Evaluation of fall versus spring dormant planting of hardwood willow cuttings with and without pre-soaking treatment

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Introduction

The benefits of pre-soaking willow and cottonwood cuttings prior to planting have been well documented (Edwards and Kissock 1975; Krinard and Randall 1979; Pezeshki et al 2005; Tilley and Hoag 2007). Pre-soaking increases stem-water content and results in improved survival and increased vigor, root and shoot biomass. However, all studies to date have examined pre-soaking followed by immediate planting in laboratory or field conditions in the spring where plants can immediately begin growing after planting. A literature review yielded no reports of tests evaluating the efficacy of soaking, followed by a fall-dormant planting. This may be partly due to the fact that spring planting is generally encouraged over fall dormant planting (Hoag 2007).

In this experiment we evaluated four treatments to determine if pre-soaking cuttings in the fall provided any establishment benefits over traditional planting methods. We compared cuttings planted in the fall following a 14 day pre-soaking treatment (F14), to fall planted with no pre-soaking (f0), spring planted following 14 day pre-soak (S14), and a non-soaked spring planting (S0).

Materials and Methods

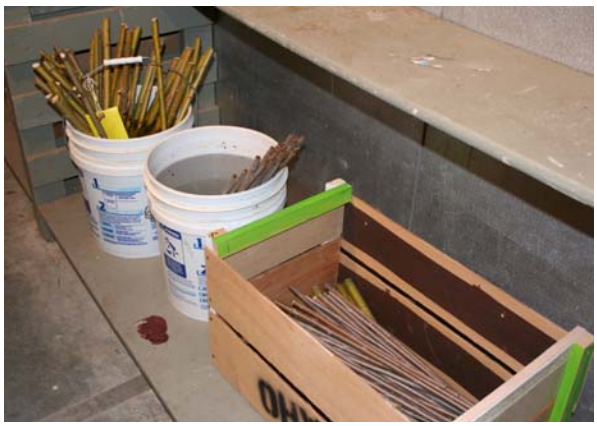


Figure 1. Dormant willow cuttings soaking (left) and stored without soaking (right) prior to fall planting.

Cuttings of peachleaf willow and coyote willow were harvested from the PMC willow cutting nursery while dormant on November 19, 2007 for the fall portion of the trial. Cuttings for the spring treatments were harvested dormant on March 10, 2008 for peachleaf willow and March 21, 2008 for the coyote willow. Cuttings were 20 inches long; peachleaf willow cuttings had a basal diameter of 1.5 to 2 cm (0.6- 0.8 in) and coyote willow cuttings had a basal diameter of 8 to 12 mm (0.3- 0.5 in). All side branches and terminal tips were trimmed at the time of harvest. Cuttings subjected to the soaking treatments were placed vertically in 5 gallon buckets filled 16 inches deep with water. The buckets were then placed in cold-dark storage at 4ºC for 14 days prior to planting. Plants not soaked were placed in cold-dark storage at 4ºC until planting (fig 1).

Fall cuttings were planted December 10, 2007 into 40 cubic inch conetainers filled with a perlite/vermiculite mix and placed outside to undergo natural temperatures and conditions (fig 2). Spring cuttings were planted into conetainers on April 7, 2008.

Figure 2. Cuttings planted into conetainers in the fall and left outside over winter.

After planting, flats containing the cuttings were placed in an outdoor 4' X 8' X 1' tank, for subsurface irrigation (fig 3). The ponds were initially filled so water rose 3 inches up the cones. Water levels were then manipulated to rise and fall providing adequate moisture for sprouting and growth.

The experiment was designed as a complete block with five replications of five cuttings per treatment.

On May19 (42 days after planting) the peachleaf willow cuttings were carefully removed from their cones and soil was washed away. Roots and shoots were removed and separated and air dried for four days until all moisture had been removed. Roots and shoots of plants within replications were combined and weighed. Live cuttings were totaled within each replication and divided by 5 for a percent survival.

Coyote willow cuttings were harvested on June 16 (70 days after planting) and weighed on June 24. Data were analyzed using an Analysis of Variance (ANOVA) followed by a Tukey's test to separate means if significance was detected at p=0.05.

