Deep-Planting Techniques to Establish Riparian Vegetation in Arid and Semi-Arid Regions

By: Greg Fenchel
Dave Dreesen
Danny Goodson
Keith White

Los Lunas, New Mexico
Plant Materials Center
A forty-acre treatment site on the Rio Grande in Veguita, New Mexico. Site dominated by a saltcedar under a cottonwood gallery.

Before treatment

Four years later

Same location 4 years after treatment
Presentation Includes

1. What, when, and where to plant (and why)
2. Effective planting methods
3. Suggested planting equipment
4. Survival results
5. Suggested publications
Bilogical Control of Saltcedar using the tamerisk beetle (*Diorhabda elongata* or *Diorhabda sublimeata*) near Big Springs, TX (2010)

ARS project leader: Dr. Jack DeLoach
**Total Acres Treated in New Mexico for Non-Native Phreatophyte Control (2002-2004)**

<table>
<thead>
<tr>
<th>Total Acres</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Canadian River</td>
<td>4,018</td>
</tr>
<tr>
<td>Pecos River</td>
<td>17,054</td>
</tr>
<tr>
<td>Lower Rio Grande</td>
<td>9,961</td>
</tr>
<tr>
<td>Upper Rio Grande</td>
<td>3,182</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>34,115</strong></td>
</tr>
</tbody>
</table>

Source: New Mexico Department of Agriculture (September 2005)
Most Treated Areas Receive Less Than 15 Inches Of Annual Precipitation

Non-native phreatophyte control is occurring mainly in major land resource areas: “Southern Desert” and “Pecos and Canadian Plains and Valleys.”

Source: NRCS (2005)
Attributes of Planting Riparian Vegetation After Clearing

- Accelerate succession to protect river or stream bank from erosion
- Select desirable vegetation instead of allowing perennial or annual weeds to dominate the site
- Enhance wildlife habitat with selected plant species
- Create pristine recreational areas
Rebecca Harms and Ron Hiebert (2006) found “that vegetation response to tamarisk removal is often negligible. Land managers should be prepared for persistent impoverished plant communities following tamarisk removal if additional restoration measures are not instigated.” Their results are from an on-site review of 33 previously treated areas (from 1 – 11 years) in the Southwest.

Recently cleared area now dominated by Russian knapweed (*Acroptilon repens*) on the Rio Grande in San Acacia, New Mexico (2010)
Over-Bank Flooding Provides Natural Establishment of Native Vegetation

Species includes:

- Cottonwood (*Populus deltoides var wislizeni*) seedlings
- Black willow (*Salix gooddingii*) seedlings
- Coyote willow (*Salix exigua*) seedlings

Sandbar on Rio Grande, Los Lunas, NM
Simulating Over-Bank Flooding Using Micro-Sprinklers to Establish a Riparian Plant Community

Drilling a shallow well on the west side of the Rio Grande in Albuquerque, New Mexico.

Same site—More than 12,000 cottonwood seedlings by the fall of the first year.
Cottonwood seedlings germinated only in the wet areas.

Same planting by the 5th year. Irrigation was removed after the second year.
Elevation of flood plain reduced to promote seasonal flooding to establish riparian plant species on the Rio Grande in Bernalillo, NM
Water Seepage From Rivers Supports a Ribbon of Trees and Shrubs in the Desert

Methods have been developed for establishing trees and shrubs that require minimal or no irrigation by tapping into this shallow water table.

Middle Rio Grande Reach, New Mexico
Riparian Plant Materials Developed to Plant in Shallow Water Tables (Less Than Eight Feet)

- Cottonwood and willow pole and whip cuttings

- Tree and shrub transplants with longstems
Species and Ecotype Selection

• Assess nearby proper functioning condition (PFC) riparian areas
• Use local ecotypes of common riparian species for your area
• If not available, purchase plants considering their origin:
  – Ecoregion
  – Elevation
  – Environment (montane, desert, floodplain, arroyo, closed basin-playa)
  – Soil texture and salinity
  – Soil moisture and water table depth
Study to Determine Depth Above the Water Table to Plant Pole Cuttings

(Swenson, 1983)

Cottonwood pole cuttings planted in soil lysimeter.

