

SOUTHWEST RIPARIAN RESTORATION CONSIDERATIONS: NEW STOCK TYPES, PLANTING METHODS AND SITE LIMITATIONS

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Abstract

Riparian restoration technology development at the Los Lunas Plant Materials Center has focused on new planting methodologies and plant material stock types which are being tested to improve establishment and reduce restoration costs. In particular, longstem transplants of riparian understory shrubs have shown promising results in plantings on cottonwood floodplain sites. Recent revegetation experiences have highlighted a number of concerns that can hinder restoration activities including the proliferation of annual weeds following saltcedar control and the effects of inundation on new plantings.

Introduction

The Los Lunas Plant Materials Center (LLPMC) has been involved with the development of plant materials and planting technologies for the revegetation of riparian areas in the southwestern U.S. for more than two decades. Although some of these activities have addressed restoration of montane riparian areas, the vast majority of our efforts have involved the cottonwood floodplain forests of the major rivers in the Southwest (Dreesen et al. 2002). During the development of riparian restoration techniques, the LLPMC has conducted numerous large-scale demonstration plantings to test plant materials and planting methods, and we have monitored the success of these plantings to determine how to improve survival and reduce costs. New planting techniques to establish riparian vegetation with minimal or no irrigation have been developed, some that can be recommended for broad application in the Southwest.

A broad overview of topics related to restoration of southwestern U.S. riparian ecosystems has been presented in a previous paper that addressed the mechanisms of riparian disturbance, the selection of revegetation species based on site characteristics, riparian plant material stock types and their production, planting procedures for the various stock types, and case studies of several large plantings in the Middle Rio Grande Valley (Dreesen et al. 2002). The current paper will serve as an update on plant material development and new planting methods as well as address site limitations which have impeded revegetation efforts or have reduced the establishment of desirable vegetation.

Deep Planting of Longstem Transplants

Many Southwest riparian sites that require revegetation have relatively deep water tables because of altered hydrology of large rivers due to flood control structures and flow management. The cottonwood floodplain forests can no longer regenerate due to the lack of flooding. The establishment of phreatophytic woody plants (overstory and understory) requires either lengthy irrigation until the transplants' root system can extend into the permanent soil moisture (capillary fringe) above the water table, or planting techniques that allow immediate or rapid root extension into this water source by utilizing deep planting methods.

The LLPMC began investigating deep planting methods over two decades ago with studies to improve pole planting methods by determining the influence of ground water depth relative to pole placement, salinity, and stock attributes (Dreesen et al. 2002). Large-scale plantings based on these results have

shown high success rates when site characteristics are not limiting. In the last decade, two other techniques have been tested on large scales:

1. The use of non-rooted dormant poles or large whips of understory species not in the Salicaceae (cottonwood and willow) family.
2. The planting of rooted stock with very long root balls.

Plantings of non-rooted poles of understory species such as New Mexico olive (*Forestiera pubescens*), false indigo (*Amorpha fruticosa*), false willow (*Baccharis salicina*) have been problematic. The best success rates achieved have approached 50 % for certain species under particular circumstances, but poorer survival rates are more common as well as some complete failures. Factors that may influence establishment of these “understory poles” include the amount of time the pole is hydrated after cutting, the age of the cutting, and planting site characteristics.

Although no comprehensive study has been made to ascertain the cause of failures, a number of factors may be important:

- Hydration times after harvest should not be longer than a few days
- Cuttings from old stems are less likely to root
- Planting in fine-textured sediments with poor aeration may retard rooting.

Because these species are considerably slower growing than cottonwoods and willows, pole length materials (>6 feet) are by necessity older stems. Although the understory pole technique can work to a limited degree, we do not recommend this technique except when it is the only remaining planting option.

The LLPMC has been producing riparian understory transplants in 30-inch deep pots (tallpots) for about 10 years. Success rates of 90% or more have been achieved in many situations when the bottom of the root balls have been placed in contact with the capillary fringe or when embedded watering tubes have been placed in the planting hole. Depending on the depth to the capillary fringe and soil moisture conditions, up to three irrigations per year using the watering tubes are applied for the first year or two. This provides deep soil moisture and allows for root extension into the moist soil of the capillary fringe.

