

PROPAGATION OF SPRUCE FROM CUTTINGS

R. W. OLIVER AND S. H. NELSON

Horticulture Division

Central Experimental Farm

Ottawa, Ontario, Canada

It has long been recognized that spruce as a genus is difficult to propagate from cuttings. Older texts give general instructions applicable to conifers as a whole and usually comment that *Abies*, *Picea* and *Pinus* are so difficult that grafting is more practical.

The most specific of the texts, one by W. L. Sheats, states that five varieties of Norway spruce can be rooted most satisfactorily if taken in October. The cuttings should be stuck in sand overlaying a mixture of peat, sand and loam in a cold frame. They should be covered over winter and kept under shade the next summer, with slight ventilation and hand syringing. Well rooted cuttings, up to 75 per cent can be transplanted the following September.

The identification and synthesis of growth promoting substances led many workers, between 1935-50, to try them on species such as *Picea pungens*, and *kosteriana*, hitherto considered very difficult. As the results were poor to mediocre, few writers published them.

Dr. Meahl has ably covered the literature on this subject in his introductory remarks. A brief review of the Canadian work, chiefly with the forest species *P. abies* and *P. glauca* give some conflicting results that may prove interesting.

Farrar (1) and Grace (2) in several cooperative experiments carried on between 1935-45 found that:

1. Cuttings from lower branches of the tree rooted more readily than those from the upper branches. This was contrary to the general opinion that cuttings from younger trees root more readily than from older trees.

2. Lateral tips rooted more easily than terminals but do not develop into such good plants.

3. Maximum rooting results with *P. glauca* were obtained from cuttings taken in July when the base of the new growth was beginning to stiffen. Norway spruce, *Picea abies*, rooted more readily and over a longer period but the optimum results were from cuttings taken in December. All cuttings in this experiment were stuck in sedge peat in a cold frame.

4. Long cuttings 10 to 20 cm. were better than short cuttings 5 to 10 cm. Ordinary cuttings of a full season's growth were superior to those with a heel.

5. Treatment with any of the so-called hormones was usually detrimental, though in some instances, roots were longer on treated cuttings indicating that rooting had taken place more rapidly. This does not agree with the early work of Thimann and Delisle who reported that auxins were a great aid. Griffiths (3) working with *P. sitchensis* also found that indolebutyric acid was beneficial.

In early work done at Ottawa between 1940-1948, Oliver found that ornamental varieties of *P. abies* rooted best when they were taken in December as compared to those taken in any other month, and, con-

trary to Farrar and Grace, that sand was superior to peat as a medium. This work was done under syringed cheesecloth in a cool greenhouse with bottom heat. He also found that treatment with growth promoting chemicals was usually detrimental and the ability to root was a varietal character. Certainly *Picea abies*, *ohlendorffi*, *pygmaea* and *remonti* rooted better than the others tested.

The first trials with mist at Ottawa were started in 1955 using two varieties, *P. abies ohlendorffi* and *P. remonti*. The mist beds included a continuous and intermittent mist bed outdoors, as well as an intermittent mist bed in the greenhouse. Four media, namely, sand, sand plus peat, finely shredded sphagnum moss and vermiculite were used. Terminal tip cuttings 6 to 8 inches in length, lateral tip cuttings 2½ to 4 inches and lateral tip cuttings 1½ to 2 inches were treated with various concentrations of hormone.

The cuttings were stuck toward the end of June in the hope that they would be sufficiently rooted by fall. However, rooting did not meet expectations and in order to present a better evaluation, a scoring system was adopted. A value of 6 was given to well rooted cuttings, 4 to medium rooted cuttings, 2 to poorly rooted cuttings and 1 to cuttings showing swollen primordia when they were lifted in late September.

The terminal tips of both varieties rooted poorly with a maximum rooting of 30 per cent. The addition of Chloromone did not increase rooting percentage but did increase the score, indicating earlier rooting.

The results with laterals were more encouraging with rooting up to 90 per cent. Vermiculite, although messy to work with under mist, gave the best root system, whereas sand produced a more brittle, cleaner root system. No difference occurred between intermittent and continuous mist outdoors, although both were superior to the intermittent mist in the greenhouse. Further, no rooting differences were observed between the two sizes of lateral cuttings. The use of Chloromone yielded a better root system, but, in general, was accompanied by a slightly lower rooting percentage.

