

CONIFER PROPAGATION IN DENMARK AND NEW CONIFER INTRODUCTIONS

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This summer it is 38 years ago since I worked at Bonnell Nursery in Renton, Washington, and at Malmo Nursery in Seattle. At that time I thought that this area must be one of the most beautiful places in the world, and I still think so. It is certainly perfect for most plants.

The first part of my talk is about "Conifer Propagation in Denmark". As we are the largest grower of conifers propagated by cuttings in Scandinavia and, as most of the other nurseries do as we do, it will be our way you will be hearing about. First a few words about the climate and wages because these two factors have great influence on explaining how and why we do things as we do.

Denmark is located approximately as far north as Sitka, Alaska, so we have short days during the winter and long summer days. The winter weather varies a lot from year to year. A few years ago we had temperatures down to -30°C (-22°F), but usually it is between $+5^{\circ}$ to -20°C , (41° to -4°F), changing between frost and rainy weather several times during the winter. The summers are usually fairly cool with an average temperature of 18°C (64°F) in July. This year the maximum temperature was 30°C (86°F) which we consider very warm.

This year labour goes per hour from 9.5 US dollars (1 US dollar = 7 Danish kroner) for unskilled labour, to 11.5 US dollars for skilled labour + 30% social costs. Of this amount the worker has to pay per year between 40 to 55% taxes on what is over 20,000 Danish kroner. We have a 38 hour work week and 5 weeks vacation. Of course, then we have free medical care, education, etc.

As a potted liner in a 10 cm (4 in.) pot costs approximately 1 to 1.6 US dollars a piece, you can see that it is easier to be a nurseryman in Canada and the USA. By the way, all overtime work is for the first two hours + 50% and, after the first two hours, it is +100%. Almost everybody is a member of a union.

In our nursery we do not grow any plants from seed. We use quite a few *Picea* and *Pinus*. They are all bought from specialized nurseries as 3 or 4 year old liners. Most of our conifer cutting production is done in greenhouses, and most of the shrubs are made outside in June and July, just covered with a layer of white plastic directly on top of the cuttings.

We have four aluminum greenhouses, 20×61 m (66×200 ft), equipped with bottom heat and normal overhead heat. The two

houses are used for propagation; the one used all year round has automatic shading controlled by a photocell which also turns the shades on at night in order to save energy. It is also equipped with mist propagation controlled by an electronic leaf. Heat, air, shade, etc. is automatically controlled. Previously we used to have different media for different species, e.g. for most *Taxus* we used peat and sand mixed, but for *Taxus baccata* 'Fastigiata Aurea' and *Taxus baccata* 'Semperaurea' we had a 2 cm (0.8 in.) layer of sand on top, and that was also used for several junipers. Today we use the same medium for all and that is 75% peat and 25% styrofoam, and the results have been excellent.

All cuttings are stuck in plastic flats, 30 × 60 cm (11.8 × 23.6 in.) or, as we have been doing in recent years, 40 × 60 cm (15.8 × 23.6 in.). Last year we stuck approximately 100,000 cuttings, trying different types of Speedling trays. The results were mostly good, but we found that where we had problems with drying out, it was either because the medium was looser in some places than in others, or that the flats did not have a good enough connection with the sand underneath, so the capillary effect did not work. So this year we have bought a machine to fill the Speedling trays and it does a very fine job giving an even firmness in the trays.

When we have found the right type of Speedling tray and have a new setup for potting, we are sure that we can improve the speed of the potting machine approximately 50% and, as we do not have to prune the roots of the cuttings, we can also improve the growth. Next year I will know for sure.

All the flats are put on a sand bottom which is sterilized between every season and renewed every three years. We use the sand in order to have good connection between the medium in the flats and the sand to achieve maximum capillary action and as much aeration of the medium as possible. Also by having the cuttings at the bottom of the greenhouse and the mistlines 1.9 m (6 ft) above them, we have a very fine mist effect, and in that way use as little water as possible and still keep the cuttings humid at all times.

