EFFECTS OF LEAF REMOVAL, LEAF TYING, AND OVERHEAD IRRIGATION ON TRANSPLANTED PYGMY DATE PALMS

by Timothy K. Broschat

Abstract. The effects of leaf removal, leaf tying, and overhead irrigation during transplanting were determined using mature pygmy date palms (*Phoenix roebelenii*). In one experiment palms had all, 2/3, or none of their leaves removed and were irrigated overhead or on the soil surface only. In the second experiment, palms had 2/3 of their lower leaves removed and those remaining were either tied up into a bundle or left untied. Half of the palms in each experiment were irrigated daily while the other half were subjected to water stress cycles. Results showed that leaf tying had no positive effect on the palms, but when coupled with overhead irrigation, was responsible for fungal infections in the crowns of some palms. With regular irrigation, palm quality and root growth were increased as the number of leaves retained was increased, but under water stress conditions, the reverse was true. Overhead irrigation had no positive effect on transplanted palms.

In the process of transplanting large specimen palms from one site in a nursery or landscape to another, most of the palm's root system is cut off. One of the most serious problems encountered when transplanting palms is water stress that results from continued transpiration by the leaves, coupled with a greatly reduced root surface area. One practice commonly employed to reduce water stress problems in transplanted palms is tying the leaves up into a tight bundle. Leaf tying should reduce the vapor pressure gradient at the surface of protected leaves due to reduced air flow (5). In practice, leaves are tied up into a bundle at the time of digging using a biodegradable twine, which is left in place until it breaks down due to rot or photodegradation and falls off. Although this procedure increases the humidity within the leaf bundle and may reduce transpiration, it also creates an environment favorable for pathogenic fungi such as *Gliocladium vermoeseni* (4). The colonization of tied palm leaves by *Gliocladium* is well known, but the possible benefits of leaf tying in terms of increased palm survival or recovery rate have not been documented.

A second method sometimes employed to reduce water stress in transplanted palms is to install small sprinkler heads in the crown of the palm. These may be turned on daily or as needed to keep the crown of the palm from becoming desiccated. While this practice should reduce water stress, it may also create a favorable environment for *Gliocladium* or other pathogens.

A third method used to decrease water loss during the transplanting process is leaf removal. Broschat (1) showed that for sabal palm (*Sabal palmetto*), survival rate and plant quality were greatly enhanced by removing all leaves at the time of transplanting. Sabal palms are unusual among palms in that virtually no cut roots survive and all must be replaced by new adventitious roots arising from the root initiation zone at the base of the trunk (2). This means that these palms are without any functional root system for 6-8 months following transplanting and are usually under severe water stress.

In most palm species, at least some roots survive and continue to function after being cut (2,3) and water stress is less of a problem than for sabal palms. In these species, the presence of leaves on a transplanted palm may improve rather than decrease palm survival rate and quality as occurs in sabal palms.

The purpose of this study was to evaluate the effects of leaf removal, leaf tying, and overhead irrigation under conditions of water adequacy as well as water stress. Pygmy date palms (*Phoenix roebelenii*) were used in this study because they have a root regeneration response similar to those of most other palms studied (2,3), and they mature at a small size so that heavy equipment is not required to transplant them.

Materials and Methods

A three-way factorial experiment with ten palms per treatment was set up on 1 April 1991 to determine the effects and interactions of leaf removal, irrigation method, and water stress on survival rate, quality, and root regrowth of transplanted pygmy date palms. Container-grown palms having a minimum of 30 cm of clear trunk were removed from their containers and their rootballs were cut down to a cube 20 cm on a side to simulate the digging of a field-grown palm for transplanting. Palms were transplanted within 24 hr. into 10-liter polypropylene containers using a pine bark, sedge peat, and sand (5:4:1, by volume) medium amended with 4.9 kg of dolomite and 880 g of Micromax (Grace-Sierra Hort. Prod., Milpitas, CA)/m^3.