Although no injury occurred in the mist beds from Chloromone treatment, it should be mentioned that treated cuttings in a plastic tent turned brown and dropped their needles, while the untreated cuttings remained green and rooted 50 per cent. In this preliminary trial the plastic tent did not have mist. The temperatures became excessive and the system was entirely unsuitable.

In further trials with hormones, it was found that increased rooting generally occurred with increased concentrations of indolebutyric acid in powder form up to 0.8 per cent.

After evaluation all cuttings were potted even though rooting was nothing more than swollen primordia. They were held most of the winter in a cool greenhouse and when moved to a warmer temperature in late winter, no casualties occurred. Further, although possibly not commercially feasible, the unrooted cuttings in good condition were moved from the outdoor beds to a cheesecloth shaded bed without mist in a cool greenhouse. Bottom heat was applied and all the cuttings rooted in the early winter months.

At the beginning of the 1956 season we were very hopeful. However, instead of a warm sunny summer as we experienced in 1955, much of the weather was dull and there was considerable rain. Rooting of the spruce cuttings stuck in 1956 was severely affected. Maximum rooting for *Picea abies ohlendorffi* was only 63 per cent and no beneficial effects of hormones were found. The rooting of *Picea abies remonti* was reduced to almost nil and *Picea glauca conica* and *Picea abies nudiformis* rooted only 30 per cent.

Due to the space used in the propagation beds for transplant studies and the propagation of material of prime interest to the Division, further studies with spruce had to be sacrificed for in the 1957 propagating season.

In conclusion, it is apparent that the terminal tip cuttings do not root very well under mist during the summer. While the addition of hormone may result in longer roots the percentage of rooted cuttings generally is not increased.

Lateral tips are relatively easily rooted, but apprehension has been voiced concerning the growth habit resulting from these cuttings. Best rooting occurred in a season where temperatures were high and there was plenty of sunlight.

LITERATURE CITED

1. Farrar, J. L. Forests Division, Department of Northern Affairs, Ottawa, Ontario, Canada.
2. Grace, N. A. Bio-chemistry Division, National Research Council, Ottawa, Ontario, Canada.
3. Griffiths, B. G. Forester, Forestry Service of the Province of British Columbia, Canada.

MODERATOR MEAHL: The floor is now open for questions

MR. MARTIN VAN HOF (Rhode Island Nurseries, Newport, R.I.): I would like to ask John Ravestein if the grafts are placed in a closed or an open bed?

MR. RAVESTEIN: We place them in an open bench without glass.

MR. VAN HOF: While I am standing up, I would like to ask Mr. Pinney if the seed that they use is one year old seed or seed collected that same year?

MR. PINNEY, JR.: Usually we use the current year's crop of seed. However, we can and do store it. I didn't mention anything about it, but as was mentioned in the literature review, you can easily store it for as long as five years in sealed containers. We usually use brown bottles, turn them upside down, dip the tops in wax and that seals them up tight.

MR. VAN HOF: Now I would like to ask Stuart Nelson, if current season's wood or older wood was used in the experiments that he described?

DR. NELSON: In all of the experiments, only one experiment was conducted with entirely current season's wood.

MR. C. E. KERN (Wyoming Nurseries, Cincinnati, Ohio): I might mention that I made several exploratory tests on Blue spruce from the 15th of August to about the 15th of September, grafting on the regular understock. Generally all the grafts we made during that period have been successful and have taken hold. I might suggest there is a field there that should be explored.

DR. CHARLES E. HESS, JR. (Hess Nursery, Mt View, New Jersey): I would like to ask Dr. Nelson what the age of the spruce stock plants was from which he got his cuttings?

DR. NELSON: I can't answer that question specifically. They were specimen trees in the ornamental grounds and I would roughly say that they were between 20 and 30 years old.

MR. JIM WELLS (J. S. Wells Nursery, Inc., Red Bank, New Jersey): The purpose of making a graft in August or September was discovered by the Dutch in Boskoop. The value is that a graft made at that time makes a normal growth from the terminal bud the following spring, which doesn't occur on grafts made in February and March.

I would like to ask Mr. Ravestein why he puts his grafts on a slant?

MR. RAVESTEIN: I do it primarily because my bench is only six and a half inches deep.

MR. WELLS: I wondered if slanting the grafts was an old-fashioned method, or one which was founded on some good reasoning. I could never see that any value accrued.

MR. RAVESTEIN: I believe that light might have something to do with it. First, we slant them one way and then after three weeks we turn them the other way. If you set them straight up from the beginning the bottom has the same amount of light as in the beginning.

