Refrigerated Storage for Hardwood Cuttings of Willow and Poplar

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When machine-planted in late spring, fall-and spring-harvested cuttings rooted as well after refrigerated storage at 24 ° F as those heeled-in over the winter.

Nurseries in the northern plains region have traditionally stored hardwood cuttings outdoors for spring planting by "heeling-in" at the time of fall harvest. However, these cuttings frequently break dormancy and begin to grow when planting is delayed. As a result, such cuttings not only root poorly, but are also difficult to handle with mechanical planters (*2*) developed for large-scale planting of cuttings.

Hocking and Nyland (*3*) reported extensive studies on refrigerated storage for conifer seedlings, but similar information is lacking for hardwood cuttings. In an exploratory test, the rooting of willow and poplar cuttings was, on the average, superior for those heeled-in overwinter. Polyethylene coverings improved the rooting of cuttings for all clones when refrigerated over the winter. Rooting of poly-covered cuttings for one poplar clone after overwinter storage at 0° F equaled that of those heeled-in, while rooting for some clones after 24° and 35° F storage equaled that for 0° F storage. This paper reports results of a study on overwinter storage of hardwood cuttings for late spring plantings.

Materials and Methods

Fall-harvested cuttings of two willow and two poplar clones were stored overwinter at three temperatures, then planted with spring-harvested and heeled-in cuttings.

Shoots from "stooling beds" were collected and cut into 8-inch (20 cm) lengths on November 1,1967; but in order to provide uniform material, only the two median cuttings from each shoot were used. These were tied in bundles of 25 and stored outdoors by heeling-in or indoors at 0°, 24°, and 35° F (-18°, -4°, and 2° C) in sealed poly-lined bins. Additional cuttings were harvested on Apri11, 1968, and stored in sealed polyethylene bags at 24° F. The heeled-in cuttings were also lifted and similarly stored the same day.

All cuttings were field planted with a four-row planter (*2*) on May 24,1968. The planting was a randomized block design with 25 cuttings of each storage treatment per plot, replicated five times for each clone. An overall spray of linuron herbicide was immediately applied for weed control and incorporated by 1 inch (2.5 cm) of irrigation. During the subsequent growing season, 6.3 inches (16 cm) of rainfall were recorded and 6.5 inches (16.5 cm) of irrigation were applied as required to promote rooting.

Moisture content of cuttings was determined at harvest time in the fall and spring and at time of planting after the five storage treatments. Moisture content was calculated as a percentage of the dry weight from eight samples of cuttings from each treatment, with the results listed in table 1.

The number of planted cuttings that manifested top growth was recorded for each storage and clone at 10 weekly intervals from June 10 to August 23. From these records, the rate of top growth was calculated to evaluate the effects of storage treatments on top growth of cuttings and the relationship of top growth to rooting.

All cuttings were lifted on October 2 and the number with roots was recorded for each storage treatment. The rooting capacity was then calculated as a percentage of the cuttings planted for each treatment and clone, as listed in table 2. Percentage data for moisture and rooting were transformed for analysis of variance to determine the significance of mean differences, but are reported as percentages in the tables.

Results and Discussion

Moisture content of poplar cuttings was, at time of harvest and after five storage treatments (table 1), some 30 percent greater than for willow cuttings. Moisture content was consistently lowest for the spring-stored cuttings and significantly higher for heeled-in cuttings of all clones.

Rooting capacity of hardwood cuttings after five storage treatments (table 2) was significantly different

Table 1.—*Moisture content[1] of hardwood cuttings of two willow and two porflar clones (means for eight samples)*

Storage treatments		Clones				Storage treatment means
		Poplar		Willow		
Harvest time	Temperature	Northwest	Tristis	Basford	Laurel	
	°F	%	%	%	%	%
Spring	24	101a[2]	94a	69a	70a	84
Fall	0	103b	96a	73b	77c	87
Fall	24	1060	99ab	75bc	73b	88
Fall	35	103b	104b	76bc	77c	90
Fall	Heel-in[3]	152d	142c	104d	114d	128

[1]Moisture content as a percentage of the dry weight after ovendrylng for 24 hours at 100' C.
[2]Means within a column followed by a common letter are not significantly different at the 5-percent level.
[3]Heeled-In cuttings lifted April 1 and stored at 24° F until planted.

