City of Austin
WATERSHED PROTECTION

Live Staking in Austin, Texas Riparian Zone Restoration Projects

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Abstract

The use of vegetation in riparian zone restoration projects is a commonly utilized method for stabilizing stream banks, reducing erosion, improving water quantity and quality, minimizing downstream flooding impacts, sequestering carbon, providing shade, and habitat for aquatic and terrestrial organisms. Understanding which planting techniques and species have the highest probability of success in riparian zone restoration projects is needed to reduce project costs and maximize the ecological benefits achieved. In order to guide riparian planting efforts in Austin, Texas the Watershed Protection Department performed a detailed literature survey to understand the potential benefits of live staking riparian trees and shrubs. Results suggest that live staking success can be achieved by utilizing cuttings between 0.5" to 3" in diameter, both planting and harvesting stakes in the dormant period (December 15 – March 15), and planting of at least 75% or more of the length of the cutting (to access ground water during the summer months). Species recommendations, harvesting methodology, storage, and planting techniques are also discussed. When done correctly, live staking in riparian restoration projects can be a low cost highly successful alternative to conventional methods.

Introduction

The long term success and sustainability of riparian zone (the land adjacent to a creek) restoration projects relies heavily on getting vegetation established in the degraded location. A healthy diverse assemblage of riparian vegetation has been shown to help stabilize stream banks, reduce soil erosion, improve water quantity and quality, minimize downstream flooding impacts, sequester carbon, provide shade, and create habitat for aquatic and terrestrial organisms (Fischer and Fischenich 2000; Stacey *et al*. 2006; Richardson *et al*. 2007; Woolsey *et al*. 2007; Richter and Duncan 2012). Recent research by the City of Austin has found success (> 62% survival) in planting bare root saplings in riparian zone restoration projects (Duncan and Richter 2012). However, steep slopes and high flows can restrict the use of bare root saplings for some restoration locations (Rossow 1992; Duncan and Richter 2012). Live staking of riparian trees has been shown to be successful in locations that have received high flows (≈ 12.6 feet per second)

(Landphair and Li 2002) and may be used as an alternative planting method. Overall, live staking is an inexpensive method to help control stream bank erosion and increase vegetation cover for small scale projects (Li and Eddleman 2002). The objective of this paper was to review the current literature related to live staking in riparian restoration projects and designing a Best Management Practice for its use. Recommendations on appropriate plant species to use, harvesting methodology, storage, and planting will be discussed.

Methods and Results

Species Selection

Care must be taken when selecting appropriate species for planting in riparian restoration projects. Previous studies by the City of Austin have shown that differences in ecological region, drainage area, light level, and distance from the stream will significantly impact the survivability of selected plant species (Duncan *et al*. 2011; Duncan and Richter 2012). Therefore, selecting plant species form the same ecological region and drainage area, coupled with understanding the relative moisture content and light level of a targeted riparian restoration site can help to maximize plant survivability and overall success of the project (Duncan *et al*. 2011; Duncan and Richter 2012). Appropriate plant species chosen for live staking in Austin, Texas are found growing in both eco region and drainage area classifications, are commonly found growing in urban riparian environments, and have been successfully used in live staking projects. Table 1 lists appropriate plant species for use in Austin riparian zone restoration live staking projects. Each species has the corresponding shade tolerance, growth rate, height at maturity, and wetland indicator status (USDA 2012) that can help restoration practitioners select appropriate species for a site (Table 1).

Table 1: Plant species to be used in riparian zone restoration live staking projects. Each species is listed with its corresponding shade tolerance (Intolerant, Intermediate, and Tolerant), growth rate (slow, moderate, and rapid), mature height (median height of species at maturity), and wetland indicator status.

Common Name	Scientific Name	Shade Tolerance	Growth Rate	Mature Height (ft.)	Wetland Indicator
False Willow	*Baccharis neglecta*	Intolerant	Rapid	9	FAC
Buttonbush	*Cephalanthus occidentalis*	Tolerant	Moderate	15	OBL
Roughleaf dogwood	*Cornus drummondii*	Intermediate	Rapid	20	FAC
American Sycamore	*Platanus occidentalis*	Intermediate	Rapid	100	FAC+
Eastern Cottonwood	*Populus deltoides*	Intolerant	Rapid	190	FAC
Black Willow	Salix nigra	Intolerant	Rapid	100	FACW+

Harvesting

Live staking in warmer regions can be challenging due to short rainy winters and the limited time period that vegetation is dormant (Allen and Leech 1997; Landphair and Li 2002). To maximize success and survivability of newly planted live stakes, both harvesting and planting should occur within the vegetation dormant period (Allen and Leech 1997; Landphair and Li 2002). The Texas Department of Transportation found that cuttings survived 6.09 times greater

when installed in March over May (Landphair and Li 2002). In Texas plant dormancy generally occurs between December 15th and March 15th (Landphair and Li 2002). The diameter of harvested cuttings can be anywhere from 0.5" to 3" in diameter (Allen and Leech 1997; Polster 1999; Landphair and Li 2002; Shafer and Lee 2003; Pezeshki *et al*., 2007) and as long as is necessary to access the water table, especially during summer months (Allen and Leech 1997: Shafer and Lee 2003). Generally, cutting lengths ranging from 1.5' to 5' have been successful utilized (Allen and Leech 1997; Polster 1999; Shafer and Lee 2003; Pezeshki *et al*., 2007). Cuttings should be harvested from healthy, 2-5 year old branches from trees as near as possible too or that have similar conditions to the planting site (Solano 2005). The butt end of the branch should be cut at a 45-degree angle while the tops cut flat; make sure to avoid rough cuts or branch splintering (Solano 2005). Cuttings should be trimmed to a single stem removing all lateral branches and leaves prior to storage (Crowder 1995).

