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PLANTING TECHNIQUES FOR VEGETATING RIPARIAN AREAS FROM THE ABERDEEN PLANT MATERIALS CENTER

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ABSTRACT

The Aberdeen PMC has been working on riparian and shoreline plantings since 1986. Initial research was done on shorelines of American Falls Reservoir in southeastern Idaho. In 1990, we established a planting on Trout Creek in northeastern Nevada utilizing planting techniques developed from this initial study. Small diameter power augers proved to be the most promising planting technique for riparian revegetation despite their cost and site access limitations. We found that various planting supplements like hormones, fungicides, and fertilizer, did not necessarily enhance the survival and rapid establishment of cuttings. Generally, our results show that larger diameter cuttings, planted as deep as possible (at least into the midsummer water table) with soil firmly packed around the implanted stem, gave the highest success rate. Several woody plants had good initial establishment success: Coyote Willow (*Salix exigua*), Laurel Willow (*Salix pentandra*), and Lemmon Willow (*Salix lemonii*). Further testing on Prairie Willow (*Salix humilis*), Siouxland Cottonwood (*Populus deltoides*), 'Imperial' Carolina Poplar (*Populus canadensis*), and Robust Popular (*Populus robusta*), which were outstanding in the American Falls Reservoir study, is planned.

INTRODUCTION

The USDA Natural Resources Conservation Service Aberdeen Plant Materials Center (PMC) is located in southeastern Idaho near Aberdeen, about 40 miles northwest of Pocatello. Even though we are located in Idaho, our service area includes southern Idaho, southeastern Oregon, the northeast tip of California, Nevada, and Utah. All of the work we do is for the benefit of farmers, ranchers, and government agencies located in all of these states, not just Idaho.

The Aberdeen PMC was established in 1939 for the purpose of assembling, testing, and releasing plant materials for conservation uses; determining techniques for their successful use; providing for their commercial increase; and promoting the use of plant materials needed to meet the objectives and priorities of the National Conservation Program.

One priority in the Aberdeen PMC long range plan is 1) the development and release of new plants for revegetation of shoreline and riparian areas, and 2) development of efficient planting techniques to establish new plants in these areas.

Initially, our research focused on the establishment of vegetation along the shoreline of American Falls Reservoir in southeastern Idaho. The objectives of the study were: (1) to test various plants for their erosion controlling ability along the shorelines (including unprotected stretches and stretches partially or fully protected by structures), (2) perfect low cost, high volume planting techniques, (3) ensure low maintenance costs, and (4) improve aesthetic values, wildlife and fish habitat. The study was composed of two phases. The initial study was started in 1986 and lasted for about 2 years. The second phase, which will probably end in 1992, incorporated the information obtained during phase 1 and built upon it.

In 1990, as a result of increased public interest in riparian areas, it was decided that many of the willow and poplar accessions, planting procedures, and techniques that had been developed in the American Falls Reservoir study could be applied to the revegetation of riparian stream corridors. The Aberdeen PMC established an exclosure on a section of perennial stream in northeastern Nevada called Trout Creek to test those accessions, procedures, and techniques.

LOCATION

Trout Creek is located about 15 miles southeast of Jackpot, NV and about 80 miles south of Twin Falls, ID. Trout Creek is a small perennial stream that has been overgrazed and eroding for a long period of time. It meanders down a broad valley for about 20 miles to the confluence of Salmon Falls Creek. The stream of water is from 3-6 feet across and 6 to 18 inches deep in the summer months. The stream channel has been cut down about 6-8 feet from the valley floor. Vertical eroding banks are common down the entire length of the stream channel. Typical bank vegetation includes Basin Big Sagebrush (*Artemisa tridentata tridentata*), Rubber Rabbitbrush (*Chrysothamnus nauseosus*), and an occasional basin wildrye (*Leymus cinereus*). The stream bottom was grazed down to the soil surface before it was fenced. Consequently, the plant community was very difficult to ascertain. Typically, Sedges (*Carex sp.*), Rushes (*Juncus sp.*), horsetail (*Equisetum sp.*), clovers (*Trifolium sp.*), mint (*Mentha sp.*), plantain (*Plantago sp.*), and nettles (*Urtica sp.*) were found. No willows were observed in the exclosure. Limited historical records indicate that willows grew on the stream banks in the mid-1800's, but heavy cattle use and incised channels had destroyed all but a few isolated pockets.

MATERIALS

The sources of the riparian woody species that were used in the Trout Creek study and the American Falls Reservoir study came from 1) the Plant Materials Centers, and 2) native stands of woody species found in close proximity to the planting area.

