Reinken Bridge Longstem Transplant Study

Project No. NMPMC-T-0601-RI

The USDA Natural Resources Conservation Service Los Lunas Plant Materials Center (LLPMC) staff planted 600 New Mexico olive (*Forestiera pubescens*) longstem transplants and 690 Fremont cottonwood (*Populus fremontii*) pole cuttings on two separate 20-acre sites near the Reinken Bridge in Belen, New Mexico. All plantings were completed in February 2006. The sites, owned by the Middle Rio Grande Conservancy, are located on the northeast side of the Reinken Bridge over the Rio Grande adjacent to the community of Belen (T5N, R2E, Sections 6, 9, and 4; lat 34.66ºN, long −106.74ºW). In addition to increasing the aesthetics of the Rio Grande bosque, the expected benefits of the project include improving wildlife habitat and recreational opportunities and increasing the plant diversity and microflora; thereby creating a much healthier ecosystem than the existing saltcedar monoculture (Fig. 1). Additionally, this project provided the LLPMC an opportunity to test both new plant materials and planting methods. Based on the expected benefits in water conservation, the project received funding from Senator Bingaman's program for the control of non-native phreatophytes and Rio Grande bosque watershed restoration.

Figure 1. South edge of site showing "wall" of uncleared saltcedar.

Methods

Site preparation

A year and a half before planting, saltcedar (*Tamarix* sp., dominant species), Russian olive (*Elaeagnus angustifolia*), and Siberian elm (*Ulmus pumila*) (all three on the New Mexico "Class C" noxious weed list, National Plant Board 2007) were removed by extraction method using an excavator with articulate thumb. The winter prior to planting, kochia (*Kochia scoparia*) was mowed. The removed plants were chipped, and these chips were applied for a mulch cover ranging from 2- to 6-inches in depth. Resprouts of all woody noxious species were spot-treated once in the fall with the herbicide Arsenal (isopropylamine salt of imazapyr) before the February 2006 plantings. Additionally, in June 2007, LLPMC staff foliar-sprayed (using a four percent solution mix of 2,4-D and glyphosate) perennial pepperweed (*Lepidium latifolium*, classified in New Mexico as a "Class A" noxious weed), kochia, mare's tail (*Hippuris vulgaris)*, and other

large annual weeds that would compete for water, light, and nutrients (excluding inaccessible areas near the river's edge).

Planting methods

Nursery longstem stock consisted of 2- to 3-year-old New Mexico olive transplants grown at the LLPMC in Stewie and Sons, Inc. one-gallon tree pots (4" x 4" x 14") to a stem height of up to 7 feet (i.e., total plant height = 8.5 feet). Vigorous, healthy cottonwood pole cuttings (sourced from the Bosque del Apache National Wildlife Refuge) 12- to 15-feet long and 2- to 4-inches in diameter at the cut-end were taken from 3-year-old fertilized plantation stock at the LLPMC (Fig. 2). As directed, the transplants were planted to the depth of capillary water and pole cuttings were planted in ground water. At the time of planting, capillary water depth varied from 3- to 5-feet, while ground water varied from 6- to 7-feet deep. The technique of deeply burying the root crown in contact with the capillary fringe enables establishment of understory transplants without supplementary irrigation (LLPMC 2007). The soil appeared to be sandy. All transplants were planted with a 9-inch by 8-foot augur attached to a front-end loader on a 65-hp farm tractor. The transplants were placed in the 8-foot holes and back-filled with hand shovels. A 20-inch section of schedule 20 PVC thin-wall pipe perforated along the bottom one-third of the pipe was inserted into the holes. The pipe was used as a flag to locate plants, to distinguish plantings from volunteer plants, and to provide irrigation at root crown depth in the event watering was needed.

Figure 2. Healthy cottonwood pole plantings with two seasons' growth.