All of the leaves were removed from a third of the palms, 2/3 of the lower leaves were removed from another third, and none of the leaves were removed from the remaining third. Any leaves remaining on the palms were tied up into a bundle using plastic twist ties. Palms for each of these treatments were placed in a fiberglass house to exclude rainfall. This house has a maximum light intensity of 840 $\mu M/m^2/sec$. Half were irrigated using overhead sprinklers and the other half were irrigated with a hose such that only the soil was wetted. Chlorinated municipal water was used for both irrigation methods. Within each of these groups, half of the palms were irrigated daily and the other half were subjected to a series of dry periods lasting up to 2 weeks each. A split plot design with 10 replications was used in this experiment. After 5 months, palms were removed from their containers and any new roots were rinsed free of soil, cut off flush with the original rootball, dried at 60°C and weighed. The number of dead and living leaves per palm were counted and the status of the palm (living or dead) was recorded. Data were analyzed by analysis of variance and the statistical significance (P) of each main effect or interaction was calculated.

A second experiment with 10 palms per treatment was set up on 3 Aug. 1993 to determine the effects of leaf tying on palm survival, quality, and recovery rate. As in the first experiment, the rootballs of container-grown pygmy date palms were cut down to a 20 cm cube and were similarly transplanted into 10-liter containers. Two-thirds of the lower leaves were removed from all palms. The remaining leaves were tied up into a bundle using plastic ties for half of the palms, but the leaves of the others were not tied up. Half of each treatment was irrigated daily using overhead and manual soil irrigation on alternate days, but water was withheld for up to 2 weeks for three drought cycles for the water stressed palms. Plant quality, root regrowth, and survival rate were recorded after three months as in the previous experiment.

Results and Discussion

In the leaf removal experiment, all palms that were irrigated daily survived, but survival rate was significantly less ($P<.0001$) for those subjected to water stress (Figure 1). Root dry weight and number of living leaves were significantly greater ($P<.0001$) and number of dead leaves were fewer ($P<.0001$) for non-stressed palms than for those subjected to water stress (Figures 2-4). Root dry weight and number of living and dead leaves increased ($P<.0001$) as the number of leaves left on the palm was increased for non-stressed palms.

For water stressed palms, however, root dry weight and survival rate decreased ($P<.0001$, and .003, respectively), but the number of dead leaves increased ($P<.0001$) as the number of leaves left on the palm was increased (Figures 1,3,4). These data suggest that under conditions of adequate

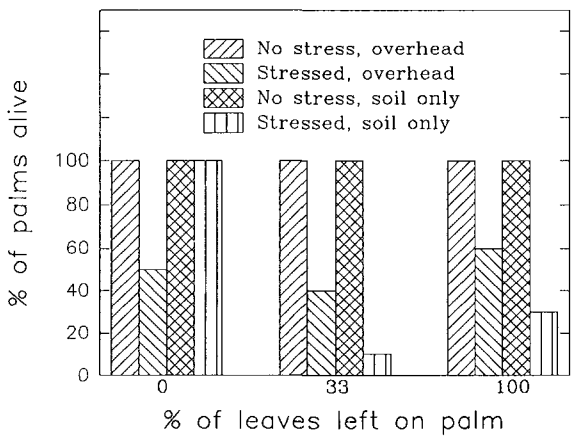

Figure 1. Effects of leaf removal, water stress, and irrigation method on the survival rate of transplanted pygmy date palms.

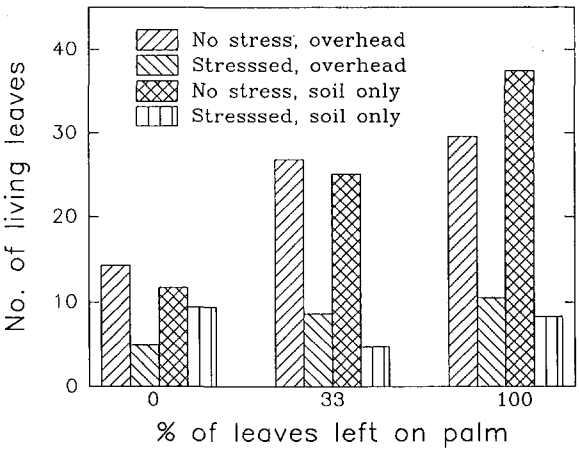

Figure 2. Effects of leaf removal, water stress, and irrigation method on the number of living leaves retained by transplanted pygmy date palms.