All conifer cuttings have the lowest 2 to 3 cm (0.8 to 1 in.) branches stripped off, and that way they are also wounded. After being stripped they are laid in flats and dipped in a captan solution. We use a hormone powder by the name of Floramon, containing 0.4% NAA (naphthaleneacetic acid) mixed with 10% captan powder, 1 to 1, for almost all cultivars. We have done a lot of research during the years and there are a few cultivars where we had a slightly better result using IBA (indolebutyric acid), but it is easier just to use only one kind. I am sure that we could get just as good a result using IBA, but we have many years of experience using Floramon, which is a Danish product and therefore easily obtained. Every other week the cuttings are sprayed with Benlate, and every other week we spray with a different fungicide. When the cuttings

are rooted, a fertilizer is also applied. During spring, summer, and fall we try to have 22°C (72°F) in the sticking medium and a maximum temperature of approximately 26°C (79°F) in the air. From October on we lower the temperature and have in December approximately 15°C (59°F) in the sticking medium and a minimum of 10°C (50°F) air temperature, as we have found that a higher temperature seems to cause decay at the base of the cuttings, perhaps because we have very little light during the winter. In February we begin increasing the temperature. This is the way all conifer cuttings in greenhouses are treated, and now to the time of year when we make the cuttings.

Approximately July 1st we begin with juniper cuttings, starting with *Juniperus communis* 'Repanda', which is one of our most used junipers. Then the *Juniperus squamata* cultivars follow, then the *Chamaecyparis lawsoniana* and *C. pisifera* cultivars from approximately August 1st through September. After that we make *Taxus baccata* 'Repandens' and other *T. baccata* cultivars. Starting mid-October we stick the upright *Juniperus communis* cultivars. By this time most of the cuttings stuck in July and August are rooted and they are moved to the third greenhouse. In the empty spaces we now fill up with the *Taxus cuspidata* and *T. × media* cultivars. We think it is fine if they can have some frost before being stuck, but it is not necessary; 200,000 of these are not stuck under mist, but covered with plastic tents and we have fine results doing it that way. However, it is more difficult to watch them.

In January and February we pot all the junipers and *Chamaecyparis* in greenhouses three and four. As we empty the propagating houses we put *Thuja occidentalis* cuttings in and want to have them all finished by mid-March when our spring season usually starts. All rooted cuttings have been potted in 10 cm (3.9 in.) pots by that time. Actually we could start potting the *Taxus* in March–April when most of them are rooted, but we do not have the space nor the time. So they are potted during the summer together with *Thuja*.

As you can see, it takes approximately 10 months to produce a fine liner of *Chamaecyparis* and *Juniperus*. If, for instance, a juniper 'Mint Julip' is potted at the optimal time all the way through, then after two years you can have 30 to 40 cm (12 to 16 in.) and 40 to 50 cm (16 to 20 in.) plant in a 3½ liter (231 in³) container, which is the usual sales size.

I might add that, together with the mentioned plants, we also make cuttings of *Microbiota*, *Abies balsamea* 'Nana', *Metasequoia*, evergreen shrubs, etc.

All *Picea abies* and *Picea glauca* cultivars are made outside in June. They are stuck in beds which have first had approximately 10 cm (3.9 in.) of peat and 4 kgs (8 lbs.) of NPK (12-3-9) applied and rototilled, sterilized, then covered with plastic for three weeks to

obtain maximum sterilization effect. After this all weeds and fungi have been killed. The beds are 75 cm (30 in.) wide and, after being levelled, we put 2 cm (0.8 in.) of a low pH sand on top.

The largest numbers are made of *Picea glauca* 'Conica', the dwarf Alberta spruce, of which we make approximately 80,000 cuttings. They are not stripped or treated with anything. They are under automatic mist and covered with milk white 50% plastic shade, on top of which we put white Fibertex, a type of cloth during sunny days to keep the temperature down. Nearly all cuttings are rooted by October, but we keep the plastic on during the winter. We have to be very careful that the cuttings are watered during March and April because the sun is strong and we cannot use mist. The unrooted cuttings will root in the spring.

In May the plastic cover is removed and during the summer the rooted cuttings are potted. We use a lot of these for Christmas decoration, from liners to 60 to 70 cm (24 to 27 in.) and larger plants. Sometimes we also root arborvitae and other conifers the same way if we have not made enough during the winter or if we get extra orders for rooted cuttings.