Results

All cuttings in the peachleaf willow portion of the trial survived to harvest. Significant differences were detected between treatments for both root and shoot production. Pre-soaking in the fall for 14 days resulted in the highest production for both variables and had significantly greater root mass than the spring non-soaked treatment (1.91 g versus 1.18 g respectively), but did not differ significantly from the fall non-soaked or the 14 day spring pre-soaking treatment. Both fall treatments and the 14 day spring pre-soak had significantly greater shoot production than the spring non-soaked treatment. Shoot biomass for the fall 14 day soak was highest at 9.05g. The fall non-soaked and spring 14 day soaking

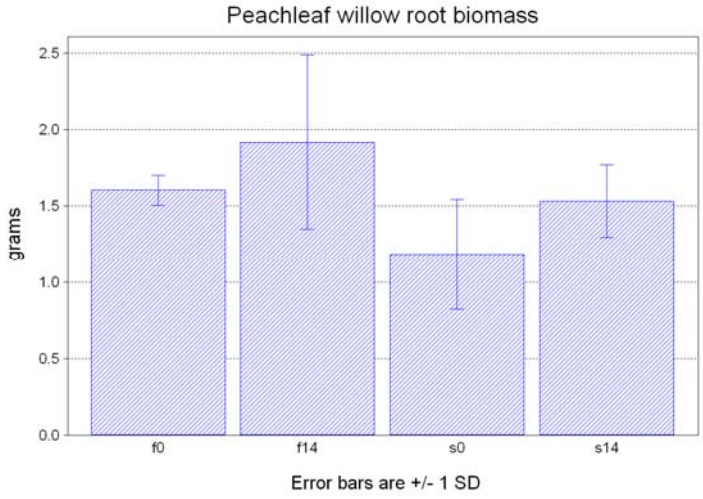
Figure3. Cuttings in 4x8x1 metal tank for irrigation and establishment.

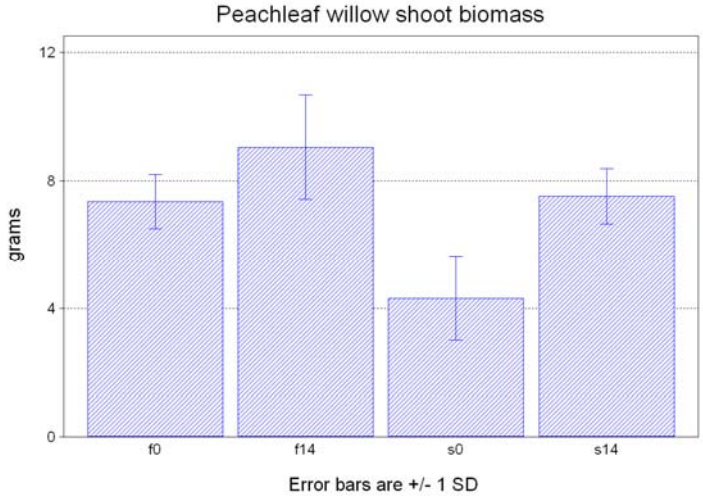
treatments had similar weights of 7.35 and 7.51 g respectively, while the spring non-soaked treatment had considerably lower shoot production with 4.32 g.

Table 1. Effects of soaking on peachleaf willow

	% Survival	Root biomass	Shoot biomass
Fall 0	100*	1.60 ab	7.35 a
Fall 14	100	1.91 a	9.05 a
Spring 0	100	1.18 b	4.32 b
Spring 14	100	1.53 ab	7.51 a
cv (0.05)	na	0.71	1.99

*not separable at p=0.05





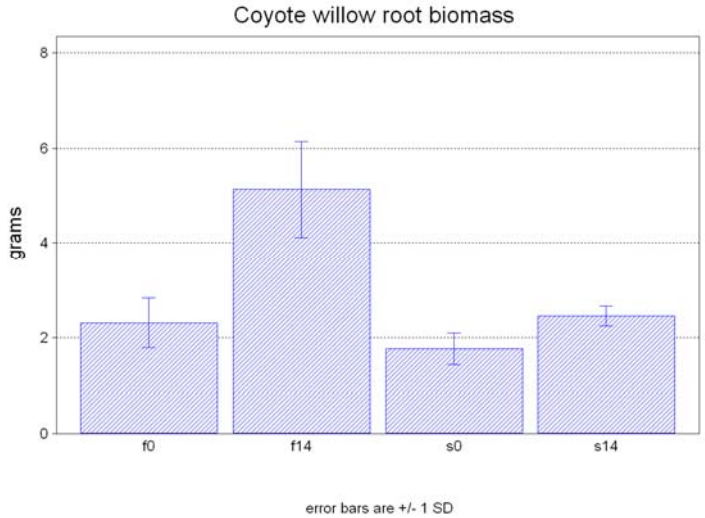
In the coyote willow trial the F14 treatment had slightly lower (though not significant) percent survival than the other three treatments. The F0, S14 and S0 all had 100% survival while the F14 treatment had an average of 92% survival. The F14 treatment had significantly greater root production than the other three treatments. F14 root production

