

PROPAGATION PRACTICES IN SCANDANAVIA

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With a total population of only a little over 20 million people the four nordic countries of Denmark, Sweden, Norway and Finland have a limited range of propagation techniques and, with the exception of Denmark, these are largely related to forestry practice. In May and June, 1974, I was fortunate to travel to this geographic region on a Nuffield Foundation Farming Scholarship awarded to me in 1973. Although in this paper I will be discussing some of the propagation methods encountered, the object of my visit was very much broader. I studied forestry techniques which had an application to the Nursery Stock Industry, as well as mechanisation, the use of soil-less substrates as related to nutrition, plastic structures, and modern production of nursery crops. To these ends I met Forestry and Horticultural Professors, Consultants, Advisors, Research Workers and commercial representatives associated with the numerous nurseries, research establishments, and a few manufacturing firms where their product(s) were appropriate to my tour.

My presentation is divided into four parts:

1. Field propagation by seed, cuttings and grafting.
2. Frame propagation of cuttings.
3. Glasshouse propagation in mist benches and mist beds and rockwool blocks.
4. Plastic structure propagation using Nisula rolls and paper pots.

FIELD PROPAGATION

Seed. Seed used throughout Scandanavia is largely imported or collected from northerly latitudes in order to meet the hardiness requirement of their customers; very rarely is seed imported from the south, e.g. Italy. The bed system of sowing is widely adopted as is the use of Egedaal machinery with which to construct beds, sow seed, and finally lift and transplant seedlings. In Denmark's windswept countryside the importance of adequate shelter for seed raising is vital and much use is made of *Sorbus intermedia*, *Sorbus latifolia* and *Alnus incana* for this purpose. Very few artificial windbreaks were in evidence except for the occasional upright timber posts driven into the ground in rows across the field. Stratification is usual for hard-seeded types and in Sweden this is carried out in moist sand in concrete-based rodent

protected bins. The sand is turned weekly and watered by overhead sprinklers. Rose seed is mostly stratified for about one year prior to sowing when 50% to 60% germination can be expected. *Rosa rugosa* seed, however, sown in April had germinated by 30 May.

Most seeds are sown in drills on top of raised beds and then covered with a 5-6mm depth of sand during April — these would include *Pinus* spp. and rose stocks. Larger seeds like those of *Pinus jeffreyii* and *Abies* are covered more deeply. Other seeds include *Amelanchier*, *Cotoneaster acutifolius*, *C. intergerimus* and *C. divaricatus*. Beds are normally constructed 1.50 metres wide with 0.25 metre tracks between and seeds are sown in 4 rows to each bed at 27 cm apart or, if tree seeds, there are 7 rows to each bed and, after one year, the 3 alternate rows are lifted while the remaining 4 rows are left then sold 1 year later as 2 year undercuts. One large nursery draws a subsoiler beneath each path when the final crop is lifted every 2 to 3 years to prevent compaction. Ditrापex soil sterilant treatment is given after each seed crop has been lifted, especially in the case of rose rootstocks (Ditrापex does not kill clover seeds). In Finland when pine seedlings are 1" high, 2 kilos of Atrazine is sprayed on each hectare.

Hardwood Cuttings. At Bjorkhaga Plantskola in Sweden, hardwood cuttings are inserted in the soil by a nursery-invented machine. The machine works by compressed air which operates rams up and down hollow tubes — workers place cutting in hollow tubes and the rams push them down into the soil: 70,000 to 80,000 hardwood cuttings can be inserted by a 5 man team in an 8 hour day. Cuttings of *Ligustrum*, *Spiraea vanhouttei* and *Ribes alpinum* 'Schmidt' are typical of the material grown in this way. The latter are taken in September, put into cold store, planted out in March and cut down one year later to obtain bushy plants. 4 row beds are planted in rows 40 cm apart and 60 cm paths.

