Improving Vegetative Propagation Techniques of Sweet Fern (*Comptonia peregrina*)©

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INTRODUCTION

With increased interest in growing and selling native plants (Dreyer, 1993; Niemeyer, 2000) and the need to find native alternatives to non-native species being used in landscaping and restoration work (Maine Department of Conservation, 2001; Reichard and White 2001), comes the need for updated information on propagation techniques for native plants. While sweet fern, *Comptonia peregrina* (L.) J.M. Coulter., is not a challenging plant to propagate, new information is needed for growers, particularly in the north, to find optimum propagation conditions and take advantage of short growing seasons.

Sweet fern is a low-growing shrub native to eastern North America. Its bright, glossy green, aromatic foliage turns deep red in the fall. Growing from 2 to 4 feet, it is an ideal groundcover for gardens, parking lots, and naturalized areas. In addition, it can be used in erosion control along roadsides and in disturbed areas (Zak and Bredakis, 1967). In fact, it favors poor, sandy soils. Sweet fern can fix atmospheric nitrogen via nodules on its roots and may play an important role in the nitrogen content of soil in its native range (Zeigler and Huser, 1963).

Seed germination of sweet fern is difficult (DelTredici, 1976; Dirr and Heuser, 1987; Young and Young, 1992). Due to the difficulty in achieving high germination percentages, seed may not be a commercially viable method of propagation for sweet fern. In addition, rooting stem cuttings from mature plants is not successful (Hamilton, 1974), so root cuttings are the most commonly used form of propagation.

In 1972, Hyde et al. conducted research to determine the optimum time of year to take root cuttings. They found that root cuttings taken in February through May successfully propagated at high percentages, while cuttings taken at other times of the year produced few or no rooted cuttings. In other literature, spring-collected root cuttings of sweet fern were recommended to achieve rooting percentages as high as 100% (Dirr and Heuser, 1987). Generally, healthy roots which were produced as a result of vigorous growth that contained a high carbohydrate level and were taken as cuttings during the dormant period had high chances of successfully rooting (Browse, 1980).

Of the many species of plants that could be propagated by root cuttings, some responded better at different times of the year. *Rhus typhina* propagated well when cuttings are collected in the fall and treated with cold stratification for a few months before planting. *Rhus glabra*, on the other hand, rooted better from spring-collected roots (Dirr and Heuser, 1987). Herbaceous species seemed to also do well when cuttings were taken in the dormant period (Browse, 1980), as do many other woody

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plants (*Clethra, Spiraea, Viburnum*) (Orndorff, 1987). These results indicated that season and cold stratification did affect root cuttings in different plants.

In preliminary experiments with sweet fern root cuttings, we noticed that the trays of cuttings placed outside next to a concrete greenhouse wall for cold storage rooted in an unusual pattern. The half of the tray nearest to the warm concrete wall rooted at nearly 100%, while the cuttings further away from the wall rooted poorly. This led us to conclude that there was an effect of temperature on the rooting of sweet fern cuttings. The objective of this study was to determine the effects of cold stratification duration and temperature on the rooting of sweet fern root cuttings.

MATERIALS AND METHODS

Roots were collected from a site in Orono, Maine, on 13 Nov. 2001. Roots were collected by gently lifting the root from the soil. The root segments were then cut into 2-inch sections. Diameter of the cuttings varied from $^1/_4$ to $^3/_8$ inches. After preparation, cuttings were placed into 32-cell flats (Dillen Products, Inc., Middlefield, Ohio). Two pieces were placed in each cell, crossed one over the other in an X pattern. All cuttings were planted horizontally, 1 inch deep in Metro-Mix 510 (Scott's Inc., Marysville, OH) potting media. Cuttings were thoroughly watered in after being planted.

In total, 10 trays of cutting were prepared. Within each tray there were 4 blocks, and a completely randomized block design was utilized. Nine were assigned to cold storage treatments, and one tray was placed directly in the greenhouse as a control group (Table1). Cold treatments (cold storage facility, outside under black plastic, and outside under microfoam) were designed to replicate conditions that a grower may have available. The cold storage facility was a large walk-in refrigeration unit on the University of Maine campus used for the storage of plant material. Outside, the trays of cuttings were placed under a single layer of either black plastic or microfoam. Temperatures were recorded with an Echo electronic temperature logger (Marathon Products, Inc., Modesto, California). Besides temperature, no measurements were made during cold stratification and the cuttings were not watered until they were brought into the greenhouse after their respective cold treatments.

One tray per treatment per month was moved into the greenhouse. Once moved into the greenhouse, all cuttings were placed under a 55% shade cloth, observed every day, and watered when necessary.

