

Alternatives for Tree Staking

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Abstract

Staking is a common practice following planting of most trees in the landscape. The objectives of this project were to demonstrate four methods of staking trees and the effect on subsequent caliper growth and taper development. Master gardener volunteers were involved in this project. Four methods of staking were used on two different tree species. *Acacia stenophylla* were 3.1 m tall at planting and were difficult to keep upright with one or two tall stakes. All acacias staked with root stakes or short stakes required corrective pruning to establish a new leader. *Prosopis velutina* staked with root stakes or short stakes developed greatest taper within 6 months after transplanting. Root stakes will not require removal of staking materials.

Introduction

Tree failure resulting from improper staking is among the leading causes of tree death in urban areas. Many container-grown trees require staking for a period of time in the landscape to allow new lateral roots to become established in the soil and anchor plants sufficiently. Common problems from wire ties include guy wires that are too tight, wires cuttings into the tree, and wires left too long in place. Stakes become a problem when they are too tall and physically damage branches in the canopy, when they are left in place too long, and when they are placed too close or not in the correct position according to prevailing winds. Prolonged staking reduces plant growth and stability (Harris et al., 1999). Sometimes a tightly staked plant arrives for landscape planting and the nursery stake is not removed, which further weakens the tree trunk and delays caliper and taper development.

Guidelines for proper tree staking of trees in the landscape can be found in The University of Arizona Cooperative Extension bulletin 'Planting guidelines: container trees and shrubs' (1998). This publication suggests looping a wire covered with garden hose around the tree trunk and fastening it to two stakes that are placed perpendicular to the wind. ISA guidelines recommend staking with one, two, or three stakes (Neely, 1993). A single stake should be placed upwind from the tree and tied with a figure eight loop to the tree. All tying materials should be broad, smooth and somewhat elastic where in contact with the stem. The method of using two stakes is similar to the University of Arizona recommendation. Three or four guy wires are often used to support trees with a diameter of greater than four inches. This method is more popular in the eastern United States and is not commonly used in the West.

Stakes as short as 15" or stakes (screw anchors) that are driven through the root ball into the underlying soil have been used with great success in the Netherlands (Floris, 1998). These methods provide opportunity for new roots to establish while the root ball is kept in place and while minimizing interference with trunk movement and development. Short stakes, like all above ground stakes, should be removed within two years, but screw anchors through the root ball are left in place and require no further maintenance.

A study comparing three trunk support systems on the growth of *Pyrus calleryana* trees found that the Bio-Tie system developed significantly more taper even one year after the supports were removed compared to a system that used 3 guy wires or the traditional double-stake support (Svihra et al., 1999). The Bio-Ties system (Vitech Technologies, Inc.) consists of a single stake holding the tree upright with a flexible cord, allowing for multidirectional movement of the tree.

The objectives of this project were to demonstrate four methods of staking trees in the landscape, determine the effects on caliper growth and taper development, and involve local Master Gardeners in this staking demonstration project.

Materials and Methods

On April 18, 2002, sixteen of 32 trees were planted with the help of Master Gardeners at the east side of the Pima County Cooperative Extension building in Tucson. *Acacia stenophylla* (Shoestring acacia) and *Prosopis velutina* (velvet mesquite) growing in 15-gal. containers had been purchased at a local nursery. The site had been prepared by staking the location of the trees, augering holes 5 feet wide and 18" deep, and removing large rocks. Master Gardener volunteers from Pima County Cooperative Extension were instructed in staking problems, the purpose of the project, and staking methods used in the project. Correct planting techniques and the four staking methods were then demonstrated and Master Gardeners engaged in planting and staking the trees. Trunk guards were installed to prevent girdling of the trees, and trees were watered in thoroughly. Drip irrigation was installed with five 1-gal. emitters per tree. Eight trees of each species were planted, and two trees each were staked either with one of the following methods:

1. Current University of Arizona guidelines recommended staking practices with two 8' stakes installed perpendicular to the prevailing wind direction outside the root ball and wires covered with garden hose attached the trunk to the stakes.
2. A single 8' stake was installed windward outside the root ball. A single flexible tie (Wonder Tree-Tie®) was attached to the trunk and to the stake.
3. Two short stakes, 20" tall, were placed outside the root ball perpendicular to the prevailing winds and flexible ties (Wonder Tree-Tie®) attached the stakes to the trunk.
4. Two steel rods (5/8" diameter and 36" long) were driven at 45 degree angles through the root ball into the underlying soil (root stakes).

On May 9, 2002, the remaining 16 trees were planted on the grounds of Pima County Cooperative Extension 'Our Yard' and at the Campus Agricultural Center. Volunteer Master Gardeners assisted again in the planting, and instructions, demonstrations, and the actual planting proceeded as described above. Drip irrigation was installed after planting as described above. Mulch was applied in a 6' circle around the base of each tree at a depth of 4".

Plant height and caliper were measured in June 2002 and in December 2002. Caliper of mesquite trunks were measured at 2 cm, 60 cm, and 100 cm above the soil line, caliper of acacias were measured at 2 cm, 75 cm, and 150 cm above the soil line. Taper was calculated by subtracting the top caliper measurement from the bottom caliper dividing this number by the distance between the two measurements. Results were analyzed with analysis of variance. Master Gardener volunteers were invited for a follow-up of the study and received the results in December 2002.

Permanent signage was installed at the first planting site. Five interpretative panels teach about staking practices, the effect of staking on plant development, and the results from the demonstration project.

