RUSSIAN OLIVE REMOVAL AND RESTORATION

Workshop

USDA-ARS
Fort Keogh Livestock and Range Research Laboratory
Miles City, MT • September 12-13, 2016

United States Department of Agriculture
Agricultural Research Service

Celebrating 5 Years of Successful Russian Olive Removal and Restoration Research!

Workshop Sponsors:

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AGENDA

Monday, September 12

Afternoon Talks ~ 1:00-5:00 pm:

- *History and Ecology of Russian Olive in Montana*

  Peter Lesica, Botanist, author and affiliate faculty, University of Montana-Missoula
- *Russian Olive and Wildlife*

  Sharlene Sing, Research Entomologist, U.S. Forest Service
- *Application of Biocontrol for Rangeland Weeds*

  Melissa Maggio-Kassner, State of Montana Biocontrol Coordinator
- *Russian Olive Removal and Restoration*

  Erin Espeland, Research Plant Ecologist, USDA-ARS, Sidney, MT

BBQ Supper to follow at 6:00 pm

Tuesday, September 13

Field Tour / Demonstrations ~ 8:00 am to noon

- Cottonwood planting
- Transplanting trees and shrubs
- Russian olive removal with a tree shear
- Missouri River Watershed Coalition Conservation Innovation Grant
- 5-year recovery post-removal

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Welcome!

Thanks for joining us!

In addition to the insights provided by our Monday speakers, this Russian Olive Removal and Restoration Workshop also features Tuesday demonstrations and tours of three different, but related, studies located at Fort Keogh. The various studies are focused on the impacts of Russian olive removal and subsequent restoration options over both over the short- and long-term.

We will be visiting the following study sites during the Tuesday tour. The remainder of this booklet contains some additional information from each study.

Fort Keogh Russian Olive Removal and Restoration Experiment:

This is an ongoing, multi-agency research effort to evaluate restoration options (including planting native grasses, trees and shrubs in various combinations) as well as studying the long-term impacts of Russian olive tree removal and restoration on wildlife, insect diversity and soil health. The experiment is now in its fifth year. Study partners include USDA-Agricultural Research Service researchers at Miles City and Sidney, MT, the Natural Resources Conservation Service (NRCS) Area Office in Miles City, MT and the NRCS Bridger Plant Materials Center (PMC) in Bridger, MT.

CIG Russian Olive/Saltcedar Removal Study:

This study was funded by a national NRCS Conservation Innovation Grant (CIG) awarded to the Center for Invasive Species Management at Montana State University-Bozeman and the Missouri River Watershed Coalition (MRWC). In addition to looking at impacts from the removal of Russian olive and saltcedar at several locations across a 7-state region, this study also looked at the possible use of the removed plant biomass as a bioenergy fuel source. While the initial study was completed in 2014, MRWC states will continue monitoring the treatment sites for several more years.

NRCS Cottonwood Planting Study:

This study is being conducted by researchers with the NRCS Bridger Materials Center, looking at best practices for reestablishing native cottonwoods on sites where Russian olive has been removed.

An Overview

This study is a collaboration between researchers at the USDA-ARS Pest Management Research Unit, Sidney MT (Erin Espeland, David Branson, Natalie West), Ft Keogh LARRL (Mark Petersen, Jennifer Muscha), NRCS Bridger Plant Materials Center (Joseph Scianna) and NRCS Miles City Area office (Robert Kilian, now with Bridger PMC).

Riparian zones represent the most productive areas in the Northern Great Plains, however Russian olive invasion in this landscape has taken significant fractions of pastures out of accessible forage and has altered bird communities, fish populations, and game species habitat.

Restoration can improve sites that have been degraded by weed invasion and accelerate habitat recovery. We removed Russian olive trees from a 4.8 acre site along the Yellowstone River in April 2011 and installed a controlled revegetation experiment in Spring 2012.

Revegetation was planted into mostly bare soil; there was little herbaceous cover due to canopy closure (shade) of Russian olive, also Russian olive removal created additional bare ground. There were five revegetation treatments:

- *herbaceous layer only,*
- *transplanted shrubs with herbaceous layer,*
- *transplanted trees with herbaceous layer,*
- *transplanted trees and shrubs with herbaceous layer, and*
- *control (passive restoration: Russian olive removed, no native species planted).*

Now that we have identified a best practice for Russian olive removal, the objective of this study is to determine if restoration is necessary after Russian olive is removed and then to measure the effectiveness of four restoration strategies.