In the last few years, we have encountered riparian planting sites with fairly deep water tables where the bottom of a 30-inch root ball is still quite distant from the capillary fringe. Some initial trials with deep burial of tallpot stock in holes up to 6 feet deep have shown positive results using transplants with stem heights of up to 6 feet (i.e., total plant height 8.5 ft.). This approach violates several basic horticultural tenets including the deep burial of the root crown and the use of transplants with high shoot-to-root ratios. After one or two growing seasons, samples of each of the species planted using this technique, New Mexico olive (*Forestiera pubescens*), false indigo (*Amorpha fruticosa*), false willow (*Baccharis salicina*), were excavated to ascertain the development of adventitious roots above the root ball. Impressive shoot growth and root observations indicate that extension of roots into the capillary fringe has occurred as well as the development of adventitious roots in shallow soil horizons. The main cause of mortality of longstem plantings has resulted from some sites undergoing prolonged (i.e., 6 week) inundation due to an extreme runoff event in the Middle Rio Grande Valley during the spring of 2005.

As soon as it became apparent that deep burial of longstem planting stock might hold promise for planting in sites with deeper water tables, we decided to test the same procedure with one gallon treepot (4” x 4” x 14”) longstem stock. The expense and inconvenience of producing 30-inch tallpots makes treepots an attractive alternative stock type. Longstem treepot stock of the same three species previously mentioned was installed in later comparison plantings along with deep planted tallpot stock. Similar results with survival, growth, and adventitious root development were observed. Although the growing

time to produce longstem one-gallon treepot stock may only be slightly less than tallpot stock, treepot production offers the advantages of an inexpensive container, the ease of transplanting seedlings into the container, the ease of watering and moving plants, and the simplicity of supporting and insulating treepots in the nursery. These efficiencies result in a production cost for a one-gallon longstem treepot being only one-third to one-half of a tallpot. One approach to reduce production time is to plant large bareroot seedlings into treepots, if a source for these native riparian species can be identified. Other species of the cottonwood floodplain forests that might be amenable to longstem deep plantings include golden currant (*Ribes aureum*) and skunkbush sumac (*Rhus trilobata*). We have not yet tried this technique with tree species such as netleaf hackberry (*Celtis reticulata*) or boxelder (*Acer negundo*), but we may have an opportunity to test these species in the near future. Some understory riparian species are not amenable to this technique because of the difficulty in growing stock with long stems in containers; wolfberry (*Lycium torreyi*) is a prime example.

After the initial longstem deep burial trials were installed, we came across some restoration work from Australia that has taken a similar approach, which they call “longstem tubestock” (Hicks 2003a, Hicks 2003b, Hakewell and Hicks 2004). Their work acknowledges the longstem approach runs counter to conventional horticultural recommendations regarding deep burial and establishment of plants with long stems in small containers. Their approach uses smaller container sizes, 2” x 5” forestry tubes, and attempts to produce stock with stem heights of 3 to 4 feet. Much of their deep planting has been in riparian environments, but they have also used this stock type for arid region plantings in areas with high salinity in surface soils as well sand dune restoration.

The LLPMC is planning for new deep planting trials that will be monitored for the long-term survival and growth response. Additional riparian species of longstem stock will also be included in the new trials to determine their response to deep planting. Shorter and less expensive longstem stock may also be grown in smaller containers for testing on sites where water table depths are not excessive.

Site Limitations Impeding Restoration Efforts

The experience of implementing numerous riparian restoration demonstrations for the last two decades has yielded a list of concerns that have often hampered the installation or success of projects (Los Lunas Plant Materials Center 2005a, 2005b). Problems with inundation of planting sites from extreme runoff events and dense herbaceous weed stands following exotic woody species control have been large impediments to recent projects. Other site limitations that often have affected revegetation ease or success are described as well as some potential responses or solutions to these hindrances.

Flooding Resulting in Prolonged Inundation

A site consideration that has not received adequate attention in recent years is the impact of significant flood events and prolonged inundation. This inattention is reasonable considering the drought the Southwest has been experiencing for many years. In the late spring and early summer of 2005, massive quantities of snowmelt water stored in reservoirs was released into the Rio Grande. Within the confines of the levee system, many low lying areas were flooded, and many of these areas remained inundated from six to eight weeks. Several sites that had been planted in the spring of 2004 and 2005 were inundated. High mortality rates of pole and containerized stock (tallpot and longstem treepot) were observed for plants that had been planted several months prior to the flooding. A majority of the pole plantings that had been installed in 2004 survived the inundation while those planted in 2005 succumbed. If extreme snowmelt flood events are forecast, it would be advisable to delay plantings in low areas until later in the year or into the next year, or to make sure the inundation potential for the site is known in advance.

Effect of Weed Competition on Revegetation

Proliferation of annual weeds can drastically influence reseeding efforts to re-establish native grasses and forbs. After the control of invasive exotic woody species, it is paramount that land managers consider the herbaceous weeds that frequently invade such areas after clearing and the accompanying disturbances. For severe weed infestations on disturbed sites, herbicidal control of weeds for two or more years may be necessary to reduce the weed seedbank and to maximize revegetation potential before direct seeding. The survival rate and growth of small containerized stock can be severely diminished by competition with large dense weed stands which can shade transplants and deplete soil moisture. In some extreme situations, the installation of weed barrier fabrics in V-ditches or basins can be used for planting woody species to reduce weed competition, to harvest runoff, and to reduce evaporation.

Extreme Depth to Ground Water and Severe Water Table Fluctuation

Measurement of depth to ground water using shallow monitoring wells will confirm the depth and seasonal fluctuation of the water table to help determine appropriate species and the most effective stock type (container depth or pole length) for revegetation. Extreme depths to groundwater may indicate the only practical restoration goal is revegetation with xeric shrubs and grasses rather than riparian species.

Revegetation Limitations Due to Soil Salinity and/or Soil Texture Extremes

Fine-textured soils or soils with restrictive layers can limit the selection of species and stock types for revegetation. Soils with high percentages of cobble can make augering impossible; whereas, augered holes in dry sands and gravels will often collapse before planting. Visual observation of soil samples from augered holes should be sufficient to determine if soil texture or restrictive soil layers will be limiting. Extreme salinity and sodicity of floodplain soils can profoundly influence species suitable for revegetation. Salinity problems (i.e., electroconductivity greater than 3 dS/m) can be persistent especially in clay soils where natural leaching of salts is limited. Augered soil samples can be analyzed for electroconductivity (EC) to determine if surface or subsurface salinity is a problem. Electromagnetic induction field instrumentation also can be used to rapidly estimate soil salinity for large acreages.

Loss of Planting Stock from the Scouring Action of Flood Flows

Dormant pole and whip cuttings planted to substantial depths can resist the extractive forces of flood flows compared with shallow-planted containerized and cutting stock. Willow whips with their inherent flexibility are more appropriate for higher flow regimes and less stable channel systems. In lower elevation situations where scouring is severe, it is advantageous to plant containerized stock with deep root balls during the fall to provide some root development prior to spring runoff. Some riparian species in small containers but with long stems (i.e., longstem stock) can be buried in deep planting holes for anchorage. Many riparian species should be adapted to this planting method which is comparable to natural burial by sediment deposits.

Eradication of Woody Invasive Species and Removal of Resulting Biomass

A long-term commitment for spot spraying of sprouts must be part of any control program. The dead biomass resulting from herbicide treatment can be burned in slash piles for interspersed noxious woody plants or by crown fires in monoculture stands. The removal of large diameter biomass as firewood and burning of slash is another alternative. The mulching of dead biomass is expensive, but the benefits of mulch include limiting wind and water erosion, reducing soil moisture loss, and enhancing salt leaching by decreasing evaporation and increasing infiltration. A mulch layer will also retard the growth of weeds that commonly occurs after clearing operations.

Woody Riparian Plant Communities versus Wet Meadow Communities

Planting sites should be evaluated to determine whether they are a wet meadow environment and not appropriate for woody vegetation. Shallow depth to ground water and fine-textured organic-rich or anaerobic soils are some of the factors consistent with wet meadow environments. On low elevation floodplains, saltgrass (*Distichlis spicata*) meadows are inappropriate for revegetation with woody species because of shallow groundwater as well as generally high levels of soil salinity.

Planting Equipment Access

Large equipment requires site access which can be restricted by ditches, arroyos, levees, soft sand, or steep slopes. One unanticipated problem with equipment access, which has been identified with the recent upsurge in saltcedar clearing, is the ubiquitous presence of cut stumps which can easily puncture heavy duty truck and tractor tires.

Protection and Maintenance of Revegetated Sites

The continued spot spraying of sprouts of noxious woody species and any other invasive weeds will be required for an indefinite period. The initial protection from livestock and wildlife will require adequate fencing and periodic monitoring of fence integrity. The presence of beaver necessitates poultry wire tree guards around individual pole plants as well as protection of unplanted poles and whips placed in streams or canals for hydration. Controlling defoliating insects is crucial for pole plantings during the initial growing seasons; cottonwood leaf beetle will occasionally require control.

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