Budding and Grafting. Rose budding is done on *R. multiflora* rootstocks in Sweden. In the first winter, stocks are earthed up so that the mound over the inserted buds protects them from freezing. The stock is cut off at the top of the mound level in February and the remaining snag removed the following autumn when lifting commences. Lilacs are propagated in Norway by budding and grafting. At Baldishol Nursery, *Syringa vulgaris* is used as an understock, the stocks being purchased from Boer Brothers, Boskoop, Holland. Planting is done by hand and 10,000 to 15,000 plants are planted per day by 2 people working in a team. Budding starts the last week in July and must be completed by 15 August for successful results. Even so, resultant take can be extremely variable and might be anything from 20% to 80%. Those that fail are later grafted.

Populus tremula 'Erecta' (also in Norway) is budded on to *Populus tricarpa* during the first half of August when an 80% take can be expected. Failures are re-grafted in April. Whips reach at least 3 metres in height by end of season, (ultimate size of the tree is 15 metres high and 1 to 2 metres through).

FRAME PROPAGATION

The use of frames outside is very limited and only on one nursery in Sweden was there anything noteworthy to be seen in this respect. Again at Björkhaga Plantskola, *Thujas* were being prepared on 30 May, cuttings made with secateurs leaving a trimmed heel. These were dipped very lightly as dry cuttings into "Florotone", a Danish proprietary hormone powder, then inserted into pure sand, watered in and covered with shaded lights. Rooting takes place in 2 months and cuttings remain covered until the following spring when the lights are removed and rooted cuttings are lined out in the field.

GLASSHOUSE PROPAGATION

Most glasshouse propagation appears to be done with the aid of mist and or polythene tents. *Arundinaria* (bamboo) was the only notable exception to this and is propagated by splitting and placing under heated glass in February.

The oil crisis of 1973/4 has obviously had a dramatic effect on propagation schedules and programmes.

In Denmark, standard aluminum houses are 25 metres wide and are frequently seen together with fully automated feeding and watering devices.

Mist Propagation. The uses of mist are numerous, as are the different systems to be seen. In Sweden one progressive nursery uses mist only for summer cuttings, which are taken in June, then leaves it empty for the rest of the year. Boxes of cuttings of *Potentilla fruticosa*, 'Jackman,' *P.* 'Moonlight', *Spiraea arguta*, *cinerea* 'Grefsheim' (hardier than *S. arguta*, better branching habit, shoot from base, 3 weeks earlier blooming and originates from Norway), are stood on bottomless benches and given nutrition in the water mist which, in turn, is operated by a sun integrator. Many mist units in Denmark are situated on the glasshouse floor and beds are heated by undersoil cables with the mist nozzles placed 5 ft. or so above the cuttings. Such units are often operated by an evaporimeter.

The aim of research workers in Denmark is to obtain the best clones of each species grown, together with freedom from disease and viruses — plants so distinguished are given the initials OPG which stands for "Optimum Pathogen and Genetic Plants".

Cuttings are taken and prepared with secateurs and inserted in 40 x 28 cm polystyrene or expanded polystyrene boxes 5 cm deep; mobile benches are frequently used to transport filled trays and these are stood on sand embedded with soil warming cables raising the temperature to 20°C. Mist is sprayed intermittently overhead and light shading is given on the glasshouse. Typical cuttings inserted in March/April include *Metasequoia glyptostroboides* (of which there are five different clones available) as hardwood cuttings, *Viburnum rhytidophyllum*, *Chamaecyparis*, *Juniperus*, *Thuja*, *Philadelphus*, *Prunus laurocerasus* 'Zabeliana,' *Rhus typhina* 'Laciniata,' *Rubus* spp., *Cytisus* and other evergreens.

At Lindberg's Plantskola in Sweden the mist bed is on a cambes and large deep trays are used having a medium of perlite, peat, and sand. With a bottom heat temperature of 20-25°C, *Pyracantha* are rooted in 3 weeks after insertion in the third week in May. In the spring and early autumn cuttings are lighted with mercury-vapour lamps. Often cuttings are inserted direct into their selling container such as *Hedera helix* at 3 per station in 4" dia. pots.

