Table 2. Effect of several hormone products on the rooting of softwood cuttings of two species.

Species, Rooting Period, and Number of Replications( )		Treatment	Percent of Cuttings Rooted	Average Rooting Value*	
Forsythia × *intermedia* 'Spring Glory'		Control	90.0%	19.0	N S **
5/14/81 - 6/1/81	(4)	Dip N'Grow 1 in 10	97.5	20 5	N.S.
		Dip N'Grow 1 in 20	80.0	16 3	N.S.
		Dip N'Grow 1 in 40	97 5	24 0	N.S.
		Dip N'Grow 1 in 20 Old formulation	97 5	20 5	N.S
		Woods R.C 1 in 10	97.5	22.5	N.S.
		Woods R.C 1 in 20	97.5	23 0	N.S.
		Woods R.C. 1 in 40	92.5	22.5	N S
		Hormodin 2	100.0	24 8	N.S.
Viburnum × *burkwoodii*		Control	82.5	14.0 a	
5/13/81 - 6/16/81	(4)	Dip N'Grow 1 in 10	97 5	28.3 b	
		Dip N'Grow 1 in 20	75.0	16 3 a	
		Dip N'Grow 1 in 40	90.0	15.5 a	
		Dip N'Grow 1 in 20 Old formulation	97.5	26.3 b	
		Woods R C 1 in 10	97.5	27.0 b	
		Woods R.C. 1 in 20	100 0	26 0 b	
		Woods R C 1 in 40	100.0	24.0 b	
		Hormodin 2	90 0	17 3 a	

* See text for explanation of rating scales.
** Means followed by the same letters are not significantly different at 5% level of the Duncans Multiple Range Test.

PROPAGATION OF ALASKA YELLOW CEDAR (*CHAMAECYPARIS NOOTKATENSIS* [D. DON] SPACH.) BY ROOTED CUTTINGS FOR PRODUCTION PLANTING

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Abstract. Rooted cuttings of yellow cedar from young material reached a plantable size in one growing season Two and four years after planting on typical sites, survival and height growth of the cuttings compared favorably to those of the seedlings. A hedging orchard was established from seed of selected parent trees in order to produce juvenile material for the large scale production of rooted cuttings and, in 1981, the first production of rooted cuttings for reforestation was begun

An increase in high-elevation logging activities in the Coastal Forest Regions of British Columbia has focused attention on the use of "minor" species for reforestation. Yellow cedar is an important and valuable component of certain ecosystems at these high elevations. Unfortunately, the seedling requirement for the reforestation of this species cannot be met by the nurseries because of the shortage of cones and poor seed germination. Therefore, the alternative method of producing planting stock of yellow cedar by means of rooted cuttings has been explored.

Rooted cuttings can be produced quite successfully in many conifer trees, providing that the cuttings are taken from juvenile material. In Japan, *Cryptomeria* cuttings have been used extensively in reforestation for centuries. In West Germany, a million Norway spruce rooted cuttings are produced annually from selected trees for reforestation (5). In Ontario, Canada, a program using rooted cuttings from young white spruce ortets is under way both for tree improvement and reforestation (7). In many species, however, there is a decrease in growth rate and orthotropic growth form in the cuttings as a result of increased age of the parent trees, e.g. in *Pinus radiata* (8). On the other hand, it is recognized that juvenility can be retained by "hedging" forest trees to provide a source of juvenile material for cuttings (6).

For yellow cedar, Bloome and Van Hulle (1) and Van Elk (3) in different studies of ornamentals, had little success in rooting cuttings from old trees. Similar results were obtained by Karlsson (4) when rooting old material, but when taking cuttings from 3 to 10 year old trees and setting the cuttings in coarse, well-aerated material, and applying hormones as recommended by Brix (2), rooting was successful and plantable stock was produced in one growing season.

Growth comparison between rooted cuttings and seedlings of yellow cedar

Even though rooting of cuttings from young yellow cedar trees can be accomplished easily, the material would not be considered seriously in a reforestation program without some knowledge of how the cuttings' growth performance compare to that of seedlings.

To gain information on those features, two experimental plantations were established on sites suited to reforestation by yellow cedar.

The first plantation is located at 1000 m elevation in the Mission area (Lat. 49° 10′ Long. 122° 20′) and was planted in row-plots of five trees in the fall of 1976.

The following plant categories were included:

a) Seedlings } Provenance: Mission
b) Rooted cuttings taken from 1 year old seedlings } Provenance: Mission
c) Rooted cuttings taken from 3 year old seedlings
d) Rooted cuttings taken from 7 year old seedlings — Provenance: Kelsey Bay — Lat. 50° 22′ Long. 126° 02′

The results after four years on site appear in Table 1.

Table 1. Survival and total height by year since planting at Mission.