Table 1-- Species selected for advanced testing from two initial trials at the Aberdeen PMC

Accession	Scientific Name	Common name	Source
9005049	*Salix pentandra*	Laurel Willow	Michigan
9047349	*Salix vitellini*	Golden Willow	North Dakota
9044859	*Salix alba*	White Willow	North Dakota
9053849	*Salix fragilis*	Brittle Willow	Idaho
9020059	*Salix drummondiana*	Drummond Willow	Washington
9020121	*Salix lemonii*	Lemon Willow	Washington
9020100	*Salix rigida* var. *mackenziana*	Mackenzie Willow	Washington
303584	*Salix humulis*	Prairie Willow	North Dakota
9026075	*Salix exigua*	Coyote Willow	Montana
9020099	*Salix exigua*	Coyote Willow	Washington
9044861	*Salix exigua*	Coyote Willow	Idaho
9031690	*Populus robusta*	Robust Poplar	North Dakota
9031688	*Populus deltoides*	'Souixland' Cottonwood	North Dakota
432347	*Populus* x *canadensis* (*deltoides* x *nigra*)	'Imperial' Carolina Poplar	Michigan
9005050	*Salix purpurea nana*	Dwarf Blue Artic Willow	Michigan
9007893	*Cornus stolonifera*	Redosier Dogwood	Idaho
9007889	*Cornus stolonifera*	Redosier Dogwood	Idaho

The Aberdeen PMC has been testing riparian woody species since 1982. A large planting of various windbreak species was established in 1982. It contains, among other things, about 70 different riparian accessions. A willow planting was also established in 1984. It includes about 30 different accessions of willows. These accessions were collected from native stands throughout the Aberdeen PMC service area and from PMCs in North Dakota, Montana, Washington, and Michigan. From these two initial trials on the PMC, 15 different accessions were selected for advanced testing (Table 1).

METHODS

The riparian site was fenced with a standard 4 wire design in the summer of 1987. Cattle were excluded from that time on. In the spring of 1988, the fence sections that ran across the stream were erroneously left down and cattle grazed the exclosure down to the soil. The sections were repaired in early summer, 1988.

Water depth gauges were established in 1990 to monitor the water table through the summer. This was to determine baseline levels of the midsummer water table. They have been continually monitored every summer since that time.

Before any willows or dogwoods were planted, a complete inventory of the soils, vegetation, and erosion was accomplished. SCS Engineering Technicians ran a comprehensive survey of cross sections and gradients in the exclosure to establish baseline data.

In 1990, 3 representative meanders in the test section were selected for planting. Generally, we tried to use the natural growing habits of the willows when designing the layout of the tests. Some willows sucker profusely while others mature with a large dense basal area. Creeping-type willows (*Salix exigua*), with their flexible stems and extensive rhizomatous root systems, are found on inside meanders of a stream channel. They grow where the force of the water is not directly on them. Shrub-type willows, with shorter stature, deeper root system, and somewhat flexible stems, are better adapted to the outside meanders of a stream channel. Here they act as a continuous barrier to the water flow. Tree-type willows, with large roots and trunks, are naturally found up the bank from the shrub-type or on top of the bank. Shrub-type willows often provide protection from high water for the tree-type willows when found growing together. Creeping, shrub, and tree willows were planted in association with each other. In this way, the energy of high water flows would be reduced as it went through each successive type before impacting the stream channel banks.

In 1991, we planted two promising accessions of Redosier Dogwoods (*Cornus stolonifera*) along the test meanders at Trout Creek. We wanted to test the same planting techniques that we had used on willow cuttings, on redosier dogwoods. We planted 2-3 foot unrooted cuttings, that had no special treatment, above the willows.

Each willow and dogwood accession had 5 replications of 4 individuals set out in a randomly replicated planting design. The cuttings were harvested in February, 1990 and stored in a walk-in cooler. They were planted at Trout Creek on April 2-4, 1990. They were evaluated in August, 1990 and July, 1991.

Specifications for the willow and dogwood cuttings used at Trout Creek were developed in the American Falls Reservoir study. They are:

1) Cutting diameter was 1 1/2 to 3 inches, except for creeping willows and dogwoods which rarely reach 1 inch. The general rule of thumb was that the bigger the cutting diameter the better.

2) Cutting length was determined by the depth to the midsummer water table and the height of the surrounding vegetation. The cutting had to be long enough to reach the midsummer water table and

tall enough to be above the shade cast by the surrounding vegetation. Generally, the cutting length was between 3 and 10 feet.

