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Removing Potassium-deficient Leaves Accelerates Rate of Decline in Pygmy Date Palms

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Potassium deficiency is a widespread and often serious disorder on many species of palms throughout the world (Chase and Broschat, 1991). Potassium is mobile within plants and deficiency symptoms are most severe on the oldest leaves, becoming less so on younger leaves (Mengel and Kirkby, 1982). As K deficiency becomes more severe on palms, the symptoms will affect progressively younger leaves until no symptom-free leaves remain. At this point, if untreated, new leaves will emerge chlorotic, reduced in size, and with extensive necrosis. Death of the palm's only shoot meristem often follows (Broschat, 1990).

Leaves normally remain on a healthy palm for 2 or more years, depending on the species, and each palm will retain a species-specific number of leaves (Tomlinson, 1990). Mildly K-deficient leaves are typically removed during landscape maintenance because they are visibly discolored, and severely deficient leaves appear dead except for the rachis and adjacent areas of the leaflets. Under conditions of K deficiency, K from the oldest leaves will be mobilized for use by the newly expanding leaves. Premature removal of the oldest K-deficient leaves may remove a source of K needed for plant growth. Potassium required for continued growth should then be mobilized from the oldest remaining leaves, which may previously have been symptom-free. As these leaves become symptomatic and are subsequently removed, still younger leaves will be utilized as a source of K by the meristem. Thus, removal of K-deficient leaves may accelerate the rate of decline from K deficiency in palms. The purpose of this study was to test this hypothesis on pygmy date palms (*Phoenix roebelenii* O'Brien), a species highly prone to K deficiency and which matures at a small enough size to be easily grown in containers.

Mature pygmy date palms having gray trunks at least 30 cm long were transplanted from 24-liter containers into 38-liter polypropylene containers using a 5 pine bark: 4 sedge peat: 1 sand medium amended with 880 g MicromaxR and 4.9 kg of dolomite/m3. Mild K deficiency occurred on palms fertilized with 200 g of Osmocote 17N-3P-10K per container every 6 months and moderate K deficiency was induced by fertilizing with 160 g of Osmocote 17N-3P-10K and 40 g of Osmocote 40N-0P-0K plus 20 g of MgSO4.H2O per container. Within each fertilizer treatment, 10 replicate palms had only dead leaves removed every 3 months, and 10 had dead as well as K-deficient leaves removed on the same time interval. A leaf was considered deficient if more than 3 leaflets had tips with 1 cm or more of orange discoloration.

Palms were grown under full sun (max. PPF=2100 uE.m2.sec-1) and received water as needed from rainfall and overhead irrigation. After 18 months the number of dead, deficient, and green leaves per tree were counted, and leaf samples consisting of the central 10 leaflets from the most recently matured leaf and the second oldest living leaf on each tree were collected for nutrient analysis. Leaf samples were dried, ground, and digested using a modified sulfuric acid and hydrogen peroxide procedure (Allen, 1979), with K concentrations determined by atomic absorption spectrophotometry. Data were analyzed by analysis of variance.

Both mildly and moderately K-deficient palms having deficient and dead leaves trimmed had significantly fewer green non-symptomatic leaves than those having only dead leaves removed (Table 1). These results support the hypothesis that removal of K-deficient leaves results in reduced canopy size and an accelerated rate of decline from K deficiency. In addition, significantly fewer dead and deficient leaves remained on the moderately deficient plants if both dead and deficient leaves were removed when compared to plants with only the dead leaves removed (Table 1).

For mildly deficient palms, only the number of dead leaves was reduced by removing both deficient and dead leaves compared to removal of only dead leaves. For both trimming treatments, the number of green leaves retained by moderately deficient palms was less than for the mildly deficient palms of the same leaf removal treatment ($P<.05$), suggesting that the number of green leaves retained may also be related to the amount of K in the soil available to the palm.

When both old and recently matured leaves were analyzed for leaf K concentrations, no significant differences existed among any treatments (data not shown). It appears that as long as older leaves are available to supplement K taken up from the soil, the K content of recently matured leaves will remain relatively constant until all leaves are deficient. Similar results were reported for K-deficient African oil palms (*Elaeis guineensis* Jacq.) (Hartley, 1988). Assuming that K is mobilized at a constant rate from oldest leaves under conditions of similar K deficiency, the K concentrations in the second oldest leaves should also be equivalent, regardless of the number of green leaves above it in the canopy.

In conclusion, canopy size (green leaves, as well as total living leaves) was reduced after 18 months of K deficiency in pygmy date palms when deficient leaves were periodically removed, compared to palms from which only dead leaves were removed. This supports the hypothesis that removal of deficient leaves removes a significant source of K for the growing meristem and accelerates the rate of decline from K deficiency.

