Effect of Leaf Removal and Tie-up on Transplanted Large Mexican Fan Palms (*Washingtonia robusta*)

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Several combinations of leaf removal and/or tie-up during transplanting had no effect on establishment and survival of Mexican fan palms (*Washingtonia robusta*) with well developed trunks.

Reduction of transpirational water loss is the reported benefit of leaf removal and tie-up when transplanting palms, and is a commonly recommended practice (Nixon & Carpenter 1978, Broschat 1991, Costonis 1995, Zaid 1999, Broschat & Meerow 2000). Indeed, leaf removal and tie-up have been shown to reduce transpirational water loss of palms (Hodel et al. in prep.). Such water loss is important because roots lost or damaged during transplanting are unable to take up water or do so at a much reduced level to replenish water stored in the palm trunk (Holbrook & Sinclair 1992a, 1992b).

In a recent paper, though, we showed that leaf removal and tie-up when transplanting juvenile, trunkless specimens of *Phoenix canariensis* and *Syagrus romanzoffiana* did not affect their establishment and survival (Hodel et al. 2003). Based on these results we theorized that larger palms transplanted with a well developed trunk would respond similarly if not better because they have functionally critical reservoirs of water stored in their trunks. The objective of this experiment was to determine the effect of leaf removal and tie-up on transplanted specimens with well developed trunks of *Washingtonia robusta*.

Materials and Methods

We conducted this experiment from May to October 2003 with field-grown *Washingtonia robusta* at a commercial palm nursery in Borrego Springs in the southern California low desert. This area is part of the North American Colorado Desert and averages 16.8 cm of rain annually with typical summer daytime high temperatures of 38–46ºC and nighttime lows of 20–28ºC. Temperatures during the study were within these ranges. The soil at the site was a Rositas fine sand with the pH 7.7, EC 5.02 DS/m, CEC 1.4 meq/100g, organic matter 0.24%, nitrate nitrogen 31 ppm, and total nitrogen less than 0.04%.

The study consisted of six treatments of various combinations of leaf removal and tie-up on transplanted and untransplanted palms. The palms had been planted 1.8 m apart in rows 1.8 m apart, had 1.5–2.8 m of trunk, and were four to five meters tall. We randomly selected six palms in each of four adjacent rows on which to perform the treatments. The six treatments were:

transplanted, no leaf removal, no tie-up;

transplanted, no leaf removal, tie-up;

transplanted, leaf removal, no tie-up;

transplanted, leaf removal, tie-up (standard industry practice);

not transplanted, leaf removal, no tie-up;

not transplanted, no leaf removal, no tie-up (control).

1. Digging and removal of palm with crane, typical root ball, May 2003.

2. Transplanted treatment with leaf tie-up, July 2003.

Each row was a block in which the six treatments were completely randomized, thus there were 24 palms total in the study (six treatments × four replicate rows).

The palms were transplanted and leaves removed and tied up according to typical nursery practices. Using hand shovels, the nursery staff excavated the palms that were to be transplanted, lifted them clear of the soil with a crane (Fig. 1), and laid them on the ground where we performed the designated leaf removal and tie-up treatments (Fig. 2). Leaf removal consisted of removing 50% of the total number of green leaves in the crown, all of which were from the lower part of the crown and were the oldest green leaves. Leaves were tied up on the distal part of the petiole near the blade, using nylon twine. The palms were then planted back in the hole from which they were removed. For palms not transplanted, we performed the leaf removal and tie-up treatments using a ladder to gain access to the crown of leaves.

Drip irrigation was used to irrigate the palms immediately after transplanting and throughout the study to ensure that the soil was kept moist. No fertilizers or herbicides were applied during the study.

At treatment application in May 2003 we marked the newest leaf and recorded the number of leaves prior to removal, number of leaves removed, and leaves remaining after removal. Three critical factors for assessing palm transplant success are:

Table 1. Effect of leaf removal and tie-up on mean number of new leaves produced and mean number of green and brown leaves (with percent of green and brown leaves in crown in parentheses) on transplanted large *Washingtonia robusta* palms, Borrego Springs, CA, May to October, 2003.