This experiment will continue to be monitored yearly for an indefinite number of years and will be used as a long-term research and demonstration area.

Fort Keogh Removal and Restoration Experiment

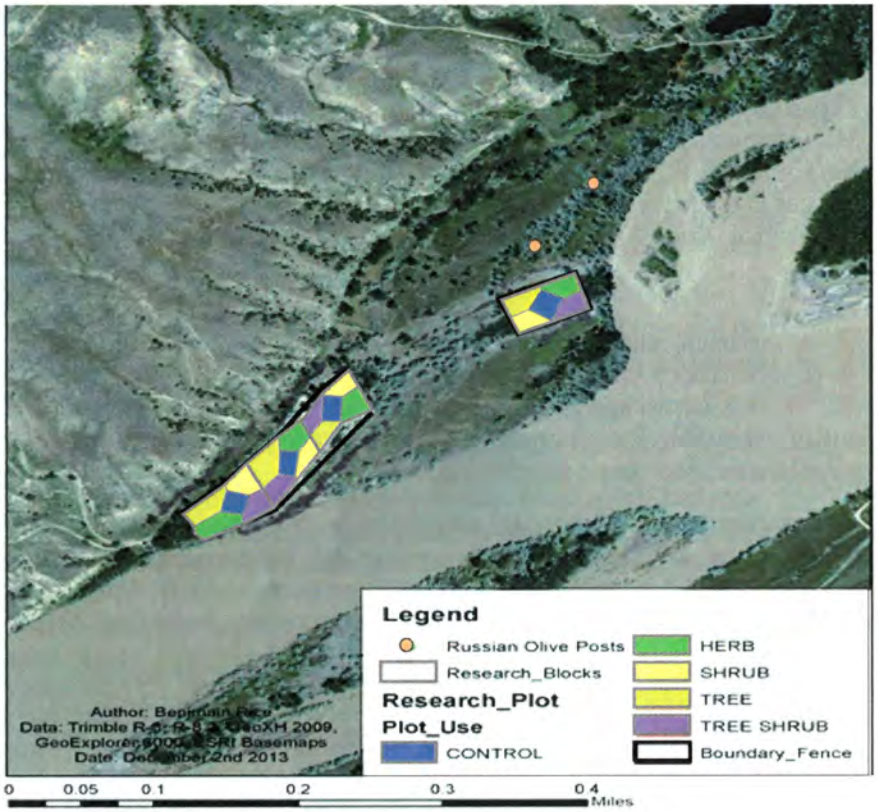


Figure 1. *Bird's eye view of experiment area*

Results after 5 years

This handout includes the following information from the Fort Keogh Russian Olive Removal and Restoration study to date:

- *best practice for RO removal*
- *cost/acre of removal*
- *cost/acre for revegetation*
- *planted species list*
- *tree/shrub survival*
- *herbaceous layer establishment*

Best practice for RO removal

Using a skid steer with a tree shear attachment and spray arm, we cut down over 2,500 trees to ground level in 4.8 acres in April 2011. We immediately applied triclopyr:basal bark oil (1:3) to the cut stump.

Costs for RO removal and revegetation

Costs per acre were 44 person hours, 125 gallons of gasoline, and $427 in chemical (5.2 gallons Element, 15.6 gallons basal bark oil). Our removal technique resulted in a 4% resprout rate the following year and continuing germination from seed after that. (*See Tables 1 and 2.*)

Table 1. *Below are follow up costs of controlling Russian olive (Tamarisk in parentheses) in cleared areas.*

year	# saplings killed/acre	total resprouts	total seedlings	person hours/acre[a]	gallons of chemical/acre
2011	20	98	0	0.63	0.16
2012	122	71	515	1.3	0.90
2013	50 (~42)	no data	238 (~190)[b]	1.3	0.34
2014	19	0	938	5	Hand-pulled
2015	4486	-[c]	5383	5.4	Hand-pulled
2016	129 (22)	-	618 (108)	7.5	1.25

[a] Cost per person hour can be estimated at $12.50/hour in 2016
[b] counts of resprouts and seedlings were combined in 2013
[c] no resprouts observed in 2015, and not detectable in 2016

