape of a common scion worked on them (5). Such influence on tree form might be best exploited in the production of ornamental trees where street or open space planting dictates to a large extent the shapes and hence the cultivars that can be used.

Table 1 Rootstock effects on growth and flowering of Ukon.

Rootstock		Girths (cm) at 15 cm above union		
		Maiden year	Year 2	Year 3
P. avium × *P. pseudocerasus*	No 17	6.0	9.1	13.5
	No 22	5.4	8.0	11.5
	No 38	5.2	7.7	11.9
P. avium × *P. incisa*	No 57	4.8	6.5	9.9
P. avium	1/227	5.0	6.3	9.1
P. avium	4/122	5.0	6.5	9.9
P. avium	F12/1	5.3	6.7	9.6
		Blossom on scale 1 (low) to 9 (high)		
		Year 4	Year 5	Year 6
P. avium × *P. pseudocerasus*	No 17	7.4	7.4	7.4
	No 22	4.8	5.4	5.0
	No 38	5.0	5.8	5.2
P. avium × *P. incisa*	No 57	1.8	3.2	2.8
P. avium	1/227	1.0	2.0	1.8
P. avium	4/122	1.6	3.4	2.6
P. avium	F12/1	2.4	2.6	2.8

Those concerned with the testing and development of hybrid rootstocks derived from *P. pseudocerasus* have always been conscious of the winter cold sensitivity of the species and the fact that this is present in different degrees among hybrids with *P. avium*. While the exceptionally cold weather at the end of January, 1972, (in contrast to an otherwise mild winter) damaged some young nursery plants including these experimental cherry rootstocks (7), experience of a range of winter conditions subsequently suggests that there is little cause for concern.

A valid reason for not using clonal rootstocks in the past was that most ornamental crabs, including *Malus* 'Aldenhamensis', *M. floribunda*, *M.* 'Profusion', *M.* 'Purple Wave', *M. sargentii* and *M. tschonskii* were shown to be sensitive to latent virus infection in the clonal stocks which caused bud failure and poor growth (2), an effect absent in fruiting cultivars of apple.

Fifteen years ago sources free from all known viruses were being produced and these now form the basis of current apple rootstock production. A scheme exists to minimize reinfection (3) involving isolation of stock beds, confirmation of trueness-to-type and occasional monitoring of their health status. Results indicate that natural spread of infection is not a hazard in apple. There is, therefore, no reason why ornamental nurserymen should not exploit the range of vigor control to produce trees suitable for patios, gardens and park situations. Growth of ornamental crabs on a range of clonal rootstocks is now being examined (Preston, pers. comm.) and impressively uniform stands of *Malus* 'Aldenhamensis', *M. floribunda*, *M.* 'Golden Hornet' and *M.* 'Hillieri' on clonal rootstocks can be seen in modern fruit nurseries where they are raised for use as pollinators in orchards.

In plums it is particularly important that clonal rootstocks are obtained from reliable sources in the UK because of the greater likelihood of imported plants originating in Continental Europe carrying the dangerous plum pox virus. Although this aphid-borne virus has been found in the UK, frequent inspection of nurseries linked with a rapid detection technique (1) affords good prospects of containment.

Ornamental species. While advantage can be taken of ongoing fruit work for related ornamentals there is no similar spring-board to facilitate the introduction of clonal rootstocks for the majority of ornamental tree species. Neither is the objective likely to be met by controlled breeding as carried out by the fruit rootstock breeder, because resources are so limited and the task so enormous for ornamentals. Here it is necessary to search for rooting, compatibility, disease resistance and other desirable characters among the natural seedling populations raised for rootstocks, each additional character greatly increasing the work necessary. Preliminary investigations of mixed populations of cuttings suggest that some species will yield worthwhile results readily, while others await improved propagation techniques before progress can be made (Table 2).

Table 2. Rooting percentages of hardwood cuttings bulked from heterogenous seedling populations.

	percentage		percentage
Sorbus intermedia	100	*Alnus cordata*	45
Tilia cordata	95	*Acer platanoides*	31
Acer campestre	90	*Acer pseudoplatanus*	25
Tilia × *vulgaris*		*Sorbus aria*	5
(Syn.: *T. europaea*)	82	*Tilia* × *euchlora*	2
Tilia americana	63	*Quercus rubra*	0
Tilia platyphyllos 'Rubra'	48		

Species which readily form natural hybrids such as *Tilia* × *vulgaris* (*T. cordata* × *T. platyphyllos*) clearly offer the prospects of compatability with a range of important cultivars, such as *T. platyphyllos 'Rubra'* and *T.* × *euchlora* (*T. cordata* × *T. dasystyla*), if rooting can be achieved and clonal rootstocks raised. A species such as *T. cordata* is clearly a source of potential rootstocks for *T.* × *euchlora* which is difficult itself to root (Table 2).

Considerable variation in rooting ability and cutting production has been reported among bushes raised from a small population of seedlings (6). This work has been extended to *T.* × *vulgaris* and rootstocks raised by hardwood cuttings to produce clones of both species. The first budding trials show high levels of bud-take (Table 3) and uniform production of maiden *T.* × *euchlora* trees.

Table 3. Bud-take of *T.* × *euchlora* on clones derived from seedlings of *T.* × *vulgaris* and *T. cordata* (percent).

		Clone	2	3	5	6	7	8	11
T. × *vulgaris*	Maidens growing		13	2	6	20	8	6	4
	Rootstocks budded		14	3	6	23	8	6	4
		Clone	13	16	22	23			
T. cordata	Maidens growing		6	11	11	13			
	Rootstocks budded		6	11	18	13			

No attempt has been made yet to maximize establishment of cuttings by modifying the propagation technique that was developed for fruit rootstocks. Marked year-to-year differences exist which need investigating, but data suggest that there is an inverse relationship between the extent to which cuttings of some clones develop roots while being stimulated in heated bins and their subsequent field establishment (Table 4) in accordance with experience of apple rootstocks (4).

Table 4. Relationship between percent rooting in heated bins (4 year's data arranged in ascending order) and percent establishment of *T.* × *vulgaris*.

Clone 6	Rooting	3	67	96	100
	Establishment	77	62	29	3
Clone 7	Rooting	15	61	90	100
	Establishment	46	44	10	16
Clone 8	Rooting	0	56	97	100
	Establishment	60	39	24	38

CONCLUSION

Opportunity exists to exploit apple and cherry clonal rootstocks to produce uniformly high quality trees of ornamental cultivars. In the interests of maintaining healthy propagation material, rootstocks — particularly of plums — should be produced in the UK. First attempts to raise clonal rootstocks of *Tilia* indicate that high productivity, rooting and compatibility exists within seedling populations of two species. This provides the basis for improving the propagation technique to produce clonal rootstocks reliably.

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COMMERCIAL PROPAGATION OF FRUIT TREE ROOTSTOCKS

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This discussion considers the production of fruit tree rootstocks, the techniques that are now commercially in use, the reasons for choosing these techniques of production and applying them to individual subjects based on production costs, suitability for site, and the management of our particular nursery.

HISTORY

It has only been in the last ten years that our nursery has started to produce rootstocks. Before this we relied upon imports from the Continent, mainly because they had the ability to produce them fairly cheaply with very suitable soil for stoolbeds or layer production.

With the introduction of the EMLA Virus Free scheme from E. Malling and Long Ashton we had a health status that had never been achieved before for any plant. Realizing the value of such a status we decided to go into production ourselves, firstly to supply our own needs, which was achieved about three years ago, and since then to supply our own trade, and very recently prospects of actually exporting which must be the ultimate reward for a very successful research objective.