Treatments			Number of Leaves		
Transplant	Leaf Removal	Leaf tie-up	new	green	brown
			July 17, 2003		
1Yes	No	No	1.8D	3.5D(22)	12.5A(78)
2Yes	No	Yes	2.5CD	4.8CD(31)	10.5AB(69)
3Yes	Yes	No	4.5BC	2.5D(27)	6.8BC(73)
4Yes[z]	Yes	Yes	1.3D	7.5C(65)	4.0CD(35)
5No	Yes	No	6.8A	12.8B(100)	0.0D(0)
6No[y]	No	No	6.5AB	20.0A(100)	0.0D(0)
			October 16, 2003		
1Yes	No	No	3.5B	6.5B(34)	12.5A(66)
2Yes	No	Yes	3.8B	7.5B(42)	10.5AB(58)
3Yes	Yes	No	4.3B	7.8B(53)	7.0B(47)
4Yes[z]	Yes	Yes	4.3B	9.5B(66)	4.8B(34)
5No	Yes	No	9.3A	23.8A(100)	0.0C(0)
6No[y]	No	No	10.0A	27.3A(100)	0.0C(0)
			Cumulative		
1Yes	No	No	5.3B	—	—
2Yes	No	Yes	6.3B	—	—
3Yes	Yes	No	5.8B	—	—
4Yes[z]	Yes	Yes	5.5B	—	—
5No	Yes	No	16.0A	—	—
6No[y]	No	No	16.5A	—	—

Mean number of new, brown, and green leaves within a column in the same date followed by different letter are significantly different according to Fisher's Protected Least Significant Difference Test, P<0.001.

[z]Standard industry practice (SIP).

[y]Control.

survival;

number of new leaves produced, which is a measure of growth;

number and ratio of green and brown leaves in the crown, which is an assessment of the esthetic quality of the palm.

Thus, in July 2003, about half way through the study, and October 2003, at the end of the study, we recorded the number of new leaves produced for each interval and the number of green and brown leaves present on each palm. We classified brown leaves as those having more than half the blade area brown.

We conducted analysis of variance tests (ANOVA) and compared means for number of new leaves and number of green and brown leaves in July and October and cumulative number of new leaves over the course of the study using Fischer's Protected Least Significant Difference Test.

Results

Survival. All palms in this study survived and established successfully.

Number of new leaves produced. Untransplanted treatments produced significantly more leaves than transplanted treatments for the last half of the study and cumulatively over the course

of the study (Table 1). Within the four transplanted treatments, there were no differences in number of leaves produced over the last half of the study and cumulatively over the course of the study. However, by July differences among the treatments were not as well defined. At that time the transplanted leaf removal/no tie-up treatment was intermediate between and not significantly different from the untransplanted control (no leaf removal/no tie-up) and the transplanted standard industry practice (SIP) (leaf removal/tie-up).

Number of green and brown leaves. Untransplanted treatments had significantly more green leaves in their crowns in July and October than transplanted treatments (Table 1). Among the transplanted treatments, the SIP (leaf removal/tie-up) had the most green leaves in July although it was not significantly different from the no leaf removal/tie-up treatment. By October, though, there were no differences in number of green leaves among the transplanted treatments.

In July there were no significant differences in number of brown leaves in the crowns between the two untransplanted treatments and the transplanted SIP (leaf removal/tie-up) although by October untransplanted treatments had significantly fewer brown leaves than all transplanted treatments. Differences in the number of brown leaves among the transplanted treatments in July and October were not as clearly defined although the SIP (leaf removal/tie-up) and the leaf removal/no tie-up treatments had fewer brown leaves than the no removal/no tie-up treatment.