MR. JOHN VERMEULEN (J. Vermeulen & Son, Inc., Neshanic Station, New Jersey): Another reason for slanting the grafts under glass is that the unions are closer to the glass and higher temperatures. The higher temperatures resulted in better callusing and knitting. That essentially was the old-fashioned way in Boskoop.

MR. JACK HILL (D. Hill Nursery Co., Dundee, Illinois): I wonder if any one on the panel has had experience and are able and willing to report on outdoor grafting of spruce? We know there is considerable outdoor grafting of these plants in Western Europe. At one time it was called bottle grafting and has been known by various other names. Has anybody had a reasonable amount of experience with this technique?

DR. NELSON: I would like to attempt an answer to this question. I cannot give first-hand knowledge on this, but Dr. Teuscher at the Montreal Botanic Gardens has been doing this for some years now and presented a paper at the Canadian Nurserymen's Association meeting about a year ago. He actually doesn't use scions in the true sense of the word. What he is doing is the opposite of what you are thinking about, since the stocks are lifted and potted up and the scion is not detached from the tree. He grafts the understock right onto the tree.

Whether this is working or not, I don't know. You can obtain his method and results by writing to Dr Teuscher.

MR HANS HESS (Hess' Nursery, Mt. View, New Jersey): I would like to report on another rather radical method of grafting spruce. I think Jim Wells will verify what I am about to describe. While he was with Koster and Company he visited this gentleman's establishment and saw the method by which he produced Blue spruce with tremendous success. This gentleman brought in his understocks in the fall. He trenched them in outside, and in the spring of the year, around the latter part of March, as soon as the stocks began to show the first root action, he brought them into his cellar. He grafted them and then planted them out in a bed which had cinder blocks for the border, and he put shades over them. He plunged the union about an inch or two below the surface, and there they stayed, scion, understock and everything. This gentleman, although he has since passed on, had the most perfect stand of spruce that I have ever seen. They made a short amount of growth and set a firm, mature terminal bud for the following season's growth.

I know at Koster and Company, propagators have tried to duplicate this procedure but they have not had the success that this gentleman had. I haven't tried it myself because at that time of year we are too busy to be thinking about grafting.

Jim, you might like to comment on this technique.

MR. JIM WELLS: Yes, indeed, I can bear out what Hans said. The man's name was William Wright, his success was continuous and phenomenal and wasn't just a flash in the pan. His take was excellent year after year after year. I think the reason for it was his skill as a grafter.

This brings up something that we haven't mentioned here this morning, namely the need in spruce grafting of a very careful attention to the depth of cut, particularly on the scion. When I was at Dundee, we ran some tests on that and found a very definite relationship between the percentage of take and the depth of cut made on the scion. A light cut on the understock, hardly touching the wood, or cutting deep into the understock didn't seem to make too much difference. We noticed that a very light cut just revealing the cambium tissue was slightly better than a deep cut. I believe if you can find anything specific for Bill Wright's success, the method of cutting was it.

MR. CONSTANT DeGROOT (Sheridan Nurseries, Sheridan, Ontario): Two years ago we bought 250 Koster Blue spruce from France and they were all triangle or wedge-grafted, quite a different method from the one Jim Wells mentioned, or the usual veneer graft.

I would also like to a remark here on Jack Hill's question concerning outdoor grafting. Last year I found a Mugho pine, and grafted it outside right in the bed. Only 3 out of the 15 grafts were successful.

MR. CARL GRANT WILSON (Cleveland, Ohio): I would like to ask Mr Pinney if he has ever found cones on a real deep Blue spruce, and if so, after seeding, what, if any, percentage of good blues were obtained.

MR. PINNEY, JR.: I suspected this question would come up. It is a difficult one to answer since when we buy Blue spruce seed we specify or we hope that our seed dealers will supply us with seed from specimens that are of good color. That doesn't necessarily guarantee at all that you will get a seedling that is blue. Once again the answer would have to be relative. What do you consider a Blue spruce? They range all the way from green to the blue Moerheims. If you want a seedling close to a Moerheim color I would have to say that I have probably only seen one or two in my life in our seed beds that came anywhere close to it. If you want something that is relatively blue, maybe you might get anywhere from 20 per cent downwards, depending on what you accept as being blue.

MR. C. W. M. HESS (Hess' Nursery, Mt. View, New Jersey): I would like to say that we have an isolated seed source of Moerheim spruce. There is no chance for pollination with other species. We have picked seeds from this Moerheim block, planted them and obtained only 40 per cent blues. It bears out what you have said, Mr. Pinney.