Rockwool Blocks. Perhaps the most remarkable technique seen during my travels was the use of rockwool (Grodan) blocks both by research stations and commercial growers in Denmark. Commercially they were mainly used for the "cheaper" mass-produced items and, in these cases, cuttings were inserted directly into the block. Plants included *Euonymus fortunei* (*E. radicans*) 'Variegata'¹ (3 per station), *Salix purpurea*, *Symphoricarpos x chenaultii* 'Hancock' (3 per station), *Lonicera nitida* 'Elegans' (2 per station), *Pyracantha* 'Beral' and 'Lani', *Potentilla fruticosa* 'Jackman', *Hypericum* and *Cotoneaster* 'Skogsholm'. If cuttings failed to root the block is turned upside down and the cutting inserted in the base. Blocks 1 litre in size, i.e. 10 x 10 x 10cm were used for this stage but where larger plants of, say, *Juniperus* were required they were transferred to 6 litre blocks. No shading is given to the glasshouse and cuttings are sprayed for 5 minutes in every daylight hour. If the plants are unsold they are cut back and sold the following year!

One or two nurseries mix peat and rockwool together to obtain an open well-aerated compost and it was in such a mixture that I saw a nursery growing 8-week roses. 'Red Garnett,' 'Pink Garnett' and 'Pink Rose Carol' cuttings were inserted when the first flower bud was showing colour. One leaf node cuttings were then taken and a 99% take was obtained. Cuttings were inserted 4 or 5 per pot standing on a bench giving a bottom heat temperature

¹(Bot.Ed. Note: 'Gracilis', 'Carrierei', 'Silver Gem'?)

of 16-20°C and were covered with a plastic tent. After constantly spraying, the cuttings root in 8 to 10 days.

RESEARCH AT HORNUM

Odd Bovre is responsible for research work into rockwool and Finn Knoblauch has assisted with nutrition, density of blocks, and in developing the Hornum fertiliser solution. Some startling results have been achieved in a very short time and I will briefly indicate those which are most interesting.

(i) *Cornus alba* 'Sibirica'. Propagated 1st April, 2 cuttings per 0.4 litre block under mist at 22°C bottom heat. After 4 weeks moved to glasshouse at min. temperature of 8-10°C and air given when temperature reaches 25°C; 0.4 litre block fits into 2 and 3 litre blocks which in turn fit into 6 litre blocks.

(ii) *Miniature roses*. Cuttings are taken in September and October and put in 0.4 litre blocks, kept frost free during winter and in February are forced into growth for cutting production. Four to five leaf-bud cuttings are then taken and inserted in one block or pot; after six weeks the buds show colour and after a further week of hardening off, and allowing one week for distribution, an 8-week crop can be taken.

(iii) *Betula verrucosa*. Sow 20th February in 0.4 litre blocks and transferred 1st April to 2 litre blocks and on 1st May 3-5cm high, finally transferred to 6 litre blocks. On 20 September trees are 3.25 metres in height.

(iv) *Populus x canadensis (P. hybrida)* 'Bachelieri'. Taken as hardwood cuttings and reach 5 metres in height after 5 months.

(v) *Sorbus aucuparia*. Cuttings taken from forced glasshouse-grown stock plants in March/April and inserted on 4 April were 0.3 metres high on 20 May and would be 3 metres high at the end of the season under glass.

(vi) *Platanus x acerifolia*. Taken as 2 nodal hardwood cuttings and inserted halfway down a 1 litre block in January. Bottom heat temperature maintained at 15-18°C taking 6 weeks to root and then transferred to 6 litre blocks about the first week in April.

(vii) *Prunus avium* 'F12/1'. Leaf-bud cuttings inserted 18th April after dipping in 1000 ppm IBA quick dip in 50% alcohol. Cuttings are taken as firm but soft material from glasshouse grown stock plants as leaf-bud cuttings, using internodal and tip cuttings; 76% rooting was obtained after 4 weeks. Propagated by mist under white polythene tent in propagation rockwool blocks.

PLASTIC STRUCTURE PROPAGATION

In Denmark low white polythene tunnels are used in the propagation of *Viburnum x burkwoodii*, *Ligustrum ovalifolium*

'Aureum', *Cotoneaster salicifolia*, *Cotoneaster x hybrida* 'Pendula,' *Skimmia*, *Salix lanata*, *Viburnum x bodnantense*, *Berberis* and *Prunus* 'Zabeliana.' These are inserted in August and potted on in March and put under heated glass.