Results and Discussion

The average height of acacias was 3.1 m at transplanting and even with a single or two tall stakes plants were difficult to keep upright. Height of acacias was 28% shorter 6 months after transplanting because the main leaders were leaning horizontally without support (Table 1). Caliper and taper increased for acacias during the first 6 months after transplanting (Table 1), indicating that plants were establishing well. After 6 months, greatest taper was found on acacias staked with two short stakes or with root stakes and the least taper on trees staked with two tall stakes (Fig. 1). This confirms previous research results where restricting trunk movement through stakes led to decreased development of taper (Harris et al., 1999).

Although acacias staked with the short stakes or the root stakes developed the greatest taper they were unable to stand upright and within a short time after transplanting were leaning or lying on the ground. All of these trees required corrective pruning approximately 0.5 to 1.5 m above the soil line to establish a future main leader. Therefore, the short stakes and the root stakes are unsuitable for staking tall plants that cannot stand without support. Acacias staked with one or two tall stakes sustained sunburn on the distal part of the leader, because the horizontally leaning branches were exposed to full sun. For many acacias these had to be removed as well and new leaders developed. When planting shoestring acacias, it is advisable to purchase shorter trees that can be staked without subsequent sunburn on branches. When taller trees are purchased, they should have enough taper and be strong enough to stand upright on their own. However, acacias often have stems that require support staking and when possible shorter rather than longer stakes should be used to support maximum taper development.

Mesquite trees were 1.7 m tall at planting and increased their height by 10% within 6 months after transplanting (Table 1). Caliper and taper increased over the six-month growing period on all mesquite, indicating their successful establishment. Greatest taper after 6 months developed on trees staked with root stakes, which allowed the greatest freedom of movement of trunks. Least taper was developed on trees supported with two tall or two short stakes. The shorter mesquite trees were ideal candidates for the root stakes and during establishment developed the most favorable taper for trunk stability. Root stakes have the additional advantage that no removal of staking material is required. Although the single tall stake resulted in acceptable taper development, the stake was too tall in relation to the tree. Root stakes should be evaluated by landscape professionals for their potential of providing an anchor for trees that are able to stand upright on their own even under windy conditions and require only an anchor during root establishment.

Acknowledgements

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Literature

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Table 1. Caliper, height, and taper of acacia and mesquite at transplanting in spring 2002 and 6 months after transplanting.

	<i>Acacia stenophylla</i>	<i>Prosopis velutina</i>
	Caliper at transplanting (mm)	
Bottom	26.0	20.6
Middle	18.5	15.2
Top	16.0	10.4
	Caliper 6 months after transplanting (mm)	
Bottom	43.5	38.8
Middle	33.2	28.9
Top	24.1*	22.8*
Height at transplanting(m)	3.1	1.7
Height after 6 months (m)	2.2	1.9
Height growth (%)	-28	+10
Taper at transplanting (mm/m)	7	10
Taper after 6 months (mm/m)	13*	16*

* significant differences between treatments

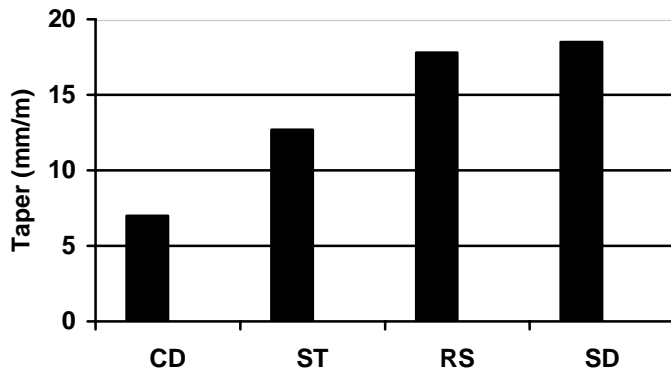


Figure 1. Taper of *Acacia stenophylla* six months after trees were transplanted and staked with four different methods (CD = conventional two 8' stakes with two ties, ST = single 8' stake with flexible tree tie, RS = two 36'' long steel rods through the root ball into the underlying soil, and SD = two short stakes, 20'' above root ball, with two tree ties).

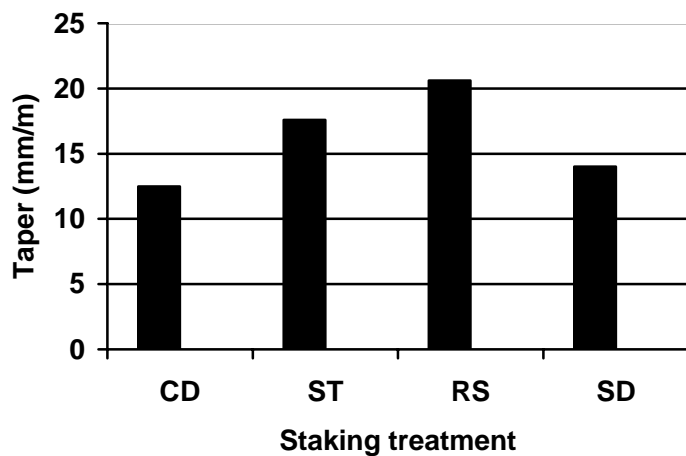


Figure 2. Taper of *Prosopis velutina* six months after trees were transplanted and staked with four different methods (CD = conventional two 8' stakes with two ties, ST = single 8' stake with flexible tree tie, RS = two 36'' long steel rods through the root ball into the underlying soil, and SD = two short stakes, 20'' above root ball, with two tree ties).