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CLONAL DIFFERENCES IN PROPAGATING CONIFERS

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At the University of Connecticut we have been working on the development of new forms of dwarf conifers. The dwarf plants we develop are not the result of hybridization, but are seedlings obtained from mutations found on various conifers. These mutations, called witches'-brooms, produce seed that yield plants which are 50% normal and 50% dwarf.

We have 20,000 seedlings at our nursery that range in age from 2 to 21 years. Most of these seedlings are from witches'-brooms found on: two *Larix* species, one *Picea* species, one *Tsuga* species, and six *Pinus* species.

Although we could obtain dwarf shrubs by merely grafting scions from the witches'-brooms, we prefer to collect and grow seeds from the brooms. We do this because with seedlings we obtain a highly variable population from which we could select some unique forms.

Although the variation among seedlings obtained from witches'-broom is, most likely, similar to the variation obtained with normal seedlings, the compact growth of the dwarf shrub makes it easier to discern a short-needled plant from a medium or long-needled plant or a blue-green plant from a green plant. Other variations that are not easily noticed on a normal seedling become more obvious on the dwarf. As a consequence, the dwarf shrubs obtained from witches'-brooms offer a wide range of variation in growth patterns.

Our objectives in this project are to select, from these progenies, shrubs that are aesthetically pleasing and different from those currently available. We evaluate them for at least 6

to 10 yeárs and then introduce them to the trade for propagation and dissemination.

Another major objective is to develop methods of rooting these difficult-to-root species. Our current approach is to establish highly select groups of young plants as sources of cuttings. The plants selected must exhibit, by their third or fourth year, growth characteristics that show promise.

Earlier work with white pine witches'-broom seedlings showed excellent rooting of 4 year old plants. On 5 year old plants, however, there was a significant reduction in the percent rooted. By initially taking cuttings from selected young seedlings and by repeating this in subsequent years, i.e. by taking cuttings only from young rooted cuttings, we hope to produce a source of cuttings that will root at fairly high percentages. If we had to wait for the 6 to 10 years required to select a plant to be named, its cuttings would most likely root at very low percentages.

Tables 1 through 7 illustrate clonal differences and, in some instances, progeny differences, on jack pine, white pine, Norway spruce, Canadian hemlock, and eastern larch cuttings rooted under mist.

Cuttings of jack pine (*Pinus banksiana*) were collected on March 16 from four 6-year-old seedlings. All cuttings were treated with 5000 ppm K-IBA and inserted into flats of granular Styrofoam and sawdust (1:1, v/v) or granular Styrofoam and peat (1:1, v/v). Rooting percentages were recorded on July 9.

Rooting was better in the styrofoam and sawdust mixture (Table 1). Clones 23 and 54 had 60% and 80% rooting, respectively, whereas clone number 21 did not root. Subsequently growth of the potted cuttings was fairly rapid and required more frequent repotting than the other pine species.

Table 1. Effect of rooting medium on the rooting percentages of jack pine (*Pinus banksiana*).[1]

	Rooting percent of clone numbers			
Medium	12	21	23	54
Styrofoam and peat (1:1, v/v)	0	0	20	20
Styrofoam and sawdust (1:1, v/v)	40	0	60	80

[1] All cuttings taken from 6 year old plants.

Cuttings from three 4-year-old white pine witches'-broom progenies were taken on December 23 and treated with 4000

ppm IBA in talc and inserted into flats containing supercoarse perlite, Rooting percentages were recorded April 18.

There were differences in rooting percentages not only among clones, but also among progenies from different witches'-brooms (Table 2) Nine of 10 Clinton clones rooted while only 5 of 10 Parsonage clones rooted.

Table 2. Clonal differences in rooting percentages of cuttings taken from 3 white pine (*Pinus strobus*) witches'-broom progenies.

	Clinton witches'-broom clones									
	9	19	29	21	22	23	29	37	46	47
Percent rooted	80	100	100	40	60	40	0	100	100	100
	Parsonage witches'-broom clones									
	1	2	3	4	5	6	7	8	9	10
Percent rooted	0	100	0	0	60	30	0	0	40	40
	Hillsboro witches'-broom clones									
	1		2	3	4	6	8	9	16	45
Percent rooted	0		0	60	50	0	100	60	100	100

Cuttings from six 7-year-old Pomfret Norway spruce witches'-broom clones were collected on January 22 and treated as follows:

a) Submerged for 24 hours in a 10% sucrose solution plus 8000 ppm IBA in talc
b) Submerged in 10% sucrose
c) 8000 ppm IBA in talc
d) Control

Rooting percentages were recorded on May 20 and were highest on cuttings treated with sucrose plus IBA (Table 3). Treatments containing sucrose induced higher rooting percentages than the treatments lacking sugar. There were sharp clonal differences among the six clones.

Table 3. Effects of sucrose and hormone treatment on the percentage rooting of 6 Norway spruce (*Picea abies*) witches'-broom clones[1].

	Percent rooting of Pomfret witches'-broom clones						
Treatment	2	9	14	17	18	20	Avg.
10% sucrose + 8000 ppm IBA	0%	0%	0%	75%	100%	100%	54.8%
10% sucrose	0	0	25	75	75	75	41.6
8000 ppm IBA	0	0	0	50	25	0	12.5
Control	0	0	0	50	0	25	12.5

[1] All cuttings from 7-year-old plants.

All cuttings from forty 7-year-old West Street Norway spruce witches'-broom clones were collected on November 17, treated with 1000 ppm IBA in talc, and inserted into flats of peat and sand (1:1, v/v). Rooting percentages were recorded on March 16.