3) Planting depth was a function of the depth to the midsummer water table, depth of the majority of the competing vegetation root mass, and a rule that 1/2 to 2/3 of the cutting should be placed in the ground.

4) Planting supplements, such as hormones, fungicides, and fertilizer, were tested in the American Falls Reservoir study. They added to the complexity of the process, but did not increase the survival or performance. They also increased the confusion on planting day with untrained crews. They were not used at Trout Creek.

5) Cutting treatment included harvesting the cuttings while the mother plants were dormant, removal of the apical bud, removal of all side branches, sealing the cutting top, and storing the cuttings in a cooler at 3-6°C until planting time. The cuttings were soaked in a 50 gallon plastic garbage can filled with tap water for 16-30 hours prior to planting.

The planting method used at Trout Creek was directly related to the diameter and length of the cuttings. In the American Falls Reservoir study, 8 different methods were tested based on speed of planting and volume. A one-person, towable, power auger with a 4 inch auger was selected as the method of choice. At Trout Creek, we used hand augers with 3 inch buckets to decrease the potential disturbance to the streambed.

In 1992, we plan to test a new piece of equipment that we designed and had built to our specifications called "The Stinger". "The Stinger" is a 4 inch by 8 foot pointed steel rod that is attached to a backhoe in place of the bucket. It operates by shoving a hole into a steep channel face and then, in another operation, pushing the cutting into the hole. "The Stinger" was first tested on American Falls Reservoir by planting willows into rock riprap. Willow and poplar cuttings, 4-5 inches in diameter, were inserted into large rock riprap from the maintenance road above the riprap. The same basic procedure at Trout Creek would cause less disturbance to the streambed because the backhoe can sit on top of the streambank. It can reach out and down to get the cuttings into the base of the cut bank and at 45° angle. Also, by pushing the cutting into the hole, we can get tight soil to stem contact which was determined to be one of the most critical factors for successful establishment.

RESULTS

After 2 years of growth at the Trout Creek site, 82 percent of the willows had survived. Three accessions had the highest vigor rating in addition to the highest survival rates (expressed as percent of average stand). These were the 9020121 Lemmon Willow (*Salix lemmonii*), the 9005049 Laurel Willow (*S. pentandra*), and the 9057507 Native Shrub (*S. lutea*). All 3 Coyote Willows (*Salix exigua*), 9026075, 9020099, and 9057506, had high survival rates, but the vigor ratings were lower than expected (Table 2). The low vigor ratings could be the result of the small diameter (and the associated low energy storage) of the cuttings. This in turn means that the cutting only had enough energy to sprout roots, but not enough energy to put out abundant branches and leaves.

After the first growing season, 60 percent of the redosier dogwood cuttings had survived (Table 2). This initial research will be used to expand these trials to include at least 12 more redosier dogwood accessions that are presently in advanced testing.

The native collections rated higher than average in their initial establishment success. In the American Falls Reservoir study, we found that native collections did not establish well mainly because they were highly susceptible to insect and disease attacks that are common in the area. They also did not have a

high enough level of energy reserves to allow the cuttings to put out an adequate root system. These low energy levels were primarily due to the current drought conditions, in addition to the relatively regular insect and disease attacks. At Trout Creek, disease and insect infestations were not readily evident. This is most likely because the few remaining pockets of willows were separated by very long distances.

One of the biggest surprises of the Trout Creek planting was how poorly the prairie willow established. In the American Falls Reservoir study, it was always one of the top accessions in establishment success and vigor. No reasons for its poor performance were ascertained. Addition testing is planned to see if the results can be duplicated.

Native tree willows (*Salix lasiandra*) were also planted at Trout Creek. Five reps of 4 individuals were planned, but for unknown reasons, only 3 reps were planted. These cuttings were by far the tallest cuttings we attempted to plant. These cuttings were 10-12 feet tall. They were planted 2-3 feet deep with 7-9 feet of cutting above the ground surface. During the first growing season, they sprouted along the entire above ground length. Leader growth was 12-20 inches. During the second growing season, all the above ground sections had died. However, 92 percent of the cuttings were alive and had vigorous sprouts at ground level. At the end of the second growing season, leader lengths were 20-36 inches long.

At Trout Creek, as well as the American Falls Reservoir study, the larger the diameter of cutting, the better the initial establishment success. The cuttings with the highest vigor ratings had diameters of 1 1/2 inch and greater. In all 3 coyote willows and the lemmon willow, cuttings were selected with diameters of 1/2 to 3/4 inch.