Cottonwood and willow pole cuttings rooted best when planted closest to water table.
Winter Harvesting of Farm Grown Cottonwood and Willow Pole Cuttings

Some Local Retail Production Nurseries

Kevin Wrigley 505-465-1322
Hydra 505-281-5740
Santa Anna Garden Center 505-867-1322

2010 Market price
12 – $20/pole cutting (depending on length and market availability)
Storage and Transporting Poles

Pole cuttings are kept hydrated in tanks by placing the cut ends in water.

Pole cuttings can be transported dry for several hours and still maintain excellent vigor for planting.
Rooted Cutting

Cottonwood pole cutting rooted near the soil surface and at the capillary fringe of the water table.
Soils with TDS of more than 2000 ppm, or EC greater than 3 ds/m, may reduce the survival of cottonwood pole cuttings.
<table>
<thead>
<tr>
<th>Salinity Tolerance of Common Floodplain Species</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Most Tolerant</strong></td>
</tr>
<tr>
<td>Four wing saltbush</td>
</tr>
<tr>
<td>(Atriplex canescens)</td>
</tr>
<tr>
<td><strong>Moderately Tolerant</strong></td>
</tr>
<tr>
<td>Wolfberry</td>
</tr>
<tr>
<td>(Lycium torreyi)</td>
</tr>
<tr>
<td>Screwbean mesquite</td>
</tr>
<tr>
<td>(Prosopis pubescens)</td>
</tr>
<tr>
<td>Willow baccharis</td>
</tr>
<tr>
<td>(Baccharis salicina)</td>
</tr>
<tr>
<td><strong>Somewhat Tolerant</strong></td>
</tr>
<tr>
<td>Goodding’s willow</td>
</tr>
<tr>
<td>(Salix gooddingii)</td>
</tr>
<tr>
<td><strong>Not Tolerant</strong></td>
</tr>
<tr>
<td>Rio Grande cottonwood</td>
</tr>
<tr>
<td>(Populus deltoides)</td>
</tr>
</tbody>
</table>

Source: Taylor and McDaniel 1998
Soil Salinity Tolerance of Common Riparian Woody Species in Colorado

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Salinity tolerance (dS/m)</th>
<th>Native Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fourwing saltbush</td>
<td>Atriplex canescens</td>
<td>60</td>
<td>Native</td>
</tr>
<tr>
<td>Saltcedar</td>
<td>Tamarix ramosissima</td>
<td>10</td>
<td>Non-native</td>
</tr>
<tr>
<td>Silver buffaloberry</td>
<td>Shepherdia argentea</td>
<td>8</td>
<td>Native</td>
</tr>
<tr>
<td>Russian olive</td>
<td>Elaeagnus angustifolium</td>
<td>8</td>
<td>Non-native</td>
</tr>
<tr>
<td>Tree of heaven</td>
<td>Ailanthus altissima</td>
<td>8</td>
<td>Non-native</td>
</tr>
<tr>
<td>Honeylocust</td>
<td>Gleditsia triacanthos</td>
<td>6-8</td>
<td>Native/Non-native</td>
</tr>
<tr>
<td>Wolfberry</td>
<td>Lycium torreyi</td>
<td>6-8</td>
<td>Native</td>
</tr>
<tr>
<td>Black locust</td>
<td>Robinia pseudoacacia</td>
<td>5-8</td>
<td>Native/Non-native</td>
</tr>
<tr>
<td>Skunkbush sumac</td>
<td>Rhus trilobata</td>
<td>5-8</td>
<td>Native</td>
</tr>
<tr>
<td>New Mexico olive</td>
<td>Forestria neomexicana</td>
<td>6</td>
<td>Native</td>
</tr>
<tr>
<td>Baccharis</td>
<td>Baccharis salicifolia</td>
<td>6</td>
<td>Native</td>
</tr>
<tr>
<td>Rubber rabbitbrush</td>
<td>Ericameria nauseosa</td>
<td>6</td>
<td>Native</td>
</tr>
<tr>
<td>Siberian elm</td>
<td>Ulmus purpuria</td>
<td>6</td>
<td>Non-native</td>
</tr>
<tr>
<td>Big sagebrush</td>
<td>Artemisia tridentata</td>
<td>6</td>
<td>Native</td>
</tr>
<tr>
<td>Plains cottonwood</td>
<td>Populus deltoides</td>
<td>4</td>
<td>Native</td>
</tr>
<tr>
<td>Goodings willow</td>
<td>Salix gooddingii</td>
<td>4</td>
<td>Native</td>
</tr>
<tr>
<td>Northern Catalpa</td>
<td>Catalpa speciosa</td>
<td>4</td>
<td>Native/Non-native</td>
</tr>
<tr>
<td>Coyote willow</td>
<td>Salix exigua</td>
<td>4</td>
<td>Native</td>
</tr>
<tr>
<td>Golden currant</td>
<td>Ribes aureum</td>
<td>4</td>
<td>Native</td>
</tr>
<tr>
<td>Wholet's rose</td>
<td>Rosa woodsii</td>
<td>4</td>
<td>Native</td>
</tr>
</tbody>
</table>

