Recent Research on Propagation at the Research Station for Nursery Stock, Boskoop

Bernard P.A.M. Kunneman
Boomteelt Praktijkonderzoek, Rijneveld 153, Postbus 118-2770 AC Boskoop, Nederland

INTRODUCTION

This paper gives an overview of some of the propagation research projects of the Research Station for Nursery Stock at Boskoop. There are several current research projects, this paper concentrates on the following subjects:

- Improvement of seed germination
- Propagation of *Acer platanoides*
- Propagation of nematode free perennials
- Conditions during rooting
- Rooting leafless hardwood cuttings

With cuttings, research was undertaken on CO_2 enrichment; stock plant treatments; rooting conditions of cuttings; reduction of flowering during rooting of *Pieris*; development of systems for rooting of leafless hardwood cuttings and improvement of the quality of cuttings. Use of cuttings for nematode-free production of perennials was also trialled. Tissue culture techniques were developed to propagate rootstocks for fruit trees (*Malus, Pyrus,* and *Cydonia*) and for propagation of *Acer* and *Paeonia*. The research on seeds concentrated on the effect of pretreatment conditions on dormancy breakage and viability and the effect of storage conditions of pretreated seeds on germination capacity and viability.

The most resent results of tissue culture, propagation of perennials by cuttings, rooting conditions of cuttings, and seed germination, will be presented.

IMPROVEMENT OF SEED GERMINATION

There are problems in the germination of many tree species. Firstly, seed quality is not always adequate. Secondly, seeds of several species need a period of stratification before they can germinate. This has to be carefully timed so that dormancy is released without premature germination.

Currently, research concentrates on developing treatments which result in a complete release of dormancy without premature germination. This can be obtained by controlling the moisture content of the seed and the duration of the cold temperature treatment. This treatment is done without any stratification medium. Stratification at optimum moisture content and for optimum duration results in a fast germination under a wide range of climate conditions in the field.

The effect of temperature pretreatments on germination was tested at several germination temperatures in the laboratory, in a greenhouse, and in the field.

If the humidity during stratification is too high this may induce premature germination during the dormancy breaking treatment (e.g., *Acer pseudoplatanus*). The longer the dormancy-breaking treatment (at the optimal moisture content) the wider was the range of germination temperatures resulting in good germination and the faster was the germination. So, with controlled dormancy breaking treatments, the speed and percentage of germination could be improved and the range of temperatures over which a good germination occurred was widened.

Two groups of species can be distinguished, one which requires cold stratification (e.g., *Fagus sylvatica, A. platanoides, A. pseudoplatanus, A. palmatum, Pseudotsuga menziesii, Malus sylvestris, Syringa vulgaris*, and *Berberis thunbergii*) and the other requiring a warm stratification followed by a cold stratification (e.g., *Fraxinus exelsior* and *Tilia cordata*). For each of these species the optimal stratification conditions (humidity and time) has been determined.

PROPAGATION OF MAPLES

Traditionally, *Acer* for forestry purposes is propagated from seeds. *Acer* cultivars used for street or avenue trees are budded or grafted on a seedling rootstock. However, *Verticillium* wilt is a severe disease in *Acer*. Therefore, in several countries, there is a scheme for selection of verticillium-resistant cultivars and rootstocks. However, these cultivars clearly must be propagated vegetatively. Propagation by tissue culture and propagation by leafy softwood cuttings is studied at Boskoop.

Softwood cuttings were propagated in a fog house. For good rooting, stock plants had to be juvenile and in a good growing condition. In general, shoot tip cuttings rooted better than nodal cuttings and the growth of these cuttings after rooting was better. Buds of nodal cuttings often were dormant for several months.

In tissue culture of *Acer*, initialising aseptic cultures is a problem. Several species and clones are internally contaminated with fungi and bacteria. One of the major objectives of current research is to reduce contamination. This has been achieved by hot-water treatments of the plant material before starting the culture and trials have been conducted to determine optimal hot water temperature and duration of the treatment. The results with several cultivars of *A. pseudoplatanus* (sycamore maple) and with other *Acer* species were similar but the levels of hot water damage to the tissue and the efficacy in reducing of contamination were cultivar specific.