Table 2. *Cost per acre of revegetation (not including weed fabric).*

	person hours	materials (USD)
Prep spraying	0.65 (40 minutes)	$2.75
Harrowing and seeding	0.28 (17 minutes)	$42.49
Tree/Shrub transplanting	4	$44.92
Fencing	50	$1.70/foot

Planted species - Trees and shrubs

A skid steer and tractor, each equipped with a 20 cm auger, were used to excavate planting holes for the trees and shrubs. The "Tree" plots received approximately 160 trees per acre, "Shrub" plots received about 600 shrubs per acre, and "Tree/shrub" plots received 300 shrubs and 80 trees per acre. Each transplant received approximately 3.75 L of water at planting time only. (*See Table 3 for a list of tree and shrub species planted and their survival.*)

Planted species - Herbaceous layer

Herbaceous seed was broadcast seeded and a harrow and hand rake was used to ensure seed/soil contact. Herbaceous species seeded are shown in *Table 4.*

Table 3. *Percent survivorship measured in 2013 and 2014 of transplanted tree and shrub species planted in 2012.*

Species common name	Scientific name	2013	2014
Narrowleaf cottonwood	*Populus angustifolia*	25%	0%
Plains cottonwood	*Populus deltoides* ssp. *monilifera*	50%	16%
Box Elder	*Acer negundo*	50%	44%
Green Ash	*Fraxinus pennsylvanica*	87%	87%
Golden currant	*Ribes aureum*	50%	46%
Chokecherry	*Prunus virginiana*	63%	50%
Buffaloberry	*Shepherdia argentea*	66%	53%
Woods' rose	*Rosa woodsii*	92%	40%[a]

[a] *Half of the mortality from 2013 to 2014 in Woods' rose was caused by herbicide spray drift.*

Herbaceous layer establishment

It can take more than three years for some species to establish. From the seeding conducted in 2012, the maximum number of seeded species were recorded in Shrub and Tree/Shrub plots in 2015, and in 2016 for Herbaceous and Tree plots. In 2015, species begin to migrate from restored plots into unrestored controls. (*See*

Table 4. *Herbaceous species seeded with pounds live seed (PLS) per acre.*

Species common name	Scientific name	PLS/acre
Slender wheatgrass	*Elymus trachycaulus*	2.8
Western wheatgrass	*Pseudoroegneria spicata*	5.3
Prairie cordgrass	*Spartina pectinata*	0.46
Switchgrass	*Panicum virgatum*	0.32
Common yarrow	*Achillea millefolium*	0.19
Prairie coneflower	*Ratibida columnifera*	0.46
American vetch	*Vicia americana*	0.05*
Canadian milkvetch	*Astragulus canadensis*	0.16
White prairie clover	*Dalea candida*	0.48
Violet prairie clover	*Dalea purpurea*	0.34
Maximilian sunflower	*Helianthus maximiliani*	1.8
Blue flax	*Linum perenne*	0.27
Rocky Mountain beeplant	*Cleome serrulata*	0.13
Rocky Mountain penstemon	*Penstemon strictus*	0.08

* *As of 2016, American vetch has not established in any plot.*

Figure 2. *Shows change in desirable species over time and treatments.*

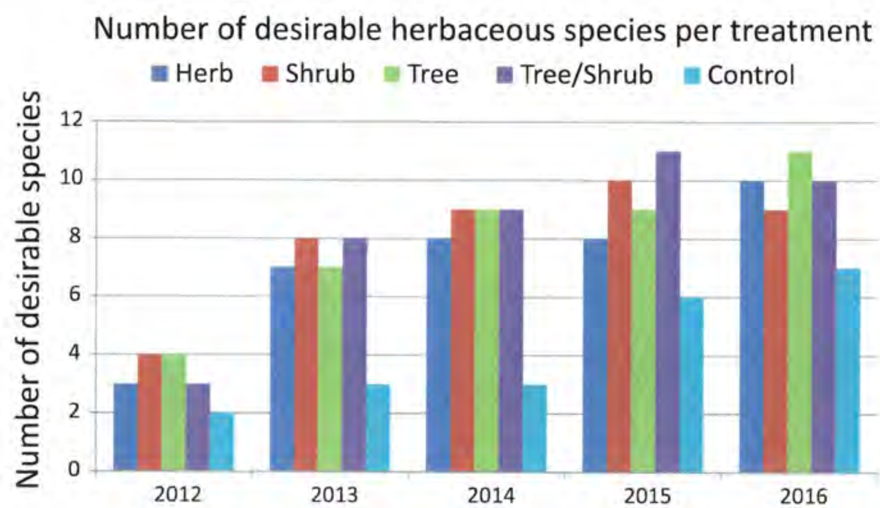


Figure 3. *Native cover is greater with active restoration compared to passive restoration.*