A majority of the cuttings that were planted at Trout Creek were 3-4 feet long. The midsummer water table is about 16-20 inches below the surface. Most of the cuttings were planted about 24-30 inches deep which left about 12 inches above the surface. Surrounding vegetation rarely exceeded 8-10 inches in height. From the American Falls Reservoir study, it was clear that the more stem that was placed in the ground, the more roots that could be produced at the root primordia. The more roots that were produced, the better the chances of survival. This was even more important at Trout Creek because of the additional problem of vegetative competition (above and below ground) from the surrounding plant community. A heavy root mat in the top 12-14 inches was present at Trout Creek while at American Falls Reservoir there was little or no vegetative competition in the drawdown zone.

Two treatments increased the establishment rate of high volume willows and poplar plantings. The first was the pre-plant soaking. The soaking initiates the swelling of the root primordia prior to planting. The second was sealing the tops of the cuttings with a 50-50 mix of white latex paint and water. The paint tended to decrease desiccation of the cutting, to decrease the sun scald on the top of the cutting, and to make the top of the cutting clearly identifiable to the planting crew.

The biggest problem that surfaced at the Trout Creek planting was rabbit damage. The exclosure was not rabbitproofed when it was built. The rabbit population is expanding in the area. With the present grazing pattern around the site, the exclosure provides the best forage for miles. The rabbits started grazing on the cuttings during the first growing season. They concentrated on the new sprouts and did not graze on the main stems.

FUTURE PLANS

Trout Creek is a long-term testing site. We have presently planted less than 1/8th of the enclosed stream channel. We plan to test other species of woody vegetation that would normally be found in a riparian system like skunkbush sumac (*Rhus trilobata*), poplars (*Populus*), Silver buffaloberry (*Shepherdia*

argentea), and chokecherry (*Prunus virginiana*). In addition to new woody plants, we plan on testing different bioengineering structures like cribs, wattling, dense pole plantings for revetments, etc. There has also been some discussion with the San Jacinto Cattle Company about fencing a large pasture above the exclosure, planting willows along the stream channel, and setting up a grazing system with the management based on willow use. With continued willow testing and the other planned research scheduled for the future, the Trout Creek Off-Center Advanced Test Site will continue to provide interested parties with important information about riparian vegetation accessions, procedures, and techniques.

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Table 2-- Preliminary establishment success for willows and dogwoods planted 2 years ago at the Trout Creek OAT Site. Establishment success is represented by the percent of average stand (column 9). This is an initial rating of survival. The average number of willow and dogwood cuttings alive is the basis for Average Stand** (column 8).

Willow Species	Rep 1*	Rep 2*	Rep 3*	Rep 4*	Rep 5*	Ave/ Reps	Total Alive	Percent of Ave. Stand	Ave. Vigor+
Lemmon 9020121	4	4	4	4	4	**4.0	20	133	1.8
Coyote 9026075	4	4	4	4	4	4.0	20	133	5.0
Laurel 9005049	3	4	4	4	4	3.8	19	127	2.2
Native Shrub*** 9057507	4	2	4	4	4	3.6	18	120	2.8
Coyote 9020099	4	2	4	4	3	3.4	17	113	5.6
Native Coyote 9057506	4	3	4	2	3	3.2	16	107	4.0
Drummond 9020059	4	0	4	3	4	3.0	15	100	4.0
Cottet Bankers	4	1	2	4	4	3.0	15	100	6.0
Mackenzie 9020100	3	4	1	3	0	2.2	11	73	4.2
Prairie 9003584	3	1	2	1	2	1.8	9	60	5.8
Blue Arctic 9005050	1	1	1	1	1	1.0	5	33	6.2
Total Alive of All Willows:							165		

Redosier Dogwood	Rep 1*	Rep 2*	Rep 3*	Rep 4*	Rep 5*	Ave/ Reps	Total Alive	Percent of Ave. Stand	Ave. Vigor+
9007893	3	4	1	0	3	2.2	11	92	2.8
9007889	3	1	3	4	2	2.6	13	108	3.3
Total Alive of All Dogwoods:							24		

* Total number of cuttings alive out of a total of 4 planted in each rep.

\+ Vigor scale is 1-9 (1 is the best, 9 is the worst, and 0 is dead).

** Average no. alive for 5 reps. Determined by dividing Total Alive For All Willows (& Dogwoods) by Average Stand (number of accessions X number of reps).

*** Native Shrub is probably *Salix lutea*.