should be, we side dress with ammonium nitrate. By the first of July our buds should be in the neighborhood of six feet tall.

Pruning is confined primarily to getting the young bud off to a fast, straight start If all side branches are kept off the shoot until it is four or five feet in height, you will be quite sure of getting a straight tree. Ninety per cent of the crooked trees we have are a result of leaving on side limbs to furnish budwood. We have on occasion topped six to eight feet whips in July in an attempt to stimulate branching but this has given us inconsistent results. Apparently the earlier you are able to top the whip, the better the chances of producing a branched tree.

For the past couple of years the average height of our block of one year buds has averaged about eight feet, with many trees topping ten feet. Most of our trees are sold as one year trees, although a few are grown the second year. At the beginning of the second year those trees which are retained are topped at 7 to 7½ feet. They make beautiful heads that growing season, and put good caliper, some reaching 1½" by the end of the second growing season Thank you.

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MODERATOR FILLMORE: We thank Mr. Nicholson very much indeed for this presentation on the propagation of varieties of honeylocust by budding. I am also personally very glad to hear a discussion of budding. I regard budding as the most advanced plant propagating technique that we have, particularly in the sense that every solitary bud on the plant becomes a potential new plant instead of having to use perhaps 15 buds, as we frequently do on a leafy cutting.

Are there any questions for Mr Nicholson?

If not we shall now proceed to "The Rooting of Conifers Under Intermittent Mist" by Dr. Stuart H. Nelson, who is in plant propagation and nursery management research at the Plant Research Institute, Ottawa, Canada. Dr. Nelson.

Dr. Nelson presented his talk in two parts, which covered the seasonal propagation of evergreens under mist. Tabular data was presented by means of slides. (Applause)

THE SUMMER PROPAGATION OF CONIFER CUTTINGS UNDER INTERMITTENT MIST*

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Conifer cuttings are usually collected in the winter months after sticking and root very slowly, even under greenhouse conditions. Rooting periods six to eight months in length are not uncommon for some

*Contribution No 38 from the Plant Research Institute, Research Branch, Canada Department of Agriculture, Ottawa, Ontario species. In view of this, successful evergreen propagation outdoors in the relatively short summer season was not anticipated Limited tests, however, with small numbers of cuttings gave encouraging results under mist during the 1955 to 1958 seasons. When the results were evaluated, it was apparent that this type of propagation had promise, but the data lacked the scope and continuity to establish definite trends. Accordingly, in 1959, experiments were initiated to establish hormone and propagation bed requirements.

There is some evidence in the literature to support the use of mist for the propagation of conifers during the summer. Fillmore (1) reported on the successful rooting of *Chamaecyparis pisifera* under mist outdoors in Nova Scotia. He also reported 100 percent rooting of *Taxus media hetzi*. Ward (4) reported fair results with two species of *Thuja* under intermittent mist in Iowa, while Steavenson (3) in Missouri reported relatively low rooting percentages with *Juniperus* when the outdoor mist beds were shaded with lath.

RESULTS AT OTTAWA

In 1959, all combinations of five hormone treatments and three types of propagation beds were tested. The hormone treatments, included a check, Hormodin No 1, Hormodin No. 2, Hormodin No. 3 (0.1, 0.3 and 0.8 percent indolebutyric acid in talc, respectively) and Chloromone (an alfalfa extract of unknown consistency). The three mist propagation beds consisted of an open bed without bottom heat, an open bed with bottom heat of 65 degrees F. and a polyethylene covered bed with no bottom heat. The latter received four seconds of mist every minute during the daylight hours, while the open beds received only eight seconds of mist every five minutes during the daylight hours. The construction of these frames has been fully described by Nelson (2).

The results are most conveniently tabulated according to genus and the treatment, the code for which is as follows:

Ck—Check treatment
H#1—Hormodin #1 (0.1 per cent indolebutyric acid in talc)
H#2—Hormodin #2 (0.3 per cent indolebutyric acid in talc)
H#3—Hormodin #3 (0 8 per cent indolebutyric acid in talc)
C—Chloromone (an alfalfa extract of unknown consistency)
IMO—Intermittent mist outdoors, 8 seconds of mist every 5 minutes
PTO—Polyethylene tent outdoors, 4 seconds of mist every 5 minutes
BH—Bottom heat of 65 degrees F.
NBH—No bottom heat.