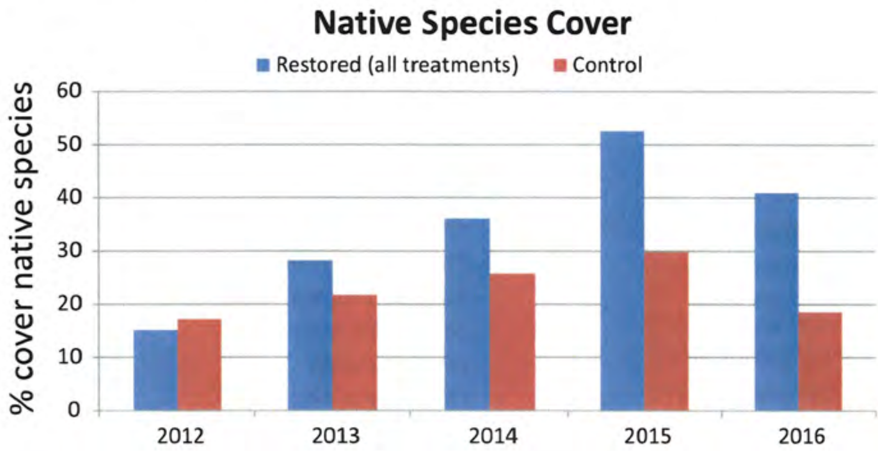


Figure 2.) Active restoration (planting native species) increases native cover relative to passive restoration (Russian olive removal with no follow-up planting). *(See Figure 3.)*

A shrub plot awaiting transplantation.

Figure 4. *Photos before, during, and after removal. All photos except b show Block 1 through time. Photo b shows what Block 4 looked like during the removal process. Photo (e) shows abundant cottonwood seedling recruitment after the flood, and (f) indicates that some of these seedlings survived through the following year.*

April 2010, pre-removal

April 2011, during removal

April 2011, post-removal

May 2011, during flood,

April 2012, pre-restoration

June 2013, post-restoration

CIG Russian Olive/Saltcedar Removal Study

About the Project

In 2010, the Missouri River Watershed Coalition (MRWC) and Center for Invasive Species Management (CISM) at Montana State University (MSU) were awarded a national CIG grant to develop innovative ideas for managing Russian olive and saltcedar throughout the Missouri River Watershed region. The four-year project included these objectives:

1. Foster the adoption of innovative conservation approaches to invasive riparian plant management by monitoring mechanical and herbicide treatment and control sites infested with Russian olive and saltcedar for short- and long-term ecological changes, riparian system health and function, environmental protection, and natural resource enhancement.

   Summary: Cut-stump and basal bark treatment successfully controlled Russian olive and saltcedar. Mulching was ineffective and produced high recruitment of both invasive trees. Vegetation recovery was variable and depended on pre-treatment site conditions (such as presence of other noxious weeds) and flooding.

2. Investigate and demonstrate the use of innovative bioenergy technologies that promote the utilization of invasive plant biomass as a fuel source.

   Summary: Russian olive and saltcedar are safe fuels on par with other woody biomass feedstocks. They are good for bioenergy when blended with other raw materials and are suitable for biochar. The cost-effectiveness of Russian olive and saltcedar as fuel is limited by transportation costs.

States Involved: Montana, South Dakota, Wyoming, Nebraska, North Dakota, Colorado, Kansas. *Note:* The MRWC states also committed to monitoring the treatment sites well into the future.

Timeline: September 2010 - September 2014

Project Team

Tracy Sterling, CIG Project Principal Investigator (2013-2014); Professor of Weed Science and Department Head, Land Resources and Environmental Sciences Department, Montana State University

Scott Bockness, CIG Project Leader (2010-2014), Center for Invasive Species Management (CISM), Montana State University

Elizabeth Galli-Noble, CIG Project Principal Investigator (2010-2013) and CIG Project Closeout Manager (2014); Director, CISM Montana State University (2008-2013); Owner, Galli-Noble Consulting (2014)

Emily Rindos, CIG Project Technology Transfer and Communications Leader (2010-2014); Assistant Director, CISM, Montana State University

Contracted Personnel

Jack Alexander, President and Senior Resource Specialist, Synergy Resource Solutions, Inc.