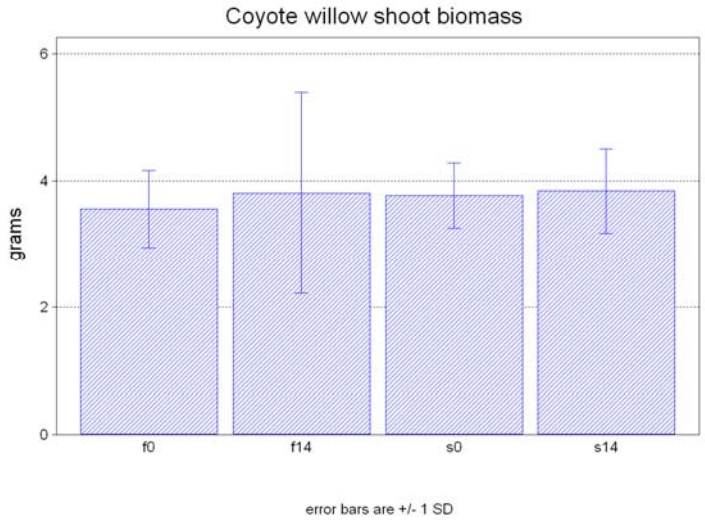
weighted 5.13 g, more than twice the root production of the next closest treatment, S14 with 2.46 g. F0 followed with 2.32 g, and S0 again had the lowest production with 1.77 g of roots. Shoot production between the four treatments was not statistically significant. Highest shoot production came from the S14 treatment with 3.84 g. F14 had 3.81 g and F0 and S0 had 3.55 and 3.77 g respectively.

Table 2. Effects of soaking on coyote willow

	% Survival	Root (g)	Shoot (g)
Fall 0	100*	2.32 b	3.55*
Fall 14	92	5.13 a	3.81
Spring 0	100	1.77 b	3.77
Spring 14	100	2.46 b	3.84
cv (0.05)	na	1.25	na

*not separable at p=0.05





Discussion

There are a number of reasons why spring plantings are more prevalent than fall plantings. Fall planted cuttings are not expected to sprout until the following growing season, thus there is reduced protection of the streambank until after the spring runoff. Additionally, fall collected cuttings are often believed to be under stress due to hot summer temperatures, reduced water availability, insects and disease. Yet with the aid of pre-soaking cuttings, this may not be the case.

Between planting and bud-break, all cuttings in the F14 group of both species showed signs of fungal infection with multiple black spots on the bare tips of each cutting. The F14 cuttings were also later in breaking bud dormancy than the cuttings in the other treatments and were believed to be dead early in the trial. It is unknown if the infection was the reason for the mortality of two coyote willow cuttings in the F14 treatment or not. Surprisingly, however, the F14 treatment performed equal to or better than all other treatments in root and shoot production.

This study shows the value of pre-soaking willow cuttings versus not pre-soaking, especially with regard to spring harvested materials. It is possible that cuttings harvested in the fall and planted dormant lose less water (and therefore maintain vigor) over the course of the winter than cuttings left on the tree until spring. Soaking the cuttings in the spring then restores the cutting water content to its pre-winter levels, providing similar results to those found with non-soaked fall harvested cuttings. Cuttings harvested and soaked in the fall may retain the increased moisture levels obtained from soaking and respond with greater root and shoot production the following spring. Pre-soaking in the fall may also cause cuttings to be in a better pre-rooting condition, resulting for some reason in better rooting vigor the next spring. Additional studies comparing cutting weights before and after soaking in the fall and spring should be performed to test this idea.

References

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