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The Effects of Increasing Lime Concentrations in the Development of Pigmy Date Palm Seedlings in Containers After 17 Weeks

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Literature concerning ornamental palm nutrition is limited. Research on palm nutrition has largely been conducted with those species grown commercially for their products, namely coconuts, dates, and oil palms. (Furr and Armstrong 1957, Hartley 1967, Menon and Pandulai 1958).

Since the foliage industry began an important upsurge about 20 years ago, interest in indoor plants has increased (Smith et al. 1982). Consequently, as problems occurred in the production of foliage plants, nurserymen brought their questions to university researchers. One result was the establishment of the Agricultural Research Center at Apopka, Florida, devoted solely to research on many tropical foliage plants. Preliminary research has been conducted with foliage palms such as *Chamaedorea elegans* Mart., *Chrysalidocarpus lutescens* H. A. Wendl., and *Howea fosteriana* (C. Moore and F. V. Muell.) Becc. Studies to determine fertilizer rates, foliar analyses and constant fertilization rates were conducted to help growers produce a more saleable plant faster (Conover and Sanders 1978, Poole and Conover 1977, Poole and Conover 1981).

The purpose of this study was two-fold: to provide additional information on foliage palms, as very little research has been conducted with *Phoenix roebelenii* O'Brien, the pigmy date palm, and to determine the effects of increasing lime concentrations in the development of pigmy date palm seedlings in containers.

Bare-rooted seedlings in the 2–3 leaf stage were potted in 11 cm black plastic containers each containing 0.72 l of amended Metro Mix 500 (marketed by W. R. Grace and Co., Cambridge, Mass.). The pH of the unamended mix was 6.5, which reflected the amount of dolomitic limestone added to Metro Mix 500 by the manufacturer (1.87–2.24 kg/0.765 m^3). The dolomitic lime treatments consisted of: 6 pots in treatment 1, no additional lime added; 6 pots in treatment 2, 35.4 g of additional lime added to 11.4 l of Metro Mix 500 (50 percent increase in lime); and 6 pots in treatment 3, 70.8 g of additional lime added to 11.4 l of Metro Mix 500 (100 percent increase).

The seedlings were placed in a completely randomized design on a greenhouse bench at Louisiana State University, Baton Rouge, LA for 17 weeks. All plants were grown under 47 percent black polypropylene shade cloth, with temperatures ranging from 18° to 41° C, and watered approximately every two weeks with 400

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Table 1. Foliage, root and total dry weights of container grown pigmy date palm as affected by 50% and 100% increases in dolomitic limestone 17 weeks after application.

Treatments	Mean Foliage Dry Weight (g)	Mean Root Dry Weight (g)	Mean Total Dry Weight (g)
1. No additional lime added to Metro Mix 500[y]	0.988a[x]	0.463a	1.45a
2. 50% (35.4 g/11.4 l) lime added to Metro Mix 500	0.688b	0.33b	1.02b
3. 100% (70.8 g/11.4 l) lime added to Metro Mix 500	0.757b	0.34b	1.10b

[y] Marketed by W. R. Grace and Co., Cambridge, Mass.
[x] Mean separation within column by Duncan's New Multiple Range Test, 5% level.

ml of water. They received one treatment of fertilizer with 400 ml of Peters 25-9-17 soluble fertilizer containing 2.3 g of fertilizer per 3.8 l.

Data examined included length of the longest leaf, leaf number, foliage, root, and total dry weights, leaf tissue analyses, and soil mix analyses at the conclusion of the experiment (Doughty 1982).

Leaf length appeared to be an unreliable growth measurement because in some observations smaller leaves were produced due to increasing light and duration as long days approached. There were no significant treatment effects on leaf length or number.

Foliage, root, and total dry weights were significantly affected by treatments. As the rate of lime increased by either 50 percent or 100 percent, the foliage, root, and total dry weights significantly decreased (Table 1).

Although number of leaves produced over 17 weeks was not significantly affected by treatment, there appeared to be a trend in the mean number of leaves. In treatment 1, no lime added, the mean leaf number was 6.33. In treatment 2, 50 percent lime added, the mean leaf number was 5.6; and treatment 3, 100 percent lime added, the mean was 5.17. This seemed to suggest that plants grown in 50 and 100 percent added lime produced fewer leaves.

Foliar tissue analysis of manganese (Mn) and zinc (Zn) showed no significant effects of treatment. However, tissue iron (Fe) and copper (Cu) significantly increased with added lime (Table 2). The increase in Cu could be explained by a strong complexing of Cu by the soil organic matter. Lindsey (1977) indicated that this complexing is believed to be an important factor explaining why Cu deficiencies occur in soils with a high pH even though both cations show

Table 2. Foliar tissue analysis of Fe and Cu as affected by 50% and 100% increases in dolomitic limestone of container grown pigmy date palm 17 weeks after applications.

Treatments	Mean Foliar Tissue Fe (ppm)	Mean Foliar Tissue Cu (ppm)
1. No additional lime added to Metro Mix 500[y]	86.43b[x]	6.30b
2. 50% (35.4 g/11.4 l) lime added to Metro Mix 500	124.05a	8.40a
3. 100% (70.8 g/11.4 l) lime added to Metro Mix 500	126.73a	8.