Discussion

No treatment improved survival or increased leaf production of the transplanted palms, indicating that, while leaves are a source of water loss, the reservoir of water in the trunk and/or the ability of the palm to regulate transpirational water loss more than compensated for the loss or reduction of water uptake by roots damaged or lost during transplanting.

Any transplanting, regardless of leaf removal or tie-up treatments, stressed the palms, though, and resulted in some of the existing leaves dying and turning brown, leading to more brown leaves in the crown than either untransplanted treatment. However, among the transplanted palms, the two leaf removal treatments resulted in fewer brown leaves than the no removal/no tie-up treatment. Thus, the primary benefit of leaf removal when transplanting *Washingtonia robusta* is probably an esthetic one because it reduces the number of brown leaves in the crown by eliminating them before they would have turned brown and died anyway from transplant stress and shock.

The percentage of green and brown leaves in the crown provides a more accurate portrayal of the esthetic quality of the palms than simple leaf numbers because, due to variations in crown size and leaf removal treatments, the palms had different number of leaves in their crowns at the onset of the study. The untransplanted palms had 100% green leaves in their crowns in July and in October (Table 1). Among the transplanted treatments, the SIP (leaf removal/tie-up) had more than double the percentage of green leaves in its crown in July (65%) than the others although by October the differences were not as great.

Summary and Conclusion

No treatment improved survival, resulted in more new growth and green leaves, or eliminated browning of leaves of large, transplanted *Washingtonia robusta* by the end of the five-month study. Thus, leaf removal and leaf tie-up do not improve transplant success with this species. However, leaf removal may improve the esthetic quality by eliminating leaves that will probably die and turn brown from transplant stress, thus increasing the ratio of green to brown leaves in the crown.

Acknowledgments

We thank Joe Ellis, owner, and John Hogan, manager, of Ellis Farms in Borrego Springs, California for use of their field-grown *Washingtonia robusta* to conduct our study.

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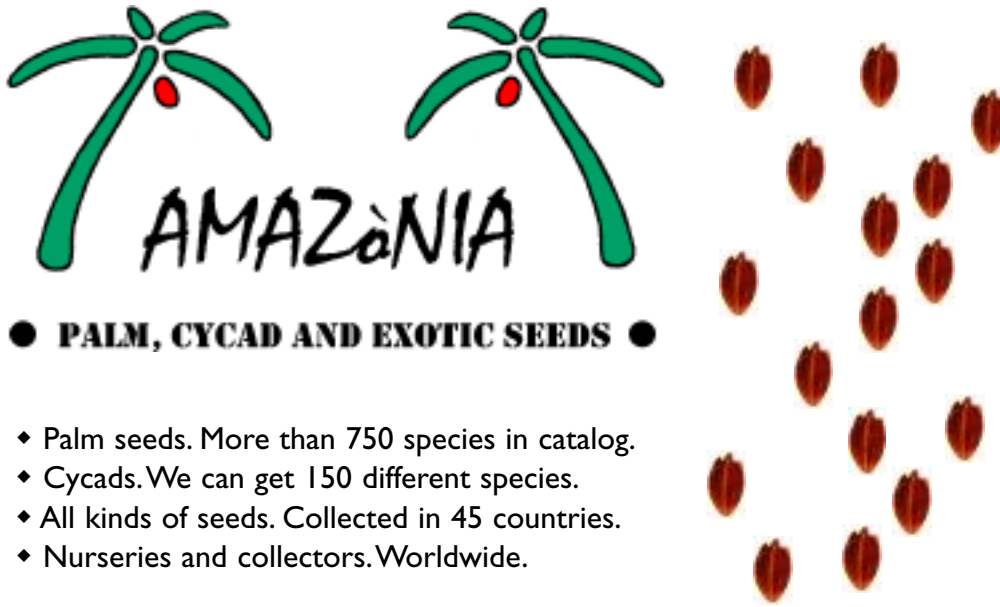

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