Stockplant Manipulation for Better Rooting and Growth From Cuttings

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QUALITY RELATED TO EASE OF PROPAGATION

Attaining a plant of large saleable size as quickly as possible is the main objective of commercial nursery stock production, with due attention to shape in terms of branching and compactness, and the development of flower buds if appropriate for the variety. Batch uniformity should be high, and production methods must be cost-effective.

These objectives are undermined if a plant is difficult to propagate. Easy-to-root cuttings suffer least if the propagation environment is less than optimal, and well-rooted cuttings establish and harden with minimal difficulty, and grow-on to produce uniform batches of plants. On the other hand, cuttings of difficult-to-propagate plants may fail to survive, or may root only poorly. Subsequent weaning is difficult and the growth of those plants which reach the container will be variable, reflecting variation in root development. Initial propagation success is, therefore, an essential component of high quality production.

STOCKPLANTS

Cuttings are very sensitive to environmental conditions that affect transpiration (Harrison-Murray et al., 1988) and it is likely that most commercial facilities are in fact sub-optimal for many varieties of cutting. Furthermore, there is not always the opportunity to handle cuttings in the most effective way during peak propagation periods and so the advantages of wounding and auxin treatment are often lost, with the result that rooting is slower and possibly fewer cuttings root

It follows that cuttings should have the highest possible rooting potential when collected, so as to offset these deficiencies in handling and environments. The choice of cutting and the opportunity to manipulate rooting potential is much greater when specially grown and maintained stockplants are available than when cuttings are taken from young plants before they are sold.

Research has identified various ways in which stockplants can be made to produce cuttings with increased rooting potential, and a theme common to them all is that improved rooting is associated with the production of shoots with relatively thin stems.

STOCKPLANTS FROM MICROPROPAGATION

For some species, field- or container-grown stockplants raised from a micropropagated source produce cuttings which root faster and in greater numbers than those from conventional sources (Howard and Marks, 1989). Further studies with the dwarfing plum rootstock *Prunus insititia* 'Pixy' have shown that micropropagated stockplants produce a higher proportion of thin-stemmed hardwood cuttings than conventional stockplants (Howard and Ridout, 1991b). Comparisons between sources is enhanced by also taking account of shoot length, and it is cuttings prepared from the proximal parts of relatively long thin shoots that root better than those from relatively short thick shoots This relationship between shoot morphology and rooting is relatively weak when comparing different sources, partly because their ratios of shoot thickness to shoot length may differ, but it is much stronger when comparing shoots within a source, where the shoot diameter : length ratio is relatively constant.

WITHIN-PLANT DIFFERENCES

Shoots from hedged stockplants of *P insititia* 'Pixy' show a strong inverse correlation between stem thickness and rooting ability, whereby thin shoots root best (Table 1).

Table 1. Rooting of *Prunus insititia* 'Pixy' hardwood cuttings related to their basal diameter

	Diameter (mm)			
	< 6	6 - 8	8 -10	> 10
Rooting (%)[1]	58	44	30	13
Number of roots per rooted cutting	6 1	4 1	3 2	2 1

[1] For rooting (%) P<.001; root number P< 01

This relationship was only revealed by improving propagation conditions, because in overwet compost thin cuttings were particularly vulnerable to asphyxiation and rotting (Howard and Ridout, 1991a). In the same experiments (Howard and Ridout, 1991b) it was shown that the superior rooting of cuttings taken from the lower region of the stockplant compared to those from the crown was correlated with a lower stem diameter (mm) : length (m) ratio. An increase in ratio from 5.9 (relatively long thin shoots) to 7.4 (relatively short thick shoots) was associated with a reduction in rooting from 87% for lower cuttings to 47% for crown cuttings

The benefit of relatively long thin stems extends to other species. Cuttings of *Rhododendron* 'Dopey' and 'Hoppy' which rooted in dry fog had a 28% smaller stem diameter : length ratio than those which failed to root.

Preconditioning Stockplants in the Dark. So-called etiolation treatments, where stockplants are prevented from receiving light, or are exposed only to very low light intensities, often improve rooting of subsequent cuttings (Maynard and Bassuk, 1988). The enhanced rooting potential is present both in the stem which grew in the dark, and the more distal part that grew during the period that the stockplants were being weaned into full light before propagation. Recent experiments with softwood cuttings of *Syringa vulgaris* 'Madame Lemoine' (Howard and Ridout, 1992) show that shoots produced in the dark have relatively thinner stems and root more readily than light-grown shoots. In the case of these softwood cuttings, we have some insight into the reasons why rooting is improved in the thin stems.

At collection, cuttings from dark pre-treatments have a similar number and area of leaves to those from normal light-grown plants, so the relatively thinner stems of the former result in a greatly increased leaf area : stem ratio. This holds good when the stem is described in various ways, including diameter, dry weight and fresh weight.

During the period of about 10 days between sticking the cuttings and the emergence of the first roots, the dark-preconditioned cuttings with high leaf.stem ratio greatly increase in dry-matter content at the base of the stem where roots will emerge— the stems of light-grown shoots, often lose weight (Table 2).

Table 2. Changes in shoot morphology and dry matter accumulation related to rooting in *Syringa vulgaris* 'Madame Lemoine' softwood cuttings

	Normal light-grown	Dark preconditioned	Level of significant difference (p)
Proximal stem diameter (mm)	3 7	3 1	< 001
Stem dry weight (g)	0 43	0 21	< 01
Ratio of leaf area (cm²) to stem dry weight (g)	205	442	< 01
Rooting (%)	16	74	< 001
Number of roots per rooted cutting	1 1	5 2	< 01
Length of longest root (cm)	0 5	2 1	< 001
Change in dry weight of proximal stem before rooting (%)	-11 4	+14 5	< 001

In unrooted cuttings, dry matter increase closely reflects the accumulation of carbohydrates, and the interpretation of these results is that carbohydrates surplus to the requirement for stem maintenance (which is likely to be relatively lower in the thin-stemmed cuttings) are available to drive the rooting process.

Implications for Nurserymen. Permanent stockplants provide the opportunity to increase rooting potential in shoots before they are collected as cuttings. Hard pruning gives rise to many shoots suitable for cuttings, but their high rooting potential is not due to their enhanced vigour, as has long been supposed, because these experiments show that weaker shoots root better than more vigorous ones.

The advantage of using relatively thin shoots for both hardwood and softwood cuttings only became obvious when the propagation environment was improved For hardwood cuttings sand beds were installed below the rooting medium to rapidly remove excess water after irrigation and so prevent basal rotting, to which thin cuttings were particularly susceptible When planting directly into the field, a compromise needs to be made between the thinner cuttings which root quickly and the thicker ones which survive longer in the poor conditions often present in soil during winter.

The advantage of thin stems to facilitate rooting in softwood cuttings can be obtained by temporarily growing stockplants in the dark, but it also extends beyond the use of dark preconditioning, because, as with hardwood cuttings, the smaller, thinner stemmed cuttings in any source rooted better than thicker ones Here also the environment was important because conditions had to be conducive to the accumulation of photosynthates. In these experiments this was achieved using 'wet fog', which allowed cuttings to receive approximately 20% available light without being stressed

LITERATURE CITED

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