We hardly do any grafting anymore, only our own *Picea pungens* 'Thomsen' (which my father found in Pennsylvania), *Taxus baccata* 'Fastigiata Aurea' and *Juniperus chinensis* 'Blaauw'. The latter two we also make by cuttings without problems, but they grow very slowly, so it still pays to graft them. They are all grafted in January in the greenhouse on established understock, holding 14 to 18°C (approximately 64°F) in the peat medium, then covered with plastic for approximately two months. As the garden centers do not sell nearly as many grafted plants as before due to the high price, we have found it cheaper to buy the relatively few graftings we need. Also it seems to me that in order to have good results, you should either graft so many that you can have a skilled man looking after them all the time, or have a smaller nursery where you can look after the graftings yourself.

I hope this gives you an impression of how we propagate conifers in Denmark. We still experiment in an amateur sort of way every time a new material, idea, or mechanical equipment comes up. I am grateful to my teacher in New Jersey and Dundee, Illinois, Jim Wells, who was always trying new ways and seeing things from a different angle, and that has made life more interesting for me—but at times also more expensive. I was very happy and delighted to find that he is the guest of honour here, and I cannot think of anyone who deserves it more.

NEW CONIFERS IN DENMARK

Juniperus communis 'Green Ace'. A spreading form, up to 30 cm in height, a rather fast growth. Something like *Juniperus c.* 'Repanda' in shape, but higher and grows faster. It has a fine green

colour and it is very healthy. I think the plant will have a great future as a groundcover where the landscape architects want a conifer and where *J.c.* 'Repanda' is too slow growing. I found it on the rugged Danish west coast; it was awarded a gold medal at an exhibition in 1986. This year it is in the trade for the first time.

Juniperus communis 'Green Carpet'. A slow growing, very flat juniper found on the west coast of Norway. Like a dwarf type of *J. c.* 'Repanda'.

Juniperus communis 'Gnom'. Dwarf, columnar shape. Originated in Hungary.

Juniperus communis 'Vemboe'. A rather fast-growing columnar shaped juniper. As this plant usually has only one topshoot, you do not see much damage by snow and, because of that, it is rather popular in Scandinavia. *J. communis* 'Ramlösa' and 'Urshult' have similar characteristics. All three come from Sweden.

We also have an upright blue type of *Juniperus communis* which is not yet in the trade. We think it has great potential. It is the most blue-needled *J. communis* I have seen. It was found in Norway. We also have approximately 12 more types selected from the wild, especially one weeping type, which seems to be a plant for the years to come.

Juniperus communis 'Grethe'. A rather compact spreading type with bluish needles, approximately 40 cm in height. Looks fine but is rather difficult to propagate and might grow too slowly for commercial use.

Juniperus chinensis 'Skalborg'. A seedling we found in our nursery. It is an upright spreading type with yellow needles. It is rather nice but might have a better chance in southern Europe and the U.S. where the climate is warmer.

Juniperus 'Blue Swede'. A very fine and hardy *J. squamata* type. Upright spreading shape and blue needles. It sells very well in Scandinavia.

Juniperus squamata 'Meyeri' × *J. chinensis* 'Pfitzerana Aurea'. Has blue needles with yellow tips. Not named yet. This is from the same lot of hybrids as 'Blue Swede'.

Juniperus scopolorum 'Blue Pyramid'. Selected by me. It is very hardy, not quite as blue as 'Blue Heaven', but the blue colour is fine and the shape is the same but more compact. It seems to me to be the only *J. scopolorum* that does well in our coastal climate.

Juniperus virginiana 'Helle'. A seedling selected by me. Form and colour very much like *J. chinensis* 'Spartan'.

Juniperus virginiana 'Kim'. Also a seedling found by me. I like this very much because of its more elegant and not so compact growth and its beautiful green colour. It carries a lot of blue berries at an early age. It was awarded a gold medal at an international exhibition in Copenhagen.

Taxus baccata 'Thomsen's Dwarf'. A slow growing conical-

shaped yew found as a seedling in our nursery.

Taxus baccata 'Ingeborg Nellesmann'. A seedling found in a nursery near Copenhagen. Similar in growth and colour to 'Dovastonii Aurea', but easier to propagate—and hardier.

Taxus cuspidata 'Nana Compacta'. A seedling selected by us. Compact, irregular form. Female plant.