Amy Ganguli, CIG Project Field Technical Leader for Synergy Resource Solutions, Inc.; Assistant Professor of Range Science, Department of Animal and Range Sciences, New Mexico State University (2012-2014); Assistant Professor of Range Science, School of Natural Resources, North Dakota State University (2009-2012)

Funding

Federal NRCS-CIG award: $1 million
State match (Montana and Wyoming): $1 million.

Treatment and Control

Objective 1: *Foster the adoption of innovative conservation approaches to invasive riparian plant management by establishing and monitoring herbicide treatment and control sites infested with Russian olive (Eleagnus angustifolia) and saltcedar (Tamarix spp.) for short- and long-term ecological changes, riparian systems function, environmental protection, and natural resource enhancement.*

Purpose

Russian olive and saltcedar cause many documented ecological problems in riparian areas, and are projected to cause billions of dollars in economic losses over the next 50 years. While numerous removal techniques exist, not all result in the desired long-term effects. The goal of Objective 1 was to foster the adoption of innovative conservation approaches to invasive riparian plant management by establishing and monitoring Russian olive and saltcedar management sites throughout the Missouri River Watershed region.

Methods

Nine sites infested with Russian olive and saltcedar were selected in three states (MT, WY, and SD). The sites were stratified by river geomorphology and land use, and included a range of infestation sizes, ages, and densities. Detailed baseline monitoring was conducted at each site using permanent transects. Data were collected on three groups of resource attributes: vegetation (biotic), soils, and hydrology.

Round one treatments were conducted in summer 2012, consisting of mechanical cut-stump treatments of Russian olive and immediate follow-up application of triclopyr ester herbicide and a basal oil mixture. Individual saltcedar plants were treated with triclopyr ester or amine herbicide and basal oil mixtures. Follow-up treatments were conducted in 2013 and 2014.

Post-treatment monitoring activities included brief site visits and photo documentation. Information collected allowed the project team to determine short-term changes in each site's vegetation community. Monitoring data also allowed the team to determine which treatment methods provided the best short-term management results, and how those results varied by initial site condition and land use. Monitoring will be repeated in future years by state and federal agency partners to evaluate long-term riparian system function and to document long-term plant community changes in both treated and untreated areas.

Results/Discussion

Monitoring efforts over three years demonstrated the effectiveness of cut-stump and basal bark treatments for Russian olive and saltcedar control. In contrast, mulching treatments without follow-up herbicide treatments were considerably less effective in their control of Russian olive and saltcedar and had high levels of seedling and sapling regeneration or re-establishment. Changes in perennial grass abundance/production and the response of undesirable non-native herbaceous and woody species varied on treatment sites according to their site potential. Site potential factors that had the greatest influence on plant community response were: historical and post-treatment management such as grazing, historical and post-treatment disturbances such as flooding and wildfire, and pre-treatment species composition. Project results illustrate the importance of site specific, adaptive management approaches for noxious weed control.

CIG Project Fact Sheet - Objective 2

Bioenergy Applications

Objective 2: *Investigate and demonstrate the use of innovative bioenergy technologies that promote the utilization of Russian olive (Elaeagnus angustifolia) and saltcedar (Tamarix spp.) biomass as a fuel source.*

Purpose

Russian olive and saltcedar are hugely problematic invaders that presently infest more than one million acres within the Missouri River Watershed region and are virtually untapped sources of biomass. This project proposed that the tons of mostly herbicide-treated biomass, much of which had simply been left in piles, could be processed on location or shipped to nearby processing facilities by producers and used as a new bioenergy source.

The primary goal of Objective 2 was to investigate and demonstrate innovative bioenergy technologies that promote the use of Russian olive and saltcedar biomass as new raw materials or "feedstocks" for bioenergy generation.

In early 2010, prior to the start of the project, the Center for Invasive Species Management and Missouri River Watershed Coalition conducted preliminary feasibility tests on samples of herbicide-treated and untreated Russian olive and saltcedar biomass. This action was taken to ensure that the material could be safely used as a bioenergy source, and had a heat value competitive with other vegetative materials currently used as fuel sources.