PRESIDENT VANDERBROOK: In answer to the question you asked, Jack, I think I am safe on saying that bottle grafting has gone out. Dad and I both did bottle grafting of Moerheims, and Kusters. This can be done by first planting Norway spruce in rows, where they can be easily watered. Small bottles which are made especially for bottle grafting are placed so the neck of the bottle is even with the top of the ground. The graft is then made, the scion grafted on the side of the Norway understock, tied, and the base of the graft placed in the bottle containing water. These bottles have to be watched carefully. In very warm weather they sometimes have to be filled twice a day with a hose. When the union is complete, sometime in June, and the graft is starting to break with new growth, the top of the understock is completely cut off and the plant allowed to stay in place for two years before it is dug.

MODERATOR MEAHL: I would also like to add a comment on the bottle grafting technique. I have also seen the bottle graft method work. A nurseryman in Pennsylvania did it on a very small scale and was very successful. I would think the particular procedure would have limitations because of its unwieldiness and need for constant attention.

MR. J. PETER VERMEULEN (John Vermeulen & Son, Inc., Neshanic Station, New Jersey): Can cuttings be used to successfully propagate the Montgomery spruce?

MODERATOR MEAHL: The report of Montgomery spruce was in the May 1 issue of the American Nurseryman in 1956. The Montgomery spruce is a chance seedling that was discovered and saved. Some of you undoubtedly have read about it. The article noted that cuttings could be successfully rooted which brings up the fact that we know from other experiments that certain plants will root readily, whereas, apparently the same kind that looks the same doesn't root. This particular plant has the ability to root readily having given as high as 90 per cent rooting.

MR. HERMANN ENGELMANN (Tipp City, Ohio): Approximately two years ago while working in Holland I became acquainted with a grower who grafted Blue spruce on field established plants in April. This procedure resulted in an 80 per cent stand, but results since have been mostly around 30 per cent.

I worked in the propagation department of the firm of LaFever in Boskoop, Holland. There we propagated a large number of Blue spruce. We planted our stocks around the 1st of May in an outdoor frame. About the beginning of August we brought these stocks inside the packing shed to dry them out. This seems to be very important to insure good results. After this we grafted the plant and placed them in an outdoor frame under double glass. In this way we got our best results, somewhere between 70 to 80 per cent.

MR. VERKADE (Verkade's Nursery, New London, Conn): I would like to ask Mr. Ravestein if he cuts his scion on both sides or one side when he grafts.

MR. RAVESTEIN: I cut them very lightly on both sides.

MODERATOR MEAHL: I think we have had a very stimulating session, and I want to thank the gentlemen who have contributed to the success of this morning's meeting. I am sorry we don't have time for additional questions.

PRESIDENT VANDERBROOK. If you will all please be seated a moment there is one item I would like you to consider. I feel it should be brought up before the membership because it will be discussed at the Saturday afternoon business session. Our secretary, Dr. Snyder has found that we are growing so fast as an organization that the work of editing the proceedings and taking care of the business end has become such a terrific job that he cannot do both jobs at the same time. Therefore, he contacted me and I in turn contacted the Executive Committee, giving them a full explanation of this suggested change. It was discussed by the committee, voted and passed, to bring before the membership the amendment to the By-laws, which you have already received. The recommendation was that the By-laws be amended as follows:

"Officers: At the annual meeting of the Society, the Organization shall elect a President and a Vice-President to serve a term of one (1) year. The Executive Committee shall consist of seven (7) members as follows: the immediate Past President, the President, the Vice-president, and four elected members. At the first annual meeting, two (2) members of the Executive Committee shall be elected for a one (1) year term and two (2) members elected for a two (2) year term. Thereafter at each annual meeting, two (2) members shall be elected to the Executive Committee to serve a two (2) year term. No officer elected by the Society shall serve for more than two (2) consecutive terms."

"The Executive Committee shall elect an Executive Secretary-Treasurer and Editor at each annual meeting. The Editor shall edit and prepare for publication the Proceedings of the annual meetings and the Newsletters of the Society."

“All officers of the Society shall serve without remuneration excepting the Executive Secretary-Treasurer and the Editor who shall each receive a salary determined by the Executive Committee.”

Now think that over, gentlemen, and have your answer ready when we come to the business meeting Saturday afternoon.

We stand adjourned until 1:30 this afternoon.

The meeting recessed at 12:00 noon.