After trays of cuttings were placed in the greenhouse, they were observed daily for signs of growth. For practical purposes, cutting was considered rooted when shoot emergence was observed. Although the root system may not develop until the shoot system has expanded (Browse, 1980), all cuttings that produced shoots also produced a healthy root system. Number of days from removal from cold storage until shoot emergence was recorded. The longest shoot in each cell was measured 1 week after shoots emerged. The same shoot in each cell was also measured 1 and then 3 months after they were removed from their respective cold storage treatment. During the 3rd month measurement, the number of shoots per cell was also recorded. A completely randomized block design was used and data was analyzed using SAS analysis of variance and means separation (Fisher's protected LSD) at a significance level of alpha = 0.05.

RESULTS

Cuttings treated in the cold storage facility were the most successful in terms of rooting and growth. In addition to rooting at high percentages, cuttings stored in the cold storage facility produced shoots sooner, produced longer shoots, and produced more shoots per cell.

Cuttings treated with 1 month of cold storage in all temperatures also rooted at high percentages, however, they were not as successful in terms of growth.

Cuttings treated with 1 month under microfoam or 2 months in the cold storage facility both rooted at 100%. High rooting percentages were also achieved with 1 month in cold storage, 1 month under black plastic, and 3 months in cold storage. In contrast, cuttings treated with cold stratification of 2 or 3 months under microfoam or black plastic rooted at significantly lower percentages (Table 2). Both of these treatments had the lowest average temperatures [-3.3°C (26°F)] and the most fluctuation in temperature (Fig. 1). This may indicate that the root cuttings do not respond well to freezing and/or fluctuating temperatures. Shoot emergence was earliest and height and number of shoots per cell were higher in cold storage facility treated roots. (Table 2, Fig. 2).

DISCUSSION

A successful cutting of any kind is one that roots readily, puts on adequate growth, and is ready for sale quickly, in order to reduce the amount of time a nursery has to hold on to each plant. Using this method of rooting cuttings of sweet fern accomplishes these goals. Cuttings only have to be handled from late fall to late spring, when there may be less time demanding on the nursery staff (Browse, 1980), and the end result is a tray of healthy cuttings. By taking cuttings in the fall and treating with cold stratification, growers, particularly in the north, can get cuttings into the greenhouse in mid winter, thus allowing for larger, healthier plants early in the spring. In contrast, spring collected cuttings will need much of the season to grow to the same size as fall-collected cuttings, resulting in cuttings that are not ready for sale until mid summer.

Sweet fern roots have adventitious buds that are stimulated to grow when the plant is injured (Hall et al., 1976). Cold stratification promotes the formation of or breaking of dormancy of adventitious buds (Hartmann et al., 1997). Taking sweet fern root cuttings in the fall and treating with cold stratification breaks the dormancy of lateral buds, thus allowing for new roots and shoots.

CONCLUSION

Cold stratification temperature and duration have an effect on the successful propagation of sweet fern from root cuttings. Higher rooting percentages, shoot growth, and number of shoots per cell can be achieved when cuttings are treated in a cold storage facility at moderate temperatures. Optimum cold stratification for rooting is 2 to 3 months in a cold storage facility at consistent temperatures of 3 to 4°C. Cold temperatures should be above freezing. Freezing and/or fluctuating temperatures seem to be detrimental to the survival of cuttings. By taking cuttings in late fall and treating with cold stratification, high rooting percentages can be obtained and a consistent crop of healthy cuttings will be produced early in the season.

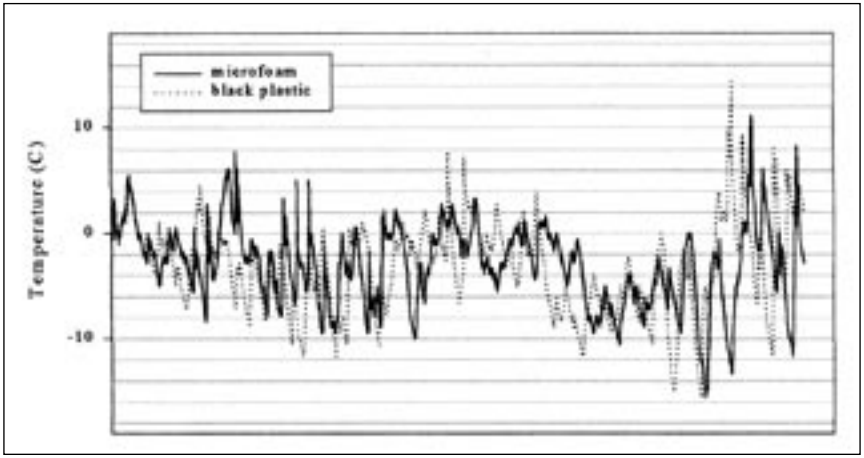

Figure 1. Temperature fluctuation in outdoor storage. Temperatures in the cold storage facility remained at a constant 4ºC.

