Formerly we used to wax spruces and quite a few other plants, placing them in open benches, but we find the method described here more successful. We have tried taking the scions in November-December and keeping them in plastic bags in coldstore at 4° Celsius and grafting them in March. Even if the scions looked a bit dry the results were just as good as with newly cut scions. The reason for this experiment was to avoid winter damage and also, in the case of prostrate evergreens, it can sometimes be hard to find cuttings and scions in winters where there is a lot of snow, although this has not been a problem in recent years.

Pinus: We use *Pinus mugo* as understock for all *Pinus*, including the five-needled types. The understocks are potted up in August and moved to the glasshouse in December to be ready for grafting in February. They are usually treated like *Picea* and inserted in sand, but inserting them in peat under a plastic tent with the unions uncovered has also been successful.

Pseudotsuga: These are treated exactly the same as *Pinus*.

Taxus: We graft *Taxus baccata* 'Fastigiata Aurea' and usually use *Taxus media* 'Hicksii' as the understock. They are treated in the same way as *Juniperus*, and they turn out fine when grafted in December. We also grow this cultivar by cuttings but the growth is then slower than when we graft.

IMPROVEMENT OF HARDY NURSERY STOCKS

J. B. SWEET, R. ANNE GOODALL and A. I. CAMPBELL

Long Ashton Research Station
Bristol, Somerset

Selection of plants with improved or new ornamental characters of horticultural value has been a feature of the nursery trade for many years. Nurserymen have been aware of the variation which occurs in plant material and have selected, propagated, named and sold improved cultivars and clones. However, the major attributes considered by propagators are ease of rooting and rapid growth, much less attention being paid to the eventual appearance of the plant. In consequence it is, e.g., the easiest rooting × *Cupressocyparis leylandii* clone, or the more rapid growing *Cornus alba* 'Gouchaltii' cultivar, that is chosen rather than the cultivars with the best appearance when mature.

Recently a more scientific approach to the selection of nursery stocks, coupled with an investigation of their virus diseases, has been initiated in several countries. At Long Ashton propagating material of several common trees and shrubs has

been obtained from twelve commercial nurseries and grown under standard conditions. Examination of the material revealed several causes for their variability. There was considerable misnaming of certain cultivars. For example, most nurseries were growing *Cornus alba* 'Gouchaltii' labelled as *C.alba* 'Spaethii' (Ed. note: *C. alba* 'Spaethii' = C. alba 'Aurea'). In addition there was confusion over the nomenclature of certain *Forsythia*, *Crataegus* and *Ceanothus* cultivars. There was considerable variation in the rooting of some cultivars, e.g. *Daphne* × *burkwoodii* 'Somerset,' *Syringa vulgaris* 'Souvenir de Louis Spaeth' and *Prunus cerasifera* 'Atropurpurea' (*P. pissardii*), and in the bud-take of *Acer platanoides* 'Crimson King' and *Crataegus* × *prunifolia*. In the *Acer*, *Crataegus* and *Syringa* cultivars these differences were possibly due to genetic variability within the cultivars, possibly mutations, and/or the variability of their respective seedling rootstocks.

Examination of the commonly used rootstocks has revealed tremendous variability in the seedling material, particularly in *Acer platanoides*, *Tilia platyphylla*, *Fraxinus excelsior* and *Crataegus oxyacantha* (*C. laevigata*). Not only are these variable in form and vigour but also in their degree of compatibility with the commonly propagated cultivars. Thus there is a great need for sources of more uniform seedlings or compatible clonal rootstocks that will produce the uniform runs of trees one is now accustomed to seeing in fruit tree nurseries.

Some of the subjects studied, e.g. *Sorbus aria* 'Lutescens' (*S. aria* 'Lutetiana'?) Salix *alba* 'Tristis' (Syn.: *S. vitellina* 'Pendula'), *Prunus serrulata* 'Kanzan' (= *P. serrulata* 'Kwanzan') and *Spiraea bumalda*' Anthony Waterer' appeared to be very uniform, varying little in form, vigour and ease of propagation.