Table 2.—*Rooting capacity[1] for hardwood cuttings of two willow and two poplar clones after five storage treatments for fall and spring harvests (means for five replications of 25 cuttings)*

Storage treatments		Clones				Storage treatment means
		Poplar		Willow		
Harvest time	Temperature	Northwest	Tristis	Basford	Laurel	
	°F	%	%	%	%	%
Spring	0	56a[2]	60b	19a	13a	37a
Fall	35	61a	38a	53b	59b	53a
Fall	24	65a	65b	66bc	42b	60abc
Fall	24	65a	82b	74cd	39b	65bc
Fall	Heel-in[3]	68a	76b	86d	84c	78c

[1]Fall-rooted cuttings as a percentage of the spring plantings.
[2]Means within a column f ollowed by a common letter are not significantly different at the 5-percent level.
[3]Cuttlngs heeled-In outdoors over the winter were lifted April 1 and stored at 24' F until planted May 24.

for clones and species. On the average, the rooting of cuttings after overwinter storage was highest (78%) for those heeled-in and significantly lower (37%) for refrigerated storage at 0° F. Although rooting for both willow clones (Basford and Laurel) was significantly reduced by storage at 0° F, rooting was greatest (86% and 84%) after heeling-in. However, rooting for Basford willow was not better after heeling-in than after 24° F storage. On the other hand, rooting for Tristis poplar was significantly reduced by storage at *35*° F, whereas that for Northwest poplar was not significantly different for any storage treatment. Rooting of spring-harvested cuttings was, on the average, mediocre (60%) for willow and poplar and not significantly different from that for overwinter storage at 24° or 35° F.

These rooting results for machine planting of poplar cuttings after heeling-in compare favorably to those reported by Cram (*1*) for hand-plantings.

Records on rate of flush showed that top growth of cuttings after planting was earliest for clones heeled-in over the winter. Growth after refrigerated storage was significantly later and gradually declined with lower temperatures.

The relationships of moisture content and storage temperature to rooting of willow and poplar cuttings were variable and confusing. For example, moisture content of the fall-harvested cuttings for all clones was increased an average of 40 percent by overwinter heeling-in (when lifted after 0.3 inch (8 mm) of rain on April 1 and stored in polyethylene at 24° F until planted on May 24). This additional moisture improved the rooting capacity, apparently for the same reason as reported by Peterson and Phipps (*4*). However, the slight increase in moisture content of refrigerated willow cuttings sealed in polyethylene failed to increase rooting. On the other hand, refrigerated storage at 0° F also delayed top growth after planting for all clones, but also significantly reduced the rooting of willow cuttings. Storage at 24° F also delayed top growth for all clones, but still produced the highest rooting for one willow and one poplar clone.

Top growth records, which have been used by Peterson and Phipps (4) as a criterion for rooting of cuttings, proved unreliable for evaluating storage treatments. Although records for top growth and rooting were highly correlated (n = .97), some cuttings manifested top growth but failed to root. As a result, in the study, the top growth values exceeded the rooting data by 1 to 16 percent for Willow cuttings and by 8 to 78 percent for poplar cuttings.

Conclusions

The following storage treatments are recommended for delayed spring plantings of hardwood willow and poplar cuttings:

1. Outdoor storage by heeling-in overwinter. This method produced maximum yields (75%) of rooted cuttings, but the heeled-in cuttings must be lifted in early spring, sealed in poly bags, and stored at 24° F until planted.

2. Overwinter refrigerated storage at 24° F with cuttings sealed in polyethylene. This produced good yields (65%) of rooted cuttings with minimum labor in fall and spring.

3. Spring-harvested cuttings stored at 24° F in poly bags. This provided fair yields (60%) of rooted cuttings, but created more labor demands during the spring rush.

In addition, sealed polyethylene coverings are essential for refrigerated storage of hardwood cuttings to prevent dessication and retain viability.

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