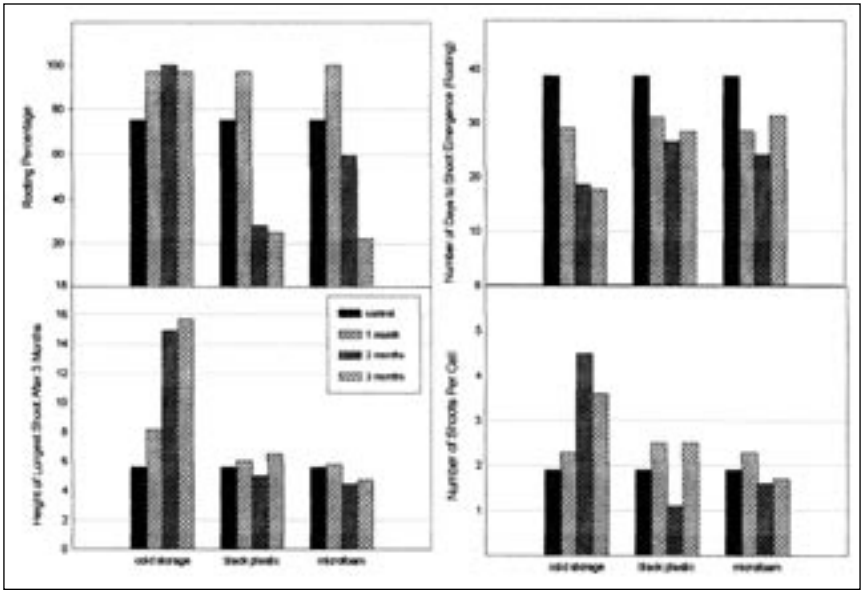

Figure 2. Effect of cold storage duration and temperature on root cuttings of *Comptonia peregrina*.

Table 1. Treatment temperatures.

Treatment	Average temperature over duration of experiment	Highest temperature recorded	Lowest temperature recorded
Control	20.0°C (in greenhouse)	32.0°C (91°F)	14°C (58°F)
1 month cold storage	3.3°C (38°F)	4.4°C (40°F)	3°C (38°F)
1 month black plastic	-0.5°C (31°F)	4.4°C (40°F)	-8°C (16°F)
1 month microfoam	-0.5°C (31°F)	7.7°C (46°F)	-7°C (18°F)
2 months cold storage	3.3°C (38°F)	4.4°C (40°F)	3°C (38°F)
2 months black plastic	-3.3°C (26°F)	7.7°C (46°F)	-11°C (11°F)
2 months microfoam	-3.3°C (26°F)	3.0°C (38°F)	-10°C (14°F)
3 months cold storage	3.3°C (38°F)	4.4°C (40°F)	3°C (37°F)
3 months black plastic	-3.3°C (26°F)	14.0°C (58°F)	-15°C (4°F)
3 months microfoam	-3.3°C (26°F)	11.0°C (52°F)	-15°C (4°F)

Table 2. Influence of cold stratification length and temperature on rooting, shoots, and height of sweet fern cuttings.

Cold stratification treatment	Rooted (%)	Days until shoots	Shoots (#)	Height 1 week(cm)	Height 1 month (cm)	Height 3 months (cm)
Control	75 ab*	38 d	1.91 c	1.81 b	4.03 c	5.68 bc
1 month cold storage	97 a	29 c	2.34 b	1.73 b	5.37 ab	8.19 b
1 month black plastic	97 a	31 c	2.55 b	1.41 bc	4.16 bc	6.04 bc
1 month microfoam	100 a	28 c	2.36 b	1.58 b	4.06 c	5.88 bc
2 months cold storage	100 a	18 a	4.50 a	2.35 a	6.02 a	14.99 a
2 months black plastic	28 de	26 b	1.00 d	1.66 b	3.52 c	5.00 b
2 months microfoam	59 bc	24 b	1.63 cd	1.78 b	3.01 c	4.47 bc
3 months cold storage	97 a	17 a	3.65 a	2.60 a	8.50 a	15.75 a
3 months black plastic	25 e	28 c	2.50 b	1.80 b	3.92 c	6.53 b
3 months microfoam	22 e	31 c	1.71 c	1.42 bc	2.72 c	4.72 b

*Mean separation within columns with different letters by LSD at $\alpha \leq 0.05$.

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