Type of plant	No. planted	Survival percentage 1980	Average height cm				
			Age 1	2	3	4	5
			Time of planting	1977	1978	1979	1980
a) Seedlings	75	98.7	34.7	42.0	61.8	95.3	129.5
b) Cuttings, ortet 1 yr.	75	98.7	44.4	58.0	79.6	107.9	142.0
c) Cuttings, ortet 3 yr.	75	100	36.2	50.4	70.9	100.9	129.7
d) Cuttings, ortet 7 yr.	60	100	34.8	47.2	65.1	95.6	129.3

The second plantation was established in the fall of 1978 on Mt. Ephinstone at 1000 m elevation (Lat. 49° 28′ Long. 123° 33′). Both the seedlings and the cuttings originated from cones collected from 10 selected trees in the Mt. Ephinstone area. At time of planting, seedlings in this test were two years of age and the cuttings, which were taken from 2-year old ortets, were one growing season old. Each family is represented by 50 seedlings and 50 cuttings and planted in replicated row-plots of 10 trees. This plantation has been browsed heavily by deer, but both types of plants have been hit equally. Survival and height growth were recorded after two growing seasons in the field and provided the following data:

Table 2. Survival and total height after two years at Mt. Ephinstone.

Family No.	Survival Percentage		Average height, cm			
			Seedlings		Cuttings	
	Seedlings	Cuttings	Time of planting	2 yrs in field	Time of planting	2 yrs in field
23	98	92	37.4	56.7	37.6	58.4
29	90	92	37.1	58.4	41.8	60.7
30	98	94	35.8	52.8	37.0	61.5
31	88	86	35.0	56.1	41.8	69.9
33	92	96	32.5	56.3	38.6	59.4
34	98	98	41.8	52.7	43.1	61.7
35	90	100	43 0	49.2	35.3	54.5
39	98	100	39.3	58.2	43.8	62.4
40	98	94	43.2	57.8	34.0	56.6
42	90	98	36.7	58.3	33.3	53.1
Mean	94	95	38.2	55.7	38.6	59.8

The most noticeable feature of these plantations is the high survival rate for both seedlings and cuttings. Ortet age did not affect survival (Table 1). The poorest family at Mt. Ephinstone, number 31, was not significantly poorer than the best (Table 2).

Cutting height growth was not affected by ortet age although cuttings from 1-year-old seedlings grew about 10 percent taller. This difference is due to a height advantage these cuttings had at a time of planting (Table 1). No correlation was found between mean height of seedlings and cuttings from the same family (Table 2). At the end of the second growing season in the field, most cuttings had obtained orthotropic growth form and there was no obvious difference between the seedlings and the rooted cuttings.

Judging by these early results, the use of rooted cuttings can be considered as an alternative in a reforestation program when seedling planting stock is in short supply.

Establishment of hedging orchard and rooting cuttings for reforestation

The successful results from the rooting of yellow cedar cuttings in 1974 led to the decision to establish a hedging orchard to provide material for the future production of rooted cuttings for reforestation. The selection of parent trees of good phenotype and the collection of cones from these trees were carried out by staff from the Vancouver Forest Region between 1975-78. The seedlings from these selected trees were grown in the nursery, and in 1978-79 the hedging orchard was established at Cowichan Lake Research Station. The seedlings were planted in rows 3.75 m apart with 90 cm between the seedlings. Each row of 50 seedlings represents one family of half sibs. The total orchard is 0.8 ha. With the wide spacing between the rows it is possible to rogue out a family if necessary and replant a more suitable one without having to consider competition from neighboring rows. Two years following the planting of the hedge rows, the seedlings had reached their productive size. It is estimated that 4 to 5 years after establishment this orchard should yield enough material to produce 250,000 cuttings yearly.

In 1979 and 1980 some testing of growing regimes was conducted to evaluate different approaches to a large scale production of rooted cuttings. Different container types were tested, and the Spencer-Lemaire containers were found to be superior, yielding 80 percent plantable stock. Because this container opens up to release the plants, planting can take place directly from the containers without unnecessary disturbance to the delicate root systems of the cuttings. There is also a financial saving in using the Spencer-Lemaire containers as compared to other container types where the cuttings must be re-potted before field planting.

Based on these results, the Silviculture section of the Vancouver Region requested 50,000 plantable rooted cuttings for their 1981 fall planting program. To meet this request, 75,000 cuttings were clipped from the hedging orchard in January of this year, set in Spencer-Lemaire containers, and placed in greenhouses. The resulting stock will be planted under production conditions in October, 1981.

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NEW HORIZONS IN ROOTING HORMONES

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My first remembrance of using a liquid rooting hormone goes back to 1951 when I tried a 24 hour soak of English holly in ethanol and IBA. After reading in Hartmann and Kester's text (1) on plant propagation the advantages of liquid hormones I decided this was the way to go. Since that time I have been involved with improving my abilities in rooting cuttings as a commercial wholesale grower. My first tests with ethanol as a solvent showed that with certain water sources as a diluent, a precipitate would form. From there I went to additional solvents to prevent this. After trying many, I found improved rooting was because of better penetration of the hormone through the plant tissue, I determined to find the best additional solvent for penetration.

To me, the reasons for using a liquid hormone are many. Firstly, you can select the concentration best for the species or cultivars you grow. The best concentration for any given plant is varied because of climate, fertility, water, age of plant, hardness of cutting, and time of year. The way you can deter-