Chamaecyparis As shown in Table 1, no difficulty in rooting was experienced with the three species listed. Hormones, bottom heat or the high air temperature in the polyethylene tent were not required for 100 per cent rooting It should be noted, however, that all the cuttings treated with Chloromone in the open frame without bottom heat could have been transplanted by the end of six weeks, while a period of eight weeks and longer was needed for the other treatments. Increased strengths of Hormodin increased the rate of rooting slightly Bottom heat was not apparently beneficial, although this was expected, since temperatures below 65° F. were uncommon between June 15 and August 15. There were, however, indications that the combination of bottom heat and strong hormone treatments were detrimental, this was quite obvious in the polyethylene tent. In the latter, high concentrations of hormone increased the speed of rooting. Although it also increased the occurrence of rot, which resulted in a lower rooting percentage, *C. pisifera plumosa aurea* was the most severely affected.

Table 1.—Percentage rooting of Chamaecyparis spp. under intermittent mist outdoors

Plant Material	Propagation Bed	Hormone Treatment Ck.	H#1	H#2	H#3	C
C. pisifera plumosa argentia	IMO-NBH	100	100	100	100	100
	IMO-BH	100	100	100	100	100
	PTO-NBH	80	90	100	80	60
C. pisifera plumosa aurea	IMO-NBH	100	100	100	100	100
	IMO-BH	100	100	100	100	90
	PTO-NBH	60	60	40	10	0
C. pisifera squarrosa	IMO-NBH	100	100	100	90	100
	IMO-BH	90	100	100	100	100
	PTO-NBH	90	100	100	100	90

Juniperus. This genus was quite slow to root. The results presented in Table 2 represent the amount of rooting up to October 1, 1959.

As found in the winter propagation, there was also a great varietal difference in ability to root in the summer. In addition, there was a marked seasonal variation in rooting.

In 1957, *Juniperus chinensis hetzi* gave 90 and 80 per cent rooting respectively, with Hormodin #3 and the check treatment, each with bottom heat in the open mist bed. However, under similar treatments, (Table 2), the rooting was much reduced in 1959. Use of polyethylene tent reduced rooting in both years. The cuttings, this year, were still in good condition on October 1st and would likely have rooted. On the other hand, *J. chinensis keteleeri* was very subject to rot and only a few rooted cuttings escaped the rot.

The 1956 results with *Juniperus chinensis pfitzeriana aurea* showed the same trend in rooting as that observed this year, although at a lower level. The use of hormone tended to decrease the rate of rooting, even though the ultimate rooting in the polyethylene tent was higher.

The results with *J. communis depressa aurea-spica* were complete by the middle of September. The occurrence of rot was very high in the polyethylene tent. There were slight indications that hormones increased the rapidity of rooting, although bottom heat was unnecessary at this time of the year.

With cuttings of *J. horizontalis douglasi* and *J. h. plumosa,* the polyethylene tent resulted in the fastest rooting, which reduced the effects of hormones. This was apparently the best treatment for the spe-

Table 2.—Percentage rooting of Juniperus spp. under intermittent mist outdoors.

Plant Material	Propagation Bed	Hormone Treatment				
		Ck	H#1	H#2	H#3	C
J chinensis hetzi	IMO-NBH	10	10	20	10	30
	IMO-BH	10	10	10	40	10
	PTO-NBH	20	0	20	30	20
J. chinensis keteleeri	IMO-NBH	0	10	10	10	0
	IMO-BH	0	0	10	0	10
	PTO-NBH	0	0	10	0	0
J. chinensis pfitzeriana aurea	IMO-NBH	30	30	50	50	40
	IMO-BH	100	80	90	90	80
	PTO-NBH	80	90	100	100	100
J communis depressa aurea-spica	IMO-NBH	100	90	100	100	100
	IMO-BH	100	100	100	100	100
	PTO-NBH	10	20	0	0	0
J horizontalis douglasi	IMO-NBH	90	90	100	90	100
	IMO-BH	100	100	100	100	100
	PTO-NBH	100	100	100	100	100
J horizontalis plumosa	IMO-NBH	90	100	80	50	100
	IMO-BH	100	80	70	90	100
	PTO-NBH	100	100	100	100	90
J sabina	IMO-NBH	60	50	30	40	100
	IMO-BH	20	60	50	20	90
	PTO-NBH	50	50	50	40	20
J. sabina tamariscifolia	IMO-NBH	10	20	0	0	20
	IMO-BH	20	0	10	10	20
	PTO-NBH	60	30	30	40	20
J. scopulorum	IMO-NBH	30	10	10	0	10
	IMO-BH	0	10	10	0	0
	PTO-NBH	0	0	0	0	0

cies. Hormone effects were greatest in the open bed with no bottom heat, yielding increased rate of rooting with increased strength.