Methods

Russian olive and saltcedar samples were collected from five sites in Montana and Wyoming in 2010 and 2011. The samples were

sent to two independent laboratories, which conducted feasibility tests to determine BTU levels generated per pound of material, ash content, volatile matter content, and moisture content. The test results were then compared to data from forestry species traditionally used in bioenergy applications. Additional samples were tested in 2012 to determine whether elemental composition of the plant material would negatively impact its potential value for use in bioenergy applications. Test results were sent to Tom Miles, an independent consultant, for further assessment.

Results/Discussion

Laboratory feasibility tests demonstrated that Russian olive and saltcedar biomass materials could be safely used as a bioenergy source, and that their BTU (calorific values) and ash content levels were competitive with other woody biomass feedstocks. Results showed that both species fall within the "acceptable" range for bioenergy generation. Miles found that while the elemental composition of Russian olive and saltcedar biomass may be less desirable for production as standalone raw material, they could be blended with other woody species commonly used in bioenergy applications. In addition, the plant materials could be processed in biochar form and used as soil amendments in a variety of restoration practices. Miles' analyses of the costs associated with harvesting and transporting the biomass to a limited number of regional biofuels facilities indicate that, currently, woody biomass cannot compete with low-cost, traditional fossil fuel-based energy sources (coal and gas), which are abundant in the region.

NRCS Plains Cottonwood Deep Pot Study

Woody Plant Selection and Establishment

The Bridger Plant Materials Center in Bridger, MT installed a new plains cottonwood deep pot study in 2011 at the Agricultural Research Service (ARS), Livestock and Range Research Laboratory at Fort Keogh in Miles City, Montana. Recent evaluations have determined that plant survival remains steady. This study will be evaluated again in 2016.

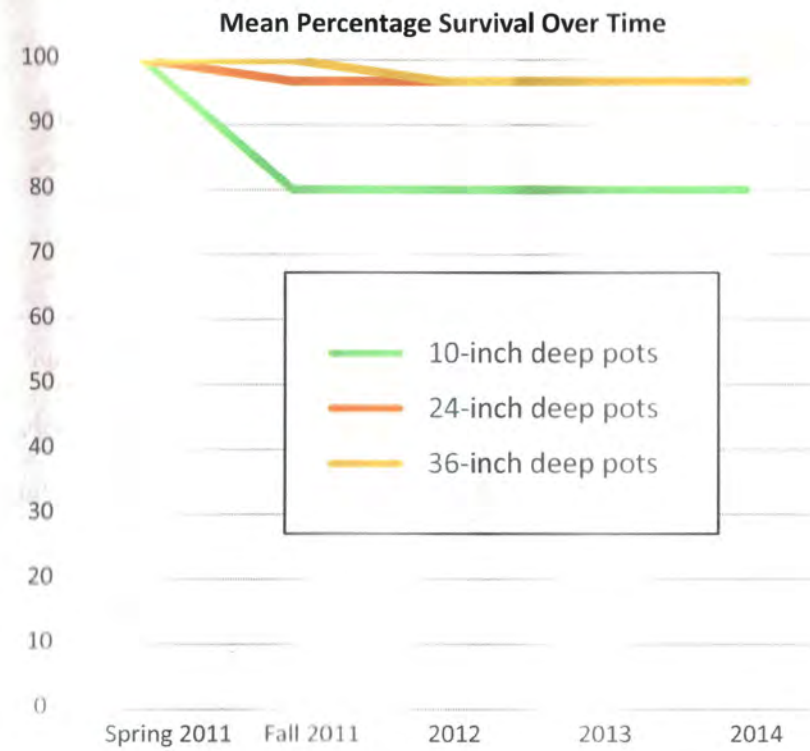
The study aims at determining if long narrow seedling containers improve the early survival and establishment of this species. After four years, survival of plants in conventional pots was substantially less than the deep pots. Although growth of plants in conventional pots was initially slower, plant growth, size, and vigor in all pots sizes was similar after five years.

Staff at the ARS station continue to collect soil moisture tension data at the study site in order to determine the seasonal and annual fluctuations in soil moisture with depth.

Cottonwood Tree Survival - Results

In the NRCS study of cottonwood tree survival, shallower pots resulted in 20% tree death the summer after transplanting. Deeper pots resulted in greater survival. A year after transplanting there was no difference in survival between 24" deep pots and 36" deep pots. Deeper pots resulted in a greater than 95% survival rate of transplants. (*See Figure 1.*)

Figure 1. *Cottonwood Survival in NRCS Deep Pot Study*



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