Evaluations

In mid-September 2007, each plant was evaluated by species by LLPMC staff for survival (live/dead above-ground growth) and every 20th shrub was evaluated for the following: length of new growth, height, vigor (color), herbivory, amount of top die-off, and overall health. The height of every 20th cottonwood was recorded. To facilitate survey efforts and eliminate double-counting, sticks were placed on top of transplant tubes and cottonwood trunks were spray-painted using a gold metallic paint. Furthermore, three plants from this planting and two from a LLPMC planting directly across the river (New Mexico olive, indigobush [*Amorpha fruticosa*], and false willow [*Baccharis salicina]*) were dug up to examine whether plants had developed

adventitious roots near the soil surface and become rooted (depth was limited to approximately 12 inches to minimize disturbance). The only water the plants had received since planting was via sub-irrigation or surface runoff (precipitation). Geospatial coordinates were recorded for all plants or groups of plants exhibiting above-ground die-off and projected on USGS digital orthographic quarter quadrants (Tome) using ESRI ArcGIS 9.1 (ESRI 2005) to evaluate spatial distribution. Data was entered into Microsoft Excel® and analyzed using Statistix 8.1 software (Statistix 2006). Differential survival of cottonwood and New Mexico olive plantings by proximity to the river was examined.

Results

Of the 1290 transplants, 880 plants were found. Based on the survival rate for those plants that were located, the total survival rate for both species reached 84.0 percent (Table 1). New Mexico olive had the highest survival rate (96.7 percent), followed by Fremont cottonwood (74.8 percent). Cottonwoods in the northern site had a survival rate of 67.9 percent, while cottonwood survival in the southern site reached 76.6 percent. Dead-top cottonwoods appeared to have a patchy distribution, relating to drought conditions (Fig. 3).

Figure 3. Dead-top cottonwoods (foreground), southern study site.

Table 1. Results of summary statistics for Reinken Bridge longstem transplant study.

	Forestiera pubescens	*Populus fremontii*
Percent survival (n = 739) Total survival = 84.0	96.7 (n = 365)	74.8 (n = 374)
Percent of all plants (n = 880)	41.9 (n = 380)	55.6 (n = 500)
Average height (inches)	52.3 (n = 18)	128.3 (n = 21)
New growth (inches)	18.6 (n = 18)	No data
Vigor (1-3, 3 highest)	2.4 (n = 18)	No data
Herbivory (0-3, 3 highest)	0.06 (n = 18)	No data
Die-off (0-3, 3 highest)	0.50 (n = 18)	No data

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Geospatial analysis revealed that the majority of dead cottonwoods in the southern site were located in open areas east of the river and at the edge of the existing cottonwood canopy. Dead cottonwoods found in clusters near the river may have died due to sandy soil texture over clay that limited their access to water. Of the three plants examined for root growth, all had developed adventitious roots within at least 6 inches of the soil surface, and New Mexico olive had developed suckers (Fig. 4).

Figure 4. Examples of subsurface adventitious root growth of longstem transplants after two growing seasons (above, New Mexico olive) and with four season's growth (left, indigobush, and right, false willow). The New Mexico olive has begun to develop suckers (top left and right).

The majority of New Mexico olive were of average- to above-average vigor (95.2 percent, n = 20) and experienced minimal woody die-off (88.9 percent) and herbivory (94.4 percent). A few plantings of New Mexico olive experienced salt damage as evidenced by salt residues accumulating on the tips of leaves, turning them yellow and eventually dark brown after drying up. Others appeared healthy and robust as evidenced by berries and with enough structure to entice a bird to build a nest (Fig. 5).

Figure 5. New Mexico olive longstem transplant growing in full sun.

New growth on New Mexico olive averaged approximately 18 inches since planting. It was noticed that several, moisture-stressed cottonwoods, although dead at the top, had resprouted from the base.

