Effect of Species and Diameter on the Survival and Growth of Live Stakes Used in Stream Restoration Projects

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Introduction

Stream corridors and their associated ecosystems are frequently subject to human modifications that lead to the degradation of water quality, the loss of fish habitat, reduced biodiversity, the loss of riparian habitat and a decrease in recreational value (Simpson et al. 1982; NRC 1992). One technique used to remediate these degradations is the practice of soil bioengineering because restoration of riparian vegetation reduces surface erosion (Coppin & Richards 1990), regulates stream temperature, and provides nutrient sources to local biota (Naiman & Decamps 1990). Soil bioengineering has been defined as the use of plants exclusively for soil and slope stabilization (Gray & Sotir 1996). One simple and inexpensive technique of soil bioengineering used in the eastern United States is the practice of live staking.

Objective

To evaluate the effects of diameters on the survival and growth of live stakes in an effort to provide practical planting recommendations for streambank restoration plantings.

Materials

Seven Species

- two shrub willows *(Salix interior, Salix sericea)*
- two tree willows *(Salix nigra, Salix amygdaloides)*
- two dogwoods *(Cornus amomum, Cornus stolonifera)*
- one non-native selected willow (*Salix purpurea*)

Five diameters (cm)

0.6-1.3 (**1**)
1.3-1.9 (**2**)
1.9-2.5 (**3**)
2.5-3.8 (**4**)
3.8-5.1 (**5**)

Three seasons

Spring
Summer
Fall

Experimental Design

Randomized Complete Block Design

Six plots

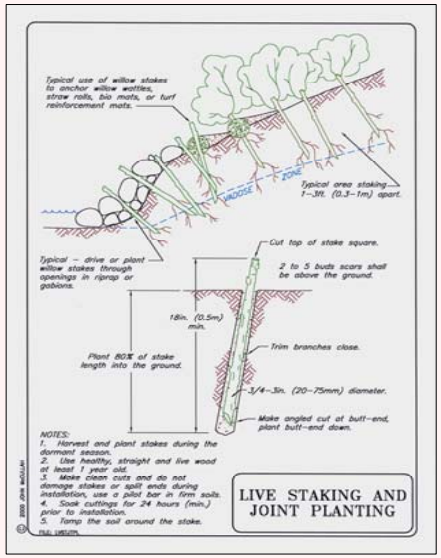
- Spring, summer, and fall of 2004 and 2005
- Three subplots within each plot
- Seven species X five diameters = 35 treatments (per subplot)
- Each subplot contains 10 samples (stakes) of each treatment

This experimental design yielded 350 stakes per subplot, 1050 stakes per plot and 6300 stakes across all planting dates. Within the treatment area, stakes were planted 0.6m apart.

Three response variables (survival, number of stems, tallest stem) were measured in order to analyze survival and growth.

Planting of experimental plot

Measuring Black willow



John McCullah, Salix Applied Earthcare

Results

Overall, diameter did not make a difference for the species tested. However, when it did, the smaller diameters resulted in higher percent survival. For the willow species tested diameter appeared to have no substantial impact on the percent survival within the traditional planting times (spring and fall).

Growth of Silky dogwood and Willow spp.

Although diameter had minimal effect on willow survival, it did influence the number of stems that grew per stake. The larger the diameters the more stems per cutting observed.

For the species tested, diameter had no substantial impact on the tallest stem.

Spring 2004 plot

Data tables

Diameter classes	% Survival					Number of stems					Tallest stem (cm)				
	1	*2*	*3*	*4*	*5*	*1*	*2*	*3*	*4*	*5*	*1*	*2*	*3*	*4*	*5*
2004 *Spring*															
Black willow	100	100	100				7.6					110.3			
Peachleaf			100	100	100	6.0						138.4			
Sandbar		100	100	100	100				9.3						147.5
Silky willow	100	100		100	100				10.4		88.4				
'Streamco'	100	100	100	100					12.2						141.7
Silky dogwood		90					2.5					30.7			
Red osier	90					1.9	1.9				32.4				
2005 *Spring*															
Black willow	100						4.0					81.1			
Peachleaf			100						7.2			69.9			
Sandbar		96.7							5.3			83.2			
Silky willow		100							8.5			61.0			
'Streamco'	100	100	100		100				7.4						85.5
Silky dogwood		96.7		96.7	MD		2.7		2.7	MD				54.9	MD
Red osier	76.7			MD	MD	1.6			MD	MD		43.2	MD	MD	

Denotes those that are not significantly different from the best within each species at the 0.05 level
Number denotes the largest mean percent survival, largest mean number of stems, tallest stem within each species
MD - missing data; no plant material available
Diameter classes 1 = 0.6-1.3; 2 = 1.3-1.9; 3 = 1.9-2.5; 4 = 2.5-3.8; 5 = 3.8-5.1

Diameter classes	% Survival					Number of stems					Tallest stem (cm)				
	1	*2*	*3*	*4*	*5*	*1*	*2*	*3*	*4*	*5*	*1*	*2*	*3*	*4*	*5*
2004 **Fall**															
Black willow	96.7								2.4			87.1			
Peachleaf	100	100	100						3.0			101.2			
Sandbar				100					5.3						100.9
Silky willow	100			100					7.5						80.1
'Streamco'		100	100	100	100				7.8						108.9
Silky dogwood	73						2.5					54.4			
Red osier	40			MD	MD	1.7			MD	MD		39.9	MD	MD	

Conclusions

Survival

Diameter had no effect; where it did, the smaller diameters resulted in higher percent survival

- Survival rates were typically greater than 80%

- Dogwoods performed unsatisfactory in summer plantings

Number of Stems

- For willow species, larger diameter cuttings produced more stems per cutting

Tallest Stem

- No substantial impact between diameters

*Though there were no statistical differences for diameters, production increased with the larger cuttings.

Sandbar willow

Second year growth

Literature cited

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