Clonal differences were apparent with 9 out of the 40 clones having 100% rooting. Thirty-one or 77% of the clones had rooting percentages that were 50% or greater, while 9 or 23% of the clones did not root (Table 4).

Table 4. Variation in rooting among 40 Norway spruce (*Picea abies*) witches'-broom clones[1].

	Rooting percent groups		
	0	50-75	100
Number of clones rooting	9	22	9

[1] All cuttings taken from three year old plants.

Two Canadian hemlock witches'-brooms progenies were quite different from one another. The Woodstock progeny consisted mainly of low shrubs with spreading horizontal branches, whereas the plants of the Hills progeny were oval and had vertically oriented branches.

Cuttings were collected on January 4 from six 5-year-old and from six 12-year-old Woodstock clones. With two-year-old wood at the bases, all cuttings were dipped into a solution of 20,000 ppm IBA in alcohol and water then inserted into flats of peat and perlite (1:1, v/v). Rooting percentages were recorded on May 10. Rooting of most all Woodstock clones was successful when taken from 5-year-old plants (Table 5). Those taken from 12-year-old plants, however, exhibited greater clonal differences and lower rooting percentages.

Table 5. Clonal differencees in rooting percentage of cuttings taken from one Canadian hemlock (*Tsuga canadensis*) witches'-broom progeny.

	Rooting percentage of Woodstock witches'-broom clones					
Clone age (yr)	1	2	3	4	5	40
5	100	100	80	90	70	40
12	0	60	80	40	0	20

All of the clones among the Hills hemlock progeny rooted 100%. The cuttings were collected from nine 5-year-old clones on January 4. With 2- or 3-year-old wood at the base, the cuttings were dipped into a solution containing 20,000 ppm IBA in alcohol and water and inserted into flats containing

peat and perlite (1:1, v/v). Rooting percentages were recorded on May 10.

Table 6. Clonal differences in rooting cuttings taken from one Canadian hemlock (*Tsuga canadensis)* witches'-broom progeny.

	Rooting percentage of Hills witches'-broom clones[1]								
	1	2	3	4	5	6	7	8	11
Rooting percentage	100	100	100	100	100	100	100	100	100

[1] All cuttings taken from 5 year old plants.

Cuttings of eastern larch, *Larix laricina*, were collected from four 8-year-old witches'-broom clones on June 13 and divided into two groups. Group 1 was treated with 10,000 ppm IBA in talc plus captan while Group 2, the control, was treated only with Captan. Both groups of cuttings were inserted into flats containing granular Styrofoam and peat (1:1, v/v). Rooting percentages were recorded on October 27.

Responses to hormone treatment illustrate no significant differences (Table 7). Only one of the four clones had a low level of rooting in both treatments. The results show that eastern larch can be rooted from 4-year-old witches'-broom seedlings.

Table 7. Effects of hormones on the percentage rooting of eastern larch (*Larix laricina*) witches'-broom clones.[1].

	Rooting percentages of Newport witches'-broom clones:			
Treatment	7	15	17	29
10,000 ppm IBA + Captan	50	30	80	40
Captan (control)	60	0	50	70

[1] All cuttings taken from 8-year-old plants.

SUMMARY

It is not surprising that witches'-broom seedlings exhibit so much clonal variation. Because the rooting of most of the conifers discussed here is difficult, it pays to spend the time searching for those individuals which are more easily rooted. Once those seedlings are identified as being good rooting clones, they should be perpetuated by the repeated collection of cuttings from rooted cuttings so as to maintain them as close to the juvenile stages as possible.

Not only will the rooting percentages be greater, but the subsequent growth of the potted cuttings will also be greater

than on cuttings taken from older plants.

WESTERN NORTH CAROLINA HEMLOCK SEEDLING PRODUCTION

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INTRODUCTION

To understand why we grow hemlock seedlings the way we do in Western North Carolina (WNC), you need to know something about us. Although we are nearly as far south as Los Angeles, WNC has nursery production areas in hardiness zones 5, 6, 7 and 8. Such dramatic differences in climate in a relatively small area are due to elevation and slope. Most of our hemlock seedling production is in the Blue Ridge and Smokey Mountains at elevations between 1500 and 3500 feet. Most hemlock field production is in Zone 7 while most seedlings and transplants are grown in Zone 6.

The mountains contribute to regular rainfall, abundant high quality irrigation water and morning fog, almost daily during mid-summer and early fall, in the coves and valleys where we grow hemlock seedlings. Our southern latitudes give us a frost-free growing season from about May 10 to October 10. This very closely parallels the period of active growth for above ground portions of hemlock seedlings. The southern mountains have not been glaciated or inundated so we often are faced with old, weathered clay soils.

Bed Preparation. The standard WNC hemlock seedling production unit is the 400 sq ft (4 × 100 ft) raised bed. Soil samples are taken in mid to late summer. If the production area is in sod or perennial weeds, the area is sprayed with Round-up.

When soil test results return, about a month later, needed fertilizer is broadcast. WNC soils are usually very low in phosphorus, calcium, magnesium, and pH. We like to lime with dolomite to a pH of 5.5 to 6.0 and achieve a calcium to magnesium ratio of about 3 to 1. Occasionally, we are unable to achieve the desired levels by liming. When this happens, we use sulfur to lower the pH, gypsum to raise calcium without raising pH and either magnesium sulfate or olivine to raise magnesium levels. Treble superphosphate (0-44-0) is most often used to raise soil phosphorus levels to the high reading we