VIRUS INFECTIONS

The role of viruses in reducing the quality, vigour and ease of propagation of nursery stocks is also being assessed.

Poor rooting of some *Daphne* 'Somerset' and *Prunus cerasifera* 'Atropurpurea' was directly associated with virus infection, as was the poor bud take of certain *Malus floribunda* and *Prunus serrulata* 'Kanzan' ('Kwanzan') clones. Virus tested (VT) material of these two latter species has been available to the nursery trade through the EMLA scheme (1,3) for several years. However, it is obvious that nurserymen are not using this material or are propagating VT material on infected rootstocks. A study of *Prunus avium* seedling rootstocks has revealed that up to 25% may be infected with prune dwarf virus, which causes bud failure, incompatibility and poor growth of many

ornamental *Prunus* species. It is, therefore, most important that VT scions are always propagated on VT rootstocks.

Surveys of nursery plants and soils have shown that nematode-borne viruses, particularly arabis mosaic virus, were prevalent, causing debilitating diseases in a few species, but often occurring as latent infections (2). However, symptomless infections of certain ash and lilac cultivars have been shown to significantly reduce the vigour of these plants.

Studies of the isolates of arabis mosaic virus from different hardy ornamentals have shown that they were very similar, so it seems likely that the nematode vector is capable of transmitting this virus between a wide range of plant species.

Virus infections in Rosaceous ornamentals have been examined in detail, and three fruit tree viruses, prunus necrotic ringspot (PNRSV), prune dwarf (PDV) and apple chlorotic leafspot (CLSV) have been found in several genera (4,5). CLSV is not thought to be important in species other than ornamental *Malus* (1) whereas PNRSV and PDV appear seriously to affect the propagation and growth of several *Prunus* species, and the apple mosaic strain of PNRSV has been associated with a brilliant yellow mosaic disease of *Aesculus* spp. (6). CLSV, PDV and PNRSV occur in a proportion of hedgerow hawthorn and blackthorn plants, and the significance of these plants in the epidemiology of these viruses is being assessed. PDV was found to be seed-transmitted in *Prunus avium*, and several clones from the material of *P. serrulata* and *P. cerasifera* 'Atropurpurea' (*P. pissardii*) from the nurseries examined were infected.

Plants free from readily detectable viruses could often be selected after virus-testing. However, some cultivars were wholly infected, so other methods of virus elimination were examined. Poplar, for example, was freed from poplar mosaic virus by heat therapy at 38°C, followed by excision and rooting of 1 to 2 cm shoot tips (4). Similarly *Rosa* and *Daphne* spp. were freed from rose mosaic and cucumber mosaic viruses, respectively.

More heat-stable viruses, particularly nematode-borne viruses, could not be eliminated from *Daphne* by this procedure. However, meristem excision and *in vitro* culture, preceded by heat therapy was found to be effective (5).

Experiments to determine the rate at which virus-tested material becomes infected are in progress, but preliminary results suggest that reinfection of trees and shrubs with nematode-borne viruses is slow, often taking several years in soil containing appreciable numbers of viruliferous nematodes.

Woody plants, unlike many herbaceous plants, generally do

not seem to become rapidly infected with viruses introduced by their natural vectors. Thus under normal conditions little infection is likely to occur during the short period that plants are grown on nurseries and hence nurserymen will generally benefit from the use of VT material. However, reinfection of the mother plants is likely to occur eventually so special precautions of soil sterilisation, isolation, regular testing and, if necessary, replacement are needed.

Experience so far has shown that, in general, VT material is likely to propagate better, grow more vigorously, survive transplantation and establish well. A strong, well established tree is more able to withstand the rigours of drought, waterlogging and disease and thus the benefits of VT material may well extend beyond the nursery.

The best of the clones of trees and shrubs obtained from the 12 nurseries are being virus-tested, so that the genetically superior material is also free from known viruses.

Discussions are now under way with the nurserymen and representatives from the horticultural colleges and the Ministry of Agriculture to determine the most appropriate method for making the virus-tested material of the selected clones and shrubs available to the industry.

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