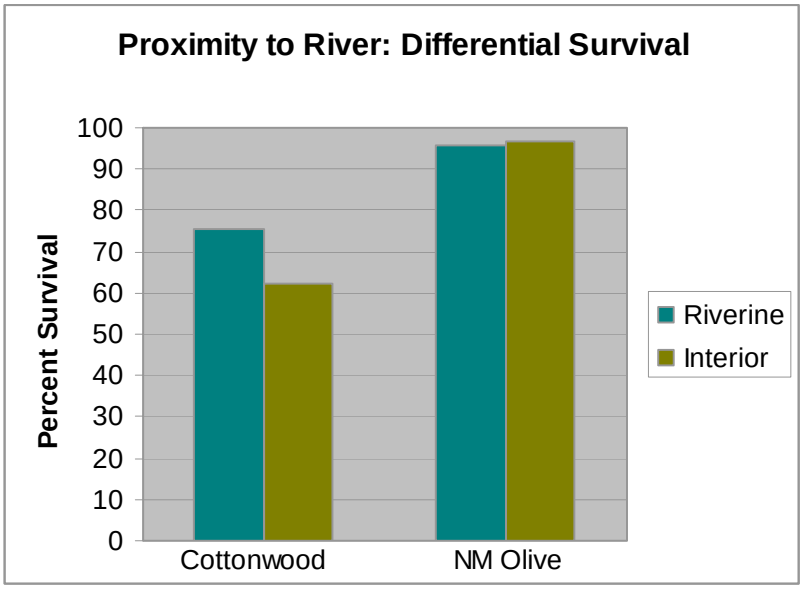
A two-sample t-test for equality of variances determined no statistical difference in the survival rates of cottonwood pole cuttings and New Mexico olive transplants related to the proximity to the river. Although the cottonwood survival rate was higher for plantings closer to the river (75.4 vs. 62.5 percent), New Mexico olive plantings in both locations did equally as well, each achieving a survival rate of over 95 percent (Table 2).

Discussion

Cottonwood plantings in the northern and southern site experienced differential survival. In the northern site, approximately 200 cottonwood pole cuttings were planted in both densely-shaded and full-sun sites close to the river and without tree-guards to protect them from beaver predation. Cottonwood's preference for sun was evidenced in the lower survival rate of those planted in the shade (LLPMC 2006). Without a tree-guard, at least a third of the cottonwoods suffered heavy beaver predation. (Based on experimentation, LLPMC results indicate that a 5-foot high by 30-inch diameter poultry wire tree-guard will protect cottonwoods from beaver predation [Dreesen et al. 2002].) These beaver-cut plants often sprouted back at the base. However, forbs growing in areas without heavy mulching often out-competed the cuttings and precluded growth. In addition to beaver predation, cottonwoods also suffered additional disturbance and loss from both flooding and bank erosion

from river undercutting during high-water flows. It is estimated that close to half of the cuttings at this northern site that were not found were lost to erosion. In the southern site, 490 cottonwood cuttings were planted, 394 of which were found. It is likely that the missed plants were dead and/or broken at the base and therefore could not be located. Regarding the approximately 200 New Mexico olive plantings that were not located in the southern site, the possibility exists that they were covered over by patches of densely-growing kochia and were not detected.

Table 2. Differential survival of cottonwood pole cuttings and New Mexico olive transplants by proximity to river.



Cottonwood pole cuttings at the northern site were also planted in both grass-covered and bare-ground (mulched) areas to the east of the river. Overall, plantings in riparian areas of the Southwest that are done in grass-covered sites experience lower survival and less vigorous growth. These plantings had to compete with the fibrous root system of the densely growing grass and herbaceous plant growth, and as a result did not put on much growth. Just like the shrubs planted upstream, these plants do better when planted in clean (mulched) soil with no herbaceous growth (LLPMC 2006). In general, the multiple disturbances present at the northern Bosque site are not typical of other planting sites, which tend to be free from such disturbances.

The species that were planted for this study are riparian phreatophytes that require irrigation until their root systems can tap into groundwater and establish healthy root systems and robust above-ground growth. For example, New Mexico olive (which is also adapted to non-riparian habitats) is routinely found in Ponderosa pine (*Pinus ponderosa*) forests that receive from 16- to 18-inches of annual rainfall. Annual precipitation for the study region is 9.2 inches per year (Western Regional Climate Center 2007). Precipitation was 16.0 percent above average from the time of planting to the end of August 2007 and 6.0 percent above average compared to the year preceding this study. Currently the region is experiencing a period of climate extremes; July 2007 precipitation was 37.6 percent below average, while August precipitation exceeded the average by 33.9 percent.

The high survival rate and vigorous growth indicated by results from the Reinken Bridge study are supported by similar, positive results from the previous four years at other restoration sites where LLPMC has planted longstems (LLPMC 2005) and in Australia (Chalmers et al. 2007). Longstem planting methodology provides a successful means to establish plantings in arid sites with shallow water tables and obviates the need for supplemental watering.

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