Juniperus sabina and *J. s. tamariscifolia* were relatively difficult to root. *J. sabina* responded favorably to Chloromone in the open beds but was adversely affected in the high temperature of the polyethylene tent. However, in 1958, the Hormodin powders were all superior to the check and Chloromone treatments. The same situation existed in 1958 with *J. s. tamariscifolia* where 96 per cent rooting occurred in the open propagation bed without bottom heat, and was extremely poor in the polyethylene tent. Since many of the cuttings were not rooted in 1959, but still in excellent condition, there must have been something connected with the season which resulted in poor rooting. In 1959 the mean air temperature was much higher than in the preceding year, and cloudiness more prevalent. More precise information at propagation bed level, however, would be required to explain these results.

Juniperus scopulorum was a difficult plant to root under most conditions. However, in 1956 and 1958, 60 and 90 per cent rooting, respectively, was obtained with Chloromone in the open bed with bottom heat. This treatment was superior to the Hormodin powder and the check treatments. In 1958, the results in the polyethylene tent were also very poor.

In summary, there were a few junipers that rooted readily and quickly, but for the species that were more difficult to root, more specific information is needed about seasonal variations in order to explain the wide variance in rooting over the years.

Taxus. Branched, two-year old cuttings were the only type available this year and their rooting ability was known to be inferior to that of current season's wood. The results were further influenced by chlorosis which developed on cuttings in the mist propagation frames. The results, as shown in Table 3, for this type of cutting have been similar in 1955, 1957 and 1958. In general, over the years, bottom heat and strong hormones have been beneficial on cuttings in the open beds. The polyethylene tent, however, yielded poor results, primarily because of rots.

Table 3.—Percentage rooting of Taxus spp. under intermittent mist outdoors

Plant Material	Propagation Bed	Hormone Treatment				
		Ck	H#1	H#2	H#3	C
Taxus baccata	IMO-NBH	20	40	40	60	10
repandens	IMO-BH	10	80	70	70	50
	PTO-BH	20	50	60	30	40
Taxus cuspidata	IMO-NBH	80	80	70	80	40
	IMO-BH	40	20	30	70	70
	PTO-BH	20	40	30	10	30

Thuja. The 1959 results are presented in Table 4, and, in general, *Thuja* was easily rooted under intermittent mist outdoors. Bottom heat was not necessary and hormones did not increase the percentage rooting. However, Chloromone increased the rate of rooting markedly in the open beds with the cuttings being transplanted in six weeks. The polyethylene tent was inferior to the other propagation facilities and the reduced rooting and prevalence of rot varied with varieties.

The poor results obtained with *T.o.* "Columbia" could not be explained. Immediately after the cuttings were placed in the mist beds, about one inch of the foliar margin of all cuttings turned brown and rot later became a problem. In 1958, this browning did not occur and 70 per cent rooting occurred from the Chloromone treatment located in the open mist beds.

In summary, *Thuja* were very successfully propagated under mist at Ottawa. Hormones, especially Chloromone, increased the rate of rooting and bottom heat was not found to be necessary. The polyethylene type of propagation facility was inferior to open mist beds for cuttings of *Thuja* at Ottawa.

Table 4.—Percentage rooting of **Thuja occidentalis** varieties under intermittent mist outdoors.

Plant Material	Propagation Bed	Hormone Treatment				
		Ck.	H#1	H#2	H#3	C
T.o "Columbia"	IMO-NBH	30	10	10	20	30
	IMO-BH	20	20	20	10	30
	PTO-BH	0	0	0	0	0
T.o. ellwangeriana	IMO-NBH	100	100	100	100	100
	IMO-BH	100	100	100	100	100
	PTO-NBH	90	90	70	70	40
T.o. hollandica	IMO-NBH	100	90	90	80	90
	IMO-BH	70	60	50	80	90
	PTO-NBH	30	20	20	30	40
T.o. hoveyi	IMO-NBH	80	80	100	100	100
	IMO-BH	80	70	100	80	100
	PTO-NBH	50	30	30	30	30
T.o "Little Gem"	IMO-NBH	100	100	100	100	100
	IMO-BH	100	100	100	100	100
	PTO-NBH	20	30	60	90	40
T.o. lutea (elegantissima)	IMO-NBH	70	90	100	100	100
	IMO-BH	100	100	100	80	100
	PTO-NBH	90	100	100	90	30
T.o. "Patmore"	IMO-NBH	100	80	100	100	100
	IMO-BH	100	100	100	100	100
	PTO-NBH	60	80	90	100	60
T.o. pyramidalis	IMO-NBH	100	100	100	100	100
	IMO-BH	100	100	100	100	100
	PTO-NBH	70	90	100	80	30
T.o. "Rheingold"	IMO-NBH	100	90	100	100	90
	IMO-BH	100	90	100	100	100
	PTO-NBH	10	0	20	20	20
T.o. saundersi	IMO-NBH	60	70	80	80	90
	IMO-BH	70	90	90	100	90
	PTO-NBH	20	0	10	10	0

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