Source: Scanna 2003, Miyomoto et al 2004 and CSU 2009
Transplants Grown in Treepots and Tallpots (2 – 4 year stock)

New Mexico olive grown in 14-inch treepot (2:1 shoot-to-root ratio)

New Mexico olive grown in 14-inch treepots (7:1 shoot-to-root ratio)

Skunkbush sumac grown in 30-inch tallpots (3:1 shoot-to-root ratio).
Some Longstem Shrubs
Available at the LLPMC
Planting Options for Containerized Stock Determined by Depth to the Capillary Fringe

Ground Water
Best Time to Plant in the Southern Desert

Pole Cuttings
December – March

Longstem Transplants
November – March?
September

Planted in September 2009
On the Rio Grande at the National Hispanic Cultural Center, Albuquerque, NM (September 2010)
Some Useful Planting Equipment

Google: soil power auger = 512,000 hits

- Water-Jet Planter
- Gasoline Engine Powered Augers
More Equipment

Bobcat® & Auger

Stinger bar attached to an excavator.

Pickup Mounted Auger

© Bobcat is a registered trademark of the Bobcat Company – a unit of Ingersoll-Rand
Electric Rotary Hammer Drills are an Excellent Tool for Planting Willows

On the Rio Chama north of Espanola, New Mexico.

On the Rio Grande near Pilar, New Mexico.
Willows Planted With Hammer Drills

On the Rio Pecos near Pueblo, New Mexico.

Same site 7 months after planting.
More Willows Planted With Hammer Drills

On the San Juan River near Waterflow, New Mexico.

Same site 7 months after planting willows.
Farm Tractor With a Front-End Loader Mounted Auger (8-Foot)

Planting cottonwood pole cuttings in an arroyo near Lamy, New Mexico.

Planting longstem tallpot transplants above a shallow water table in deep holes near Lemitar, New Mexico.
New Equipment for Loose Sand, Gravel, and Cobble

Hydraulic hammer with stinger (3.5-inch diameter) attached to the loader of a 65 hp farm tractor

10-foot longstem New Mexico olive in tree-band containers
Established Cottonwood Pole Cuttings on the Arkansas River Pueblo, Colorado
South Eastern Colorado

7 months after planting.

Same site at the conclusion of the third growing season.
On the Rio Santa Fe at Cochiti Pueblo, NM (North Central NM)

Before treatment winter of 1993

Same location summer of 2000
Pond in Hernandez, NM (North-Central New Mexico)

Before planting

Same location 13 years after planting (Aug 2010)

Funded by NM DOT
Burying the Root Crowns of Tallpot Transplants by Planting in Deep Holes to Reach Capillary Water


Funded by Bureau of Reclamation

Same site by the 3rd growing season
Same site by the 4th growing season
Burying the Root Crowns of Treepot Transplants by Planting in Deep Holes to Reach Capillary Water

On the Rio Grande in Belen, New Mexico (February 2006)
New Mexico olive by the 4\textsuperscript{th} growing season on the Rio Grande in Belen New Mexico (May 2010)
Some Successfully Deep-Planted Shrub Species

- Golden currant (Ribes aureum)
- Stretchberry (Forestiera pubescens)
- Netleaf hackberry (Celtis reticulata)
- Boxelder (Acer negundo)
- Skunkbush sumac (Rhus trilobata)
- Silver buffaloberry (Shepardia argentea)
- Wolfberry (Lycium torreyi)
- Western false Indigo (Amorpha fruticosa)
- Screwbean mesquite (Prosopis pubescens)
- Emory baccharis (Baccharis emoryi)
Adventitious Root Growth on the Main Stem of Buried Plants

False willow after 1 growing season.

