PROPAGATION OF ILEX VERTICILLATA[1]

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Abstract. Propagation of *Ilex verticillata* (L.) Gray by hardwood and softwood cuttings was evaluated. In both experiments, peat, as a rooting medium, was superior to a mixture of peat and sand. The polyethylene chambers gave better results than the intermittent mist with hardwood cuttings, but was not significantly different for softwood cuttings. Hardwood cuttings did not root satisfactorily, but basal end treatment with 10,000 or 20,000 ppm IBA was advantageous. Wounding of hardwood cuttings did not provide any better results than unireated controls. The softwood cuttings method was much more successful; the optimum level of basal end auxin application was 7,500 ppm IBA. An advantage was gained by combining the peat medium with the mist environment.

Ilex verticillata (L.) Gray, better known as common winterberry, black alder, or Michigan holly, is a deciduous shrub growing abundantly in bog areas throughout the northeastern section of the United States. In the fall, it bears fruits which are generally colored bright orange-red. At one time, the fruiting branches were very popular for wreaths, table arrangements and other Christmas decorations. In the past two decades, the use of this plant has declined, mainly because of prohibition of trespassing on public and private natural stands of *Ilex verticillata*. Because of this, some thought was given to the development of this attractive plant as a plantation crop. It was also considered desirable to help reintroduce it into landscape plantings. Thus, a successful method of propagation to assure a good supply of quality plants is highly desirable. The objective of this study was to evaluate propagation of *Ilex verticillata* by both hardwood and softwood cuttings.

A survey of the literature on propagation of holly plants revealed that a lesser amount of work had been done on hardwood than softwood cuttings. Also, sample size in most experiments was very small. Chadwick (1) and Laurie (8) reported that peat, as a rooting medium, was superior to sand or a mixture of peat and sand. Zimmerman and Hitchcock (10) indicated that hardwood cuttings rooted better between August and January. They found that rooting was possible in darkness. Optimum temperatures were 24 to 27°C. Coggeshall (2) reported benefits from the use of polyethylene film chambers (where vapor pressure deficits are reduced), and wounding of the cuttings.

Kirkpatrick (7) suggested the use of IBA powder application to the basal end of hardwood cuttings. Hans Hess (6) used 0.8% IBA in softwood cuttings, but Neal and Pease (9) preferred a 16-hr dip in 70

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ppm IBA. The latter obtained 78% rooting; but Floor (5) achieved 92% using 500 ppm IBA. Success was more evident with intermittent mist within the greenhouse than in outside frames. Fillmore (4) reported 58% success in the summer period, and by also using a fungicide. Doran (3) obtained 66% rooting.

MATERIALS AND METHODS

Hardwood Cuttings. Uniform hardwood cuttings (7-8 cm) from female plants were used. The rooting media: peat, and a mixture of peat and sand, were steam sterilized at 85°C for 1 hr. Two environments, intermittent mist, and sealed polyethylene chambers were replicated twice in a split plot design. A wire framework supported the white 4 mil polyethylene, 2 ft above the medium surface. To prevent wilting, the interiors of these chambers were misted every 2 to 3 days. The following six treatments were randomly distributed and repeated five times: control; wounding; 10,000 ppm IBA; wounding plus 10,000 ppm IBA; 20,000 ppm IBA; and wounding plus 20,000 ppm IBA. Each replication was composed of 10 cuttings which had previously been given a 5% Captan dip. Wounding comprised two proximal end cuts approximately 1.2 cm long, the depth of the cambium. Throughout the 62-day experiment, which commenced on March 1, 1972, temperature and humidity levels were recorded by means of thermohygrographs. Rooted cuttings were graded into lightly, moderately and heavily rooted categories.

Softwood Cuttings. Uniform, softwood cuttings (8-10 cm) from female plants were utilized. The environment and medium were the same as for hardwood cuttings. The basal stem treatments, applied in talc, were as follows: control (untreated); 10,000 ppm IBA; 7,500 ppm IBA and 3,750 ppm IBA.

Each treatment of 20 cuttings was replicated three times. The duration of this experiment was 58 days (June 12th to August 9th, 1973). In addition to rooting percentage values, the rooted cuttings were graded into lightly, moderately and heavily-rooted cuttings. Index values were derived by multiplication factors of 1, 3, and 5, respectively. Thus, the maximum value of any treatment replication was 100. The data was analyzed by mean separation of pooled means for basal end treatment; media; the interaction of media with environment, and environment with treatment, using Duncan's Multiple Range Test.