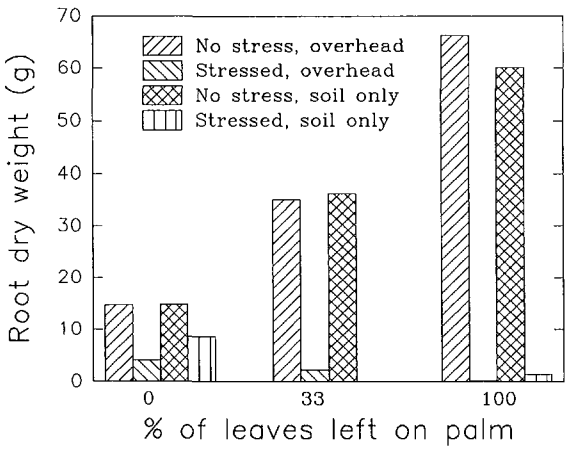

Figure 3. Effects of leaf removal, water stress, and irrigation method on the root dry weight of transplanted pygmy date palms.

water availability, the presence of leaves on transplanted palms enhances new root growth. Palm quality, as measured by the number of living leaves, was also higher (P<.0001) for palms transplanted with leaves. Under water stress conditions, however, the presence of leaves was a detriment to palm survival, perhaps due to increased transpiration. Increasing the number of leaves left on the palms decreased root regrowth and survival rates (P<.0001 and .003, respectively) and increased the number of leaves dying from water stress (P<.0001). This response is similar to

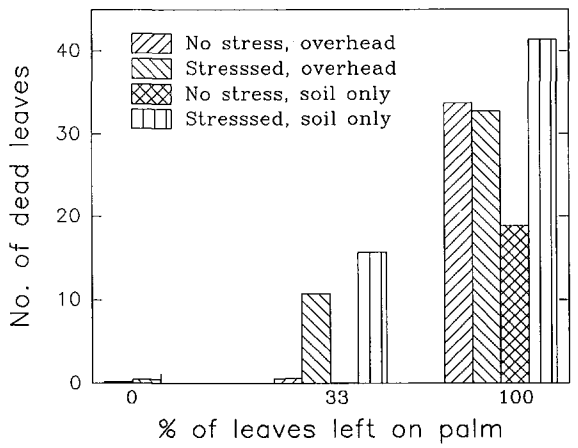

Figure 4. Effects of leaf removal, water stress, and irrigation method on the number of dead leaves on transplanted pygmy date palms.

that of sabal palms (1), a species subject to severe water stress during the transplanting process.

Irrigation method affected only the number of dead leaves (Figure 4). Palms receiving daily overhead irrigation had significantly more (P<.0001) dead leaves than those receiving daily soil irrigation. For water-stressed palms, the reverse was true and overhead irrigation significantly reduced the number of dead leaves per palm. This can be explained by examining the positions of the dead leaves and the causes of death for overhead and soil watered palms. Those receiving overhead irrigation daily often lost newer leaves due to fungal growth within the constantly wet bundle of tied leaves. Water stress, which kills the oldest leaves first, was less of a problem for daily irrigated palms, but was the sole cause of leaf mortality for water stressed palms.

In the leaf tying experiment, water stress significantly decreased the number of living leaves and root dry weight (P<.002 and .0001, respectively), but leaf tying had no effect on survival rate, quality, or root dry weight of transplanted pygmy date palms (Figures 5-7).

Conclusions

This study shows that unlike sabal palms, complete leaf removal may not always be beneficial for other species of transplanted palms. Under conditions of adequate water availability, complete

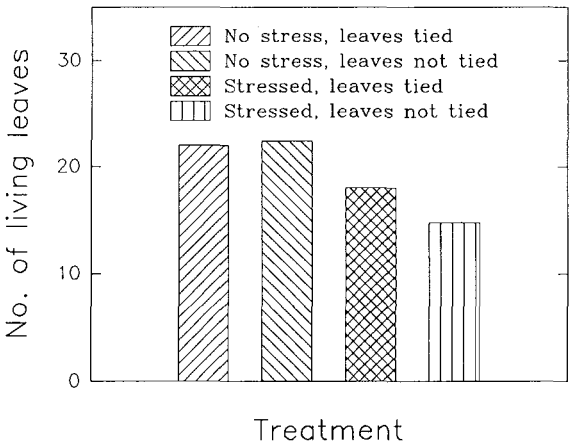

Figure 5. Effects of leaf tying and water stress on the number of living leaves remaining on transplanted pygmy date palms.