New Mexico olive by September of the 2nd growing season

False willow by September of the 4th growing season
Irrigation of Shrubs During Drought

Shrubs are irrigated monthly if ground capillary water becomes absent
Common Survival Ranges Among Planting Methods

Cottonwood and Willow Pole Plantings
- 50 to 90 percent
- Sample size of more than 10,000 during a 20-year period

Tallpot and Treepot Longstem Deep Plantings
- 70 to 90 percent
- Sample size of more than 6,000 during a 4-year period

Our Cost

Pole Cuttings and Treepot Longstems installed
- Cost = minimum of $25.00/unit planted (cost factors include planting density and accessibility of site)
Monitor Plantings
Hazards That May Impact Survival

Cottonwood leaf beetle
(*Chrysomela scripta* fabricius).

Removal of tree guards.
Long-term inundation (more than 30 days).

Annual and perennial weed control.
Planting Hazards Continued

- Improper backfilling
- Fire
- Livestock browsing and trampling
- Wildlife browsing
Available Publications

www.nm.nrcs.usda.gov

On right side, click: Plants
Native Grass Seeding for Arid Areas

www.nm.nrcs.usda.gov

On right side, click: Plants

Click: Basics of Seeding Native Grasses
On right side, click: Plants
Click: Biological Tech Note 57

• Visual Riparian Assessment Tool
• Step-by-step treatment guide to improve condition
• References 40 websites where you can download free, “state-of-the-art,” New Mexico NRCS endorsed methodologies.
Publications Continued

Journal of Soil and Water Conservation
(July/August 2008)

Deep-planting methods that require minimal or no irrigation to establish riparian trees and shrubs in the Southwest

During the past 20 years, the Los Lunas Plant Materials Center (LLPMC, USDA Natural Resources Conservation Service) has developed deep-planting techniques that require minimal or no follow-up irrigation to establish woody vegetation on disturbed riparian sites in the semiarid Southwest. The use of these techniques results in minimal maintenance and high survival rates, which will reduce ultimate revegetation costs. Invasive exotic woody species, primarily saltcedar (Tamarix sp. L.) and Russian olive (Elaegnus angustifolia L.), have been controlled on floodplain tracts totaling more than 13,750 ha (34,000 acres) along New Mexico’s major rivers during the past five years by mechanical extraction or herbicide application (New Mexico Department of Agriculture 2005). Principal motives for these efforts include conserving groundwater, reducing wildlife potential, restoring wildlife habitat, and providing greater or other beneficial uses. The alteration of surface and groundwater hydrology by flood control structures and flow regulation has encouraged the spread of invasive woody species (Stromberg et al. 2007) and has resulted in relatively deep water tables on many sites. The lack of overbank flow events on these rivers has perturbed normal ecosystem function and prevented the natural recruitment of native species comprising the gallery forest and its understory vegetation. The establishment of planted obligate riparian woody plants (i.e., phreatophytic overstory trees and understory shrubs) requires either prolonged irrigation until the transplants’ root systems can extend into the permanent unsaturated soil moisture above the water table (i.e., the capillary fringe) or deep-planting techniques that allow immediate root contact or rapid root extension into this moisture supply.

Native Plants Journal
(Spring 2010)

Deep-planting techniques to establish riparian vegetation in arid and semiarid regions

Traditional pole cuttings are harvested from plantation-grown planting stocks of tree-type cottonwood or willow species and used to establish the overstory structure of riparian forests (Figure 1). The key survival advantages of using pole cuttings are the water uptake through the stump end set in groundwater and the proliferation of adventitious roots in the capillary fringe. To maximize survival, 3- to 4-year-old, large-diameter, dormant, vigorous pole cuttings are harvested, trimmed of all lower branches, kept hydrated, and planted in early winter to early spring.

David R. Dreesen and Gregory A. Fensch

A diverse riparian community established by natural regeneration along the Rio Grande near Socorro, New Mexico, containing Rio Grande cottonwood, New Mexico willow, Gruvyer’s teasel, and green smilax (Smilax oregano). Photos by

Native Plants (131:1) Spring 2010
Thank You

gregory.fenchel@nm.usda.gov

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, sex, religion, age, disability, political beliefs, sexual orientation, or marital or family status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326-W, Whitten Building, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410 or call (202) 720-5964 (voice and TDD). USDA is an equal opportunity provider and employer.

The Natural Resources Conservation Service provides leadership in a partnership effort to help people conserve, maintain, and improve our natural resources and environment.