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Table 1. Effects of periodic trimming of K-deficient leaves over an 18-month period on the canopy structure of mildly- and moderately-deficient pygmy date palms.

Treatment		No. of Leaves	
	Green	Deficient	Dead
Mildly-deficient palms			
Dead and deficient leaves removed	23.1	7.0	1.7
Dead leaves only removed	29.2	12.0	10.5
Significance (P)	.02	NS	<.0001
Moderately-deficient palms			
Dead and deficient leaves removed	18.4	9.1	0.2
Dead leaves only removed	24.7	27.7	10.3
Significance (P)	.02	.001	.0002

Nursery Production of Pickerelweed

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Pickerelweed (*Pontederia cordata* L., family Pontederiaceae), is a perennial, emergent, aquatic plant. Three common varieties of pickerelweed have been identified: *Pontederia cordata* L. var. *cordata*, *Pontederia cordata* L. var. *lancifolia* (Muhl.) Torrey, and *Pontederia cordata* L. var. *albiflora* Raf.

Pickerelweed is found in all sections of Florida, but is more abundant in central and south Florida. Variety *cordata* has a glabrous floral tube that is shaggy pubescent in the

bud stage. The leaf blades are deltoid-ovate to triangular lanceolate with bases deeply cordate to truncate. It ranges from South America to Ontario, Canada, including much of the Eastern United States.

Variety *lancifolia* has a floral tube that is persistently pubescent with glandular hairs. The leaves are narrowly to broadly lanceolate with bases typically unlobed. It ranges from South America and the West Indies to Tennessee, including the Southeastern United States.

A third variety, *albiflora*, has white flowers. It is found in areas around Louisville, Kentucky, and in Pinellas County and the basin marsh of Paynes Prairie in Florida.

All three varieties of pickerelweed occur in streams, marshes, ditches, swamps, ponds and lakes in up to 3 feet of water. When pickerelweed plants are planted in lakes, they become established in water from 3 inches to 2 feet in depth if they are not submersed. These plants grow well in sediments high in nutrients and spread quickly to cover the littoral shelf.

Pickerelweed grows in a wide range of water quality. It may completely fill small ponds and drainage ditches, even to the point of impairing water movement. It spreads from seed and also vegetatively from creeping rhizomes rooted in the substrates. It flowers year round if not frost damaged, but most flowers are formed in summer and fall. Seed may be collected after the pollinated flower spike has bent downward. Mature seeds will shatter from the flower stalk.

Field observations indicate that the best time to germinate pickerelweed seeds is from April through July. However, the germination of pickerelweed seeds collected from plants growing in temperate climates may be somewhat different from those collected in Florida as seeds from cooler regions require a period of moist, cold storage before they will germinate.

Nursery production of pickerelweed may be accomplished with seeds or vegetative material. A root section approximately 1.5-inches in length is suitable vegetative material. These may be collected from field sites. Uncut roots remaining in the ground send up new shoots within 3 to 4 weeks during the summer growing season. The seedlings or root sections may be cultured in potting soil in standard 2-, 4-, or 6-inch commercial pots. The use of sand amended with commercial fertilizer is one way to culture weed-free plants.

One of the problems involved in planting nursery container grown plants is the height of plants in relation to water depth. Small pickerelweed plants submersed at the time of planting or within a few weeks afterwards generally die. It is important to be able to grow tall nursery plants. One way of doing this is to use 2-inch square by 6 inch deep pots. Of course, large plants will require more production space, fertilizer, etc., and will be more difficult to transport than smaller plants. But the increased survival of large plants will help offset the need to replant those that die.

Nursery grown plants may be damaged by leaf miners in the leaves or mealybugs on the roots. An insecticide, such as malathion, may be necessary to control these pests. When plants are grown in the same container over a prolonged period of 120 to 180 days, the older leaves die and may cause disease in the stems just above the roots. The old leaves need to be removed to prevent disease problems.

Tissue culture is also being used for propagation of pickerelweed. One of the top priorities of the future is to grow as many plants as possible from seeds, vegetative material, or tissue culture to reduce the number of mature plants harvested from wetlands. Commercial production of pickerelweed will help preserve natural wetlands. This is important because it takes many years for a man-made wetland to perform the same function as a natural one. Pickerelweed is one of the most commonly used aquatic plants for mitigation, shoreline restoration, and roadside revegetation projects. Pickerelweed is also used for water gardens and ponds in home landscapes as well as indoor aquaria.

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Aquatic plant images provided by the Information Office of the University of Florida, IFAS, Center for Aquatic Plants (Gainesville)