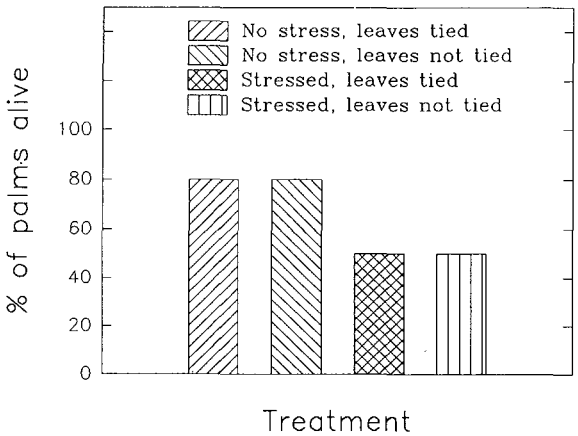

Figure 6. Effects of leaf tying and water stress on the survival rate of transplanted pygmy date palms.

leaf removal reduces plant quality and root regrowth rate. Under water stress conditions, however, complete leaf removal enhances survival rate and root regrowth rate, although both of these parameters were lower than for adequately watered palms. The practice of leaf tying does not appear to improve palm quality or transplant survival and root regrowth rates, and ties used during digging and transportation should therefore be removed once palms are installed in the landscape.

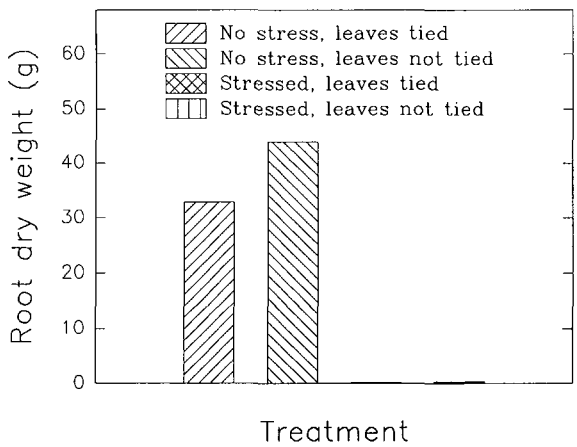

Figure 7. Effects of leaf tying and water stress on the root dry weight of transplanted pygmy date palms.

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Résumé. Les effets de l'enlévement des feuilles, du rattachement des feuilles et de l'irrigation aérienne dans la cime durant la transplanattion étaient évalués avec des dattiers (*Phoenix roebelenii*). Les résultats montrèrent que le rattachement des feuilles n'avait aucun effet positif sur les dattiers, mais que couplé avec une l'irrigation sur le feuillage, il y avait alors présence d'infections fongiques dans la cime de certains arbres. Avec une irrigation régulière, la qualité des arbres et la croissance des racines s'amélioraient avec l'augmentation du nombre de feuilles rattachées; mais sous des conditions de stress hydrique, l'inverse était aussi vrai. L'irrigation aérienne des arbres n'avait aucun effet positif sur les dattiers transplantés.

Zusammenfassung. Während der Verpflanzung von Zwergdattelpalmen wurden die Effekte von Blattentfernen, Blattbinden und overhead-Bewässerung bestimmt. Die Ergebnisse zeigten, daß das Zusammenbinden von Blättern keine positiven Auswirkungen auf die Palmen hatte, während, gekoppelt mit mit der overhead-Bewässerung, es durch das Binden zu Pilzinfektionen in den Kronen einiger Palmen führte. Mit regelmäßiger Bewässerung verbesserte sich die Palmenqualität und das Wurzelwachstum sowie die Zahl der erhaltenen Blätter, aber unter Wasserstreßbedingungen verschlechterte sich der Zustand. Die overhear-Bewässerung hatte keine positiven Auswirkungen auf die verpflanzten Palmen.