Storage

Once cut, there seems to be little consensus as to the length between collection and replanting. Studies report that regrowth after a storage period (anywhere from 1 week to 6 months depending on the storage conditions) is possible (Landphair and Li 2002; Crowder 1995; Shafer and Lee 2003). However, precise refrigeration is required for extended storage beyond a few weeks (Landphair and Li 2002). Others state that replanting directly after cutting is most favorable for regrowth (Solano 2005). Due to lack of refrigeration facilities and likely transport between harvest and planting locations it seems unlikely that both immediate planting and/ or long term storage is feasible. It has also been suggested that presoaking cuttings in water for a minimum of 24 hours up to 14 days will improve establishment and survival (Allen and Leech 1997; Solano 2005). Therefore, all newly harvested live stakes should be stored in water for a minimum of 24 hours but no more than 10-14 days prior to planting (Allen and Leech 1997; Solano 2005). It's important to remove live stakes, from their water storage, and plant prior to root emergence from the bark (Allen and Leech 1997). Landphair and Li (2002) found that damaging the newly formed roots of cuttings can potentially hinder future growth, hence reducing overall survivability. Live stakes should be kept fully submerged during storage, under shade, and in cold water, outdoor water temp of less than 50 degrees Fahrenheit if possible (Shafer and Lee 2003). Stakes should not be allowed to dry out.

Planting

Live stakes should be planted within the same day that they are removed from storage. Create a pilot hole using a small sledge hammer and rebar and/or bore a hole using a soil auger. Insert the butt end (cut at a 45-degree angle) of the live stake into the newly formed hole and gently hammer/ twist the stake into the ground until 75-80% is covered by soil (Figure 1). Several sources reported a depth of planting of at least 75% or more of the length of the cutting (Rossow 1992; Shafer and Lee 2003; Solano 2005). Although planting depth can vary slightly, access to groundwater is vital for plant establishment and survival (Allen and Leech 1997: Shafer and Lee 2003). Lightly tamp soil around the planted stake and heavily water to eliminate any air pockets that may have formed in the soil around the stake (Solano 2005). Remember to trim the top of the stake if it has become smashed or split during installation (Solano 2005).

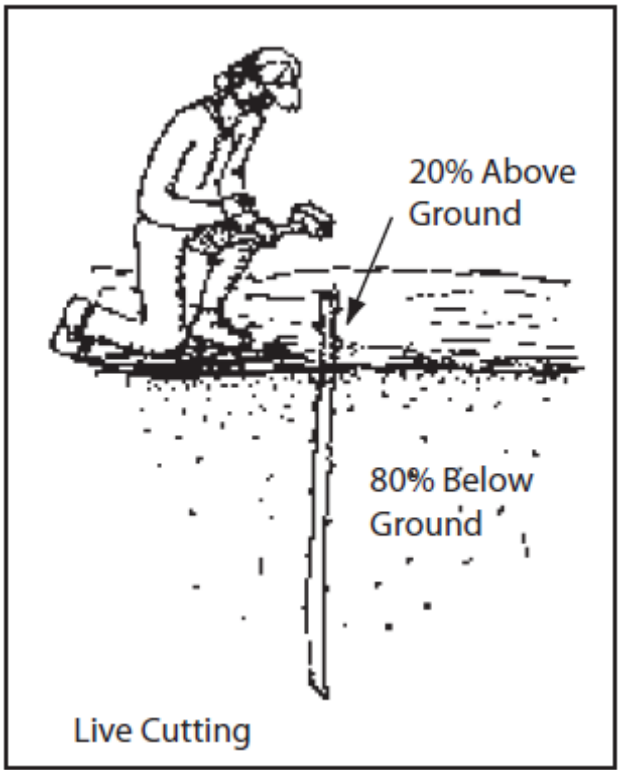

Figure 1: Plant live stakes up to 80% below the ground in order to access groundwater.

Conclusions

When appropriate plant species (Table 1) are properly harvested, stored, and planted live staking can be an effective method for increasing vegetation cover of riparian zone restoration projects. In order to ensure success the following Best Management Practices should be followed.

- Only attempt to use False Willow, Buttonbush, Roughleaf dogwood, American Sycamore, Eastern Cottonwood, or Black Willow during live staking projects.
- Both harvest and plant all live stakes during the winter dormant period of December 15th through March 15th.
- Cuttings should have a diameter range of 0.5" to 3.0", a length range of 1.5' to 5', be harvested from 2-5 year old branches, and be cut at a 45 degree angle at the butt end.
- It's important to harvest cuttings near to the planting site if possible.
- All harvested cuttings should be stored fully submerged in cold, shady water for 1-14 days and removed prior to root emergence from the bark.
- Live stakes should never dry out and should be planted the same day they are removed from storage.
- Although planting depth can vary, it's important for at least 75% or more of the cutting to be covered by soil and the butt end should have access to groundwater, especially during the dry summer months.

Recommendations

Prior to widespread implementation the methodology discussed in this paper should be field tested. Studies of species survivability and testing of the viability of the harvest, storage, and planting methods are needed.

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