Taxus × *media* 'Farmen'. A seedling found at our nursery. First we had *T. cuspidata* as its species name, but botanists thought it probably was a hybrid and asked us to change it to *T. × media*. The shape is upright spreading with long needles and a firm green colour. In test plantings in Sweden it was—together with 'Green Mountain'—found to be the hardiest and best yew, and today it is the most sold in Scandinavia because of its many fine qualities. Used for mass plantings and hedges. Also used as hedge along roads because it is salt and wind resistant, though I do believe most yews are salt tolerant.

Taxus × *media* 'Skalborg'. Also a selected plant from us. Stronger growing and more upright than 'Farmen', but more "open" so it must be sheared more. The needles are shorter and have a greener colour in early spring than most yews.

Thuja occidentalis 'Skogholmen'. Has a columnar shape like 'Pyramidalis', but does not carry seeds, which is an advantage when you sell it.

Thuja occidentalis 'Brabrant'. A fast growing arborvitae. Fairly dense in growth with a fine light green colour. A hardy plant, well-suited for hedges. Comes from Holland.

Thuja occidentalis 'Little Giant'. A round dwarf type with a nice green colour.

Thuja occidentalis 'Yellow Ribbon'. A columnar shaped arborvitae, warm yellow needles. Seems to be one of the best yellow cultivars for containers. We have not had much luck with 'Sunkist' or 'Europe Gold'.

There are plenty of other new conifer cultivars, but these are some of the best for our climate. I have also, during my visits in the USA, seen that *Juniperus horizontalis* 'Blue Chip' is used in large numbers. The real name should be 'Blue Moon', which I named it in 1962 and James Wells baptised it at an exhibition at Aalborg. I found this seedling in a Danish nursery and brought a few cuttings with me to Jack Hill, D. Hill Nursery Co. in 1956. After his tragic death nobody in the nursery knew where the plant came from. By that time it was only named *J. horizontalis*. No. 1, as there were four selected seedlings in all. No. 3 is also in production in Denmark under the name of 'Grey Pearl', but both of them are not very blight resistant in our climate.

Sinarundinaria murielae 'Simba' is a completely new plant which is for sale for the first time in a limited number this fall. This cultivar is smaller than the species, about half the size, and has more shoots and finer leaves. It originates from a batch of

seedlings from Thymes Planteskole and, according to the Botanical Garden in Copenhagen, it is very rare to get fertile seeds from *Sinarundinaria* in our climate.

Though I should only talk about new conifers, I would like to mention that a large number of shrubs have been especially selected by Hornum Research station for landscaping purposes. Among others, two *Ribes alpinum* have been selected; a male cultivar—'Hemus', which has a nice shape, very healthy leaves, and a female—'Dima', which is more "open", but also with healthy leaves. *Lonicera ledebourii* 'Vian', which is a strong grower, very wind resistant, and has very fine leaves.

LOW COST TECHNIQUES FOR SUCCESSFULLY OVERWINTERING ROOTED CUTTINGS AND LINERS

BEV GREENWELL

*Happy Hollow Nursery
Abbotsford, British Columbia, Canada*

Happy Hollow Nursery is located in the central Fraser Valley, 45 min. inland from Vancouver, B.C. We are on Sumas Mountain, 600 ft. above the flat farmland. Situated in a valley on the mountain we are protected from cold northeast winds which causes desiccation of plants down below, but are subject to being a "frost pocket" caused by air drainage off the mountain, and cold air settling in the valley.

Early fall frosts are to our advantage by putting the plants into dormancy slightly earlier than other places. Late spring frosts can be a problem after plants have started growing.

Our winter protection is based on encouraging acclimation, using the plants own abilities to withstand cold. We do everything we can to encourage cold acclimation in the fall, and everything we can to keep them dormant all winter, until danger of frost is over in spring.

Eighty percent of our business is in the production of lining-out stock, mostly deciduous and broadleaf evergreen shrubs. All cuttings are direct-stuck from plugs, 73 to a flat, 2¼ and 3¼ in. pots in the size of container they are to be sold. Overwintering has been our major limitation on volume production. Winter space is always in restraint. Not everything can go into heated houses, and not everything grows well in heated houses. Many plants require a cold period before they can properly break dormancy and grow in the spring.