RESULTS

Hardwood Cuttings. Temperatures within the chamber ranged from 15 to 40°C, with an average of 20.2°. Values of relative humidity greater than 90% were a general occurrence; but low levels of 76% frequently existed at noon. Under intermittent mist, greater fluctuations were evident, although temperature patterns were similar; the

maximum recorded was 30°C. Relative humidity ranged from 22 to 94%; but most of the time values were in the region of 50%.

Leaf buds became active after 2 weeks, but the subsequent foliage later wilted on all cuttings that failed to root. Overall rooting success was approximately 14%. Cuttings placed in peat rooted 18.8%; and 8.2% success was obtained with peat and sand.

The polyethylene chamber produced 19% rooted cuttings, whereas only 8% of those under intermittent mist developed roots. All treatments receiving IBA had values larger than the untreated control or wounded cuttings. Statistical analyses were not conducted on these data.

Softwood Cuttings. Temperature and humidity recordings were similar to those measured in the previous experiment. The peat medium gave 82.4% success, whereas 67.2% rooting occurred in peat and sand, and the difference was significant at the 1% level. Under intermittent mist there was 76% rooting and a 73% value was obtained with polyethylene chambers. The interaction of medium and environment was highly significant for each combination. The best combination, a peat medium with an intermittent mist environment produced 87% rooting.

Table 1. Rooting percentage and rooting index for *Ilex verticillata* (L.) softwood cuttings as influenced by the medium.

Medium	Rooting Per Cent	Rooting Index
Peat	82.4	63.6*
Peat-sand	67.2	43.0

*Means significantly different at the 1% level.

Table 2. Rooting percentage and rooting index for *Ilex verticillata* (L.) softwood cuttings as influenced by basal treatment.

Treatment	Rooting Per Cent	Rooting Index
7,500 ppm IBA	82.5	63.4a*
10,000 ppm IBA	75.4	61.3a
3,750 ppm IBA	76.1	55.6b
o ppm IBA	65.2	33.1c

*Means followed by the same letter are not significantly different at the 1% level.

Cuttings treated with IBA rooted significantly better than untreated cuttings (Table 2). The IBA treatments produced a greater percentage of rooted cuttings, and the cuttings were more heavily rooted. The interaction of medium, environment and treatment was highly significant. The best combination was cuttings treated with IBA, and rooted in a peat medium, under mist (Table 3).

Table 3. Rooting percentage of *Ilex verticillata* (L.) Gray softwood cuttings as a function of treatment, environment, and medium.

Treatment	Environment				
	Poly. Tent		Mist		
	Peat	Peat & Sand	Peat	Peat & Sand	$\bar{x}$
Control	70.8	69.2	74.2	46.7	65.2
Treatment #1	69.2	70.0	92.5	70.0	75.4
Treatment #2	83.3	75.0	90.0	81.7	82.5
Treatment #3	85.0	64.2	91.7	63.3	76.1
$\bar{x}$ Envir. x Media =	77.1	69.6	87.1	65.4	
$\bar{x}$ for Environment =	73.3		76.3		

DISCUSSION

Hardwood cuttings of common winterberry did not root readily. The work of Chadwick was substantiated in that better results were obtained with peat as a rooting medium. In this experiment, the polyethylene chamber was superior to the conventional intermittent mist. Wounding was not an advantage. An important difference was the application of auxin. The greatest amount of rooting was obtained with cuttings, treated with 20,000 ppm IBA and inserted in a peat medium enclosed in a polyethylene chamber. The biggest problem encountered with propagation of *Ilex verticillata* by hardwood cuttings was the release of dormant shoot buds. Even with maintenance of a high humidity the leaves on unrooted cuttings eventually wilted and died.

Softwood cuttings propagated in the white polyethylene chamber developed a slight chlorosis, but rooted quite well. However, a considerable amount of suckering was observed to arise from a point just above where the roots emerged. The peat medium gave significantly better results than the mixture of peat and sand. Equal results occurred with both environments but the foliage of cuttings under intermittent mist was in better condition. A highly significant interaction was observed between medium and environment. The superior combination was peat under intermittent mist. The peat medium retained its superiority in the polyethylene chamber. There was an obvious gain with the use of IBA. The optimum level was 7,500 ppm because it was equally effective as 10,000 ppm IBA.

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