After initiation, propagation in tissue culture is rather slow but rooting is easy. The rooted plants can be weaned and used as stock plants for propagation by cuttings. In collaboration with the CPRO-DLO institute in Wageningen, the techniques described here are being used to build up stocks of verticillium-resistant clones of rootstocks.

PROPAGATION OF NEMATODE-FREE PERENNIALS

Nematodes are responsible for severe losses in the commercial production of perennials and a wide range of species can be infected. In some species the main problems are caused by leaf and stem nematodes, in other species root nematodes are more important. Nematode infestation reduces growth and quality of the plants and nematodes can act as virus vectors.

The objective of this project is to develop a system of propagation and production of perennials to reduce nematode infestation. To keep the system clean it is essential to start with healthy plant material. This can be done by propagation of stockplants from tissue culture and by warm-water treatment of stock plants before planting.

One species propagated by tissue culture was *Paeonia*. These plants were healthy although the propagation rate was limited. Warm water treatments were used in several species (*Phlox, Paeonia, Geranium,* etc.) The effect of the warm-water treatment on the elimination of nematodes and on the survival of the plants is still being evaluated but not all species can survive the temperature and treatment duration necessary for elimination of all nematodes.

The stock was cultured in containers on special beds or in greenhouses to keep it nematode free. The mother stock can be used for propagation by division and/or cuttings. The method chosen depends on propagation rates but also on the risk that they can be reinfected by nematodes and the type of nematodes (leaf, stem, or root) which causes the problems.

ROOTING ENVIRONMENT

In many difficult-to-root species the way to success is to start with the right stock plant material. Inferior cuttings cannot be rooted properly even under optimal conditions. But with excellent cuttings from well-grown stock plants rooting can be improved by using the optimal rooting environment.

Quality criteria for rooted cuttings are: a high number of roots per cutting; a short rooting period; and quick regrowth of the rooted cutting. For some species there are additional requirements, such as batch uniformity and absence of flower buds.

At Boskoop Research Station the effect of different environmental components on rooting has been studied. The components were CO_2 concentration, air temperature, bottom heating, humidity, light intensity, and light colour.

Apart from the positive effect of CO_2 on rooting percentage, it has not been possible to make general conclusions about the reaction of the different species to different environmental components.

CO_2 enrichment increased the rooting percentage but this increase was limited in most species to between 10% and 20%. But the quality of the rooted cuttings (fresh and dry weight), and especially of the root system, was improved dramatically.

Another general conclusion was that the speed of rooting was mainly determined by the root temperature.

Day length and light wavelength (colour) had no clear effect on rooting. The effect of light intensity on rooting was very species specific and cultivar specific. Bottom heating often improved rooting. But the effect of the temperature of bottom heat depended on the air temperature and, in some species, on the season in which the cuttings were taken.

The conclusion is that optimal rooting conditions have to be determined for each species or even for each cultivar. For nursery stock, with many species it is not a realistic option to optimise for every cultivar.

ROOTING OF LEAFLESS HARDWOOD CUTTINGS

For some years the heated bin method, developed by Brian Howard of East Malling Research Station, (East Malling, Maidstone, Kent, U.K.), has been used to root leafless hardwood cuttings of several species. A method has now been developed to root such cuttings in plugs which can be planted in the greenhouse or in the open after rooting. This improves the growth of the rooted cuttings in the first growing season.

In hardwood cuttings of *Tilia, Malus* and *Pyrus*, rooting quality was determined by stock plant and stock plant condition. In these species the rooting capacity was related to dormancy. In other species like *Platanus ×hispanica* (syn. P. ×*acerifolia*) and *Morus alba* the effect of dormancy was less obvious.

The best method of rooting and weaning the cuttings depends on species. Some have to be rooted under controlled conditions to prevent premature bud burst. In other species rooting and bud burst were simultaneous processes. In species from the latter category it is very important to prevent excessive water loss by evaporation from the young cuttings. These species are rooted in a greenhouse with a combined fog and mist system. Bottom temperatures of 17C, 20C and 23C were used. The optimal temperature depended on the species. In general, species originating from more temperate regions, rooted better at higher bottom temperatures. After the rooting period (6 to 10 weeks) the plants are weaned. They can be potted and grown in a greenhouse or they can be planted in the open.