In Finland forestry seedling nurseries have a seed crop rotation of birch-pine-birch. These are sown in paper pots. Birch seedlings reach 80cm high 160 days after sowing. Seed from two birch trees is sufficient to obtain 1½ million seedlings. Both pine and birch seed is covered with perlite after sowing to prevent sunshine damage. Plastic house is kept at 18°C at pricking out time in the winter months. *Pinus cembra* seed is sown at the end of February, placed in cold storage, then transferred to the polyhouse at the end of March, the seed being sown in expanded polystyrene trays.

In Sweden, one man can produce one million paperpot seedlings. Birch and pine require 22°C for germination and 6 waterings of 0.07mm per day. *Pinus sylvestris* is pricked out into 19 x 6.5cm paper pots giving 250 pots per square metre; 2 seeds are sown per pot on 18th May and on 24th May, these are placed under plastic. Plastic is removed on 19th July or, alternatively, one seed is sown per pot on 28th May under plastic and the plastic is removed on 2nd August, and plants are set out on 20th September. *Betula pendula* (*B. verrucosa*) is sown 10th April in FH 305 (1¼" dia. x 2" deep) moved out of plastic house on 21st May, transplanted on 6th June in VH 1010 (4" dia. x 4" deep), and are 70cm high on 17th September after 160 days.

Seed source and condition is the most important part of the process. Seed is sown uncovered. Pots are filled 4/5 full with fertilised peat and only the top 1/5th is filled with limed peat.

Nisula Rolls. Birch is sown on rolls which are watered at least five times per day; 16:16:24: NPK fertiliser solution is added to the water. Germination takes one week in fertilised peat. Rolls are stored on concrete or sand in plastic houses 100 x 10 metres in size (1000 square metres). Liquid feed or foliar feeds are only given when the plants have at least three leaves present.

Birch Breeding, Plastic houses 20 metres wide, 100 metres long and 7½ metres high are clad with double skin plastic which will last 5 to 10 years. Enough seed can be produced in such a house for the whole of the south and central Finland. No artificial heat is given except slightly when CO₂ enrichment from 3 a.m. to 7 a.m., is supplied from propane burners. Tree spacing 4 x 3 metres apart. Present trees were planted in 1972 and have already been beheaded because they were touching the plastic. The spring starts in a plastic house one month earlier than outside, therefore flowering also starts one month earlier and consequently there is no interference from outside pollen sources and no wind or rain to

contend with, making the risks when crossing much less than in nature.

There is a big variation in flowering habit and the seed is collected and sown in the beginning of July from the same year's harvest of seed plants; this is very important in breeding. Pollen is stored at -18°C and seeded at -1°C to 2°C .

ONE YEAR OF PLANT PROPAGATION

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I have been associated with the Riverside Group in Guernsey for 4 years — first as a States Horticultural Adviser and more recently as their Technical Director. They are the second largest horticultural company in Guernsey — with 20 acres under glass, 130 employees, and 70 years of history.

Being principally tomato and cut flower growers, they began to examine the possibility of nursery stock production under glass in Guernsey two years ago and also out-of-doors in County Kerry.

We entered the field without any preconceived ideas as to how to grow nursery stock but with a long experience in problems of management and of plantsmanship. I want to explain how we have tackled things so far and brought this experience to develop what I believe to be a unique system of production. To avoid any difficulties within the company we had to apply our existing system of labour management to our plant propagation work. I shall try to outline this system.

We do not have foremen. Our tomato and flower growers are directly responsible to the Managing Director. I am available to give technical advice. We have a supervisor who has to ensure that each man has the necessary equipment, facilities and training to grow a crop. We have just appointed a sales/production coordinator.

Each grower on the staff has his own batch of glass to look after, be it tomatoes, roses or carnations. He gets bonuses according to his production and the profit of his batch with due reference to its potential. He is therefore very largely his own boss — he can work as an individual. In this way we feel that he can develop and achieve his own potential. He can earn a good wage ac-