Many Southwestern riparian sites

require revegetation following the removal of invasive woody species such as saltcedar and Russian olive. To establish riparian vegetation with minimal or no follow-up irrigation, to improve survival and growth rates, and to reduce long-term revegetation costs, the Los Lunas Plant Materials Center (LLPMC) has focused its efforts on developing new, deep planting techniques for use in riparian restoration in the Southwest.

Some of these disturbed sites have relatively deep water tables because flood control structures and flow regulation have altered the surface and ground water hydrology. On many of these sites, the natural regeneration of cottonwood floodplain forests can no longer occur due to the lack of overbank flooding events.

The establishment of obligate riparian woody plants (that is phreatophytic overstory trees and understory shrubs) requires either lengthy irrigation until the transplant's root system can extend into the permanent soil moisture above the water table (capillary fringe), 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 planting methods for cottonwood and willow dormant pole cuttings. The influence of ground water depth relative to pole placement, salinity, and stock attributes were evaluated regarding establishment success.

The establishment of other important woody riparian species (particularly understory shrubs) has not been generally successful using pole cuttings. As a result, the LLPMC began producing riparian understory transplants in 30-inch deep pots (known as tallpots) about 10 years ago as a means to allow rapid root extension into the capillary fringe and minimize irrigation requirements.

Success rates of 90% or more were achieved in many situations where the lower portion of the root ball was placed in contact with the capillary fringe. If the top of the capillary fringe was just below the rootball, a few irrigations using embedded watering tubes placed in the planting hole provided deep soil moisture and allowed rapid root extension into the capillary fringe. If extreme conditions such as drought and/or moderately deep water tables were encountered, a maximum of three irrigations per year were applied for the first two years using the watering tubes.

In the last several years, the LLPMC has attempted to revegetate riparian sites that have 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 showed positive results using transplants with stem heights of up to 6 feet and with total plant heights of 8½ feet. This approach violates several basic horticultural tenets which consider the deep burial of the root crown and the use of transplants with large shoot-to-root ratios as deleterious practices.

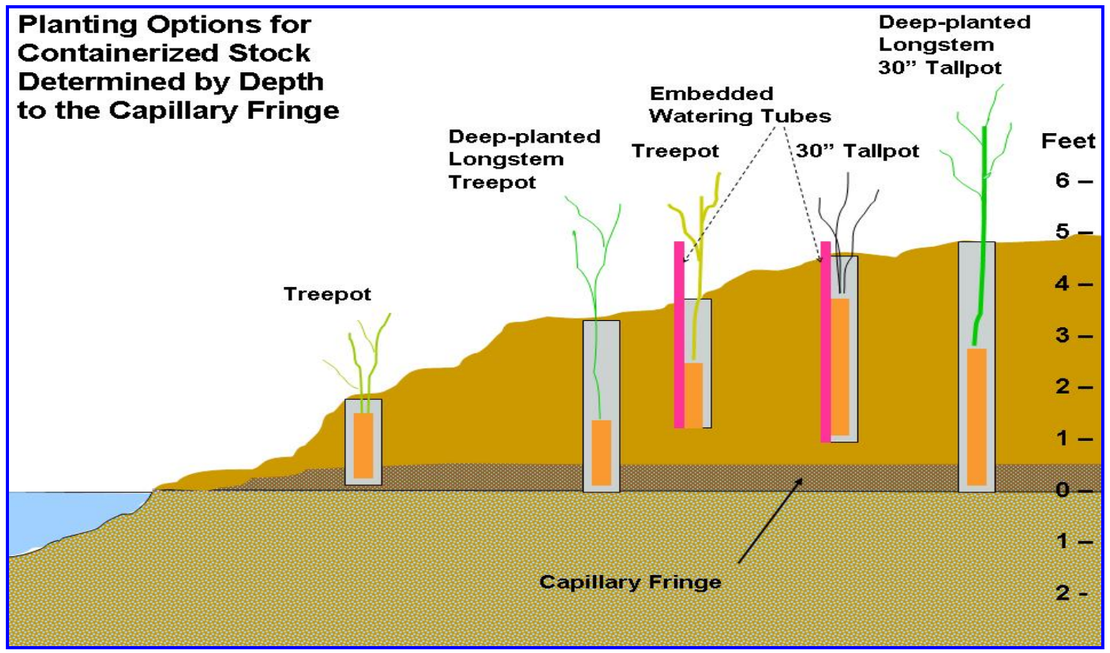
Samples of the first species planted using this technique [New Mexico olive (*Forestiera pubescens*), false indigo (*Amorpha fruticosa*), and false willow (*Baccharis salicina*)] were excavated after one or two growing seasons to ascertain the development of adventitious roots above the root ball. Impressive shoot growth and root observations indicate that the extension of roots into the capillary fringe had occurred as well as the development of adventitious roots in shallow soil horizons.

The success of these deep planting techniques seems reasonable considering that riparian species should be adapted to burial by sediments deposited by flood events, which is a common occurrence in properly functioning riparian systems.

As soon as it became apparent that deep planting of longstem planting stock might hold promise for improved establishment on sites with deeper water tables, the LLPMC tested the same procedure with one-gallon treepot (4"x4"x14") longstem stock. The expense and inconvenience of producing 30-inch tallpots makes treepots an attractive alternative stock type. Longstem treepots of the

Golden currant grown in 30-inch deep tallpots

New Mexico olive longstem stock in one-gallon treepots



same three species previously mentioned were installed in later comparison plantings along with deep planted tallpot stock. Similar survival rates, growth rates, and adventitious root development were observed.

One advantage of producing a one-gallon, longstem treepot is it takes less time to grow than tallpot stock. Other advantages include an inexpensive container, ease of transplanting seedlings into the container, ease of watering and moving plants, and the simplicity of supporting and insulating treepots in the nursery. These efficiencies result in reducing the production cost of longstem treepots by at least 50% relative to tallpot stock.

Other species of the cottonwood floodplain forests that are amenable to longstem deep plantings include golden currant (*Ribes aureum*), screwbean mesquite (*Prosopis pubescens*) and skunkbush sumac (*Rhus trilobata*). We have recently tried this technique with tree species including netleaf hackberry (*Celtis reticulata*) and boxelder (*Acer negundo*), but it is too soon to evaluate success. 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 became aware of some restoration research from Australia that has taken a similar approach, and which they call "longstem tubestock." 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"x5" 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 also have used this stock type for arid region plantings in areas with high salinity in surface soils as well as sand dune restoration.

The deep planting of longstem stock can preclude or drastically reduce the need to apply irrigation water to establish riparian shrubs and trees. The cost savings of minimal or no watering and high percentages of transplant success will in most situations, far outweigh the added expense of the planting stock and deep planting. If you are revegetating a riparian site that lacks overbank flooding and has a deep water table, contact the LLPMC to see if deep planting of longstem riparian species might work for your restoration project.

For additional information contact the Los Lunas Plant Materials Center at (505) 865-4684.

GUIDELINES FOR DEEP PLANTING LONGSTEM STOCK

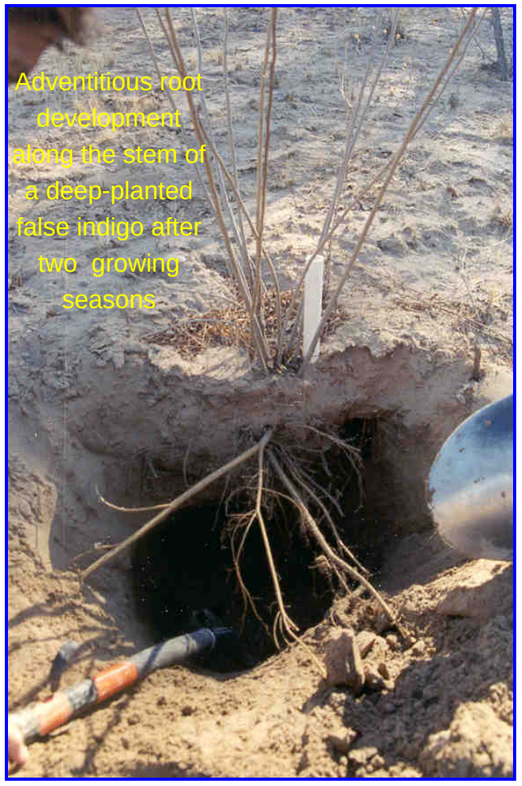
- If possible, insert the auger to the depth of the water table to disrupt any compacted zones that might restrict rapid root extension into the capillary fringe. Add enough backfill to the hole so the bottom portion of the root ball is in contact with the capillary fringe.
- Set the root ball to the desired depth and place a watering tube in the planting hole to allow deep irrigation if the water table declines or if a severe drought occurs.
- Backfill carefully around the root ball and stem to the ground surface. If sufficient water is available, thoroughly water the backfilled material immediately after planting. This is beneficial to collapse voids in the backfill and enhance soil-to-rootball contact.

Inserting watering tubes into the planting hole next to the longstem plant

False willow established using deep-planted stock

Deep Planting

The Ground Water Connection



Guidelines for Planting Longstem Transplants for Riparian Restoration in the Southwest

NRCS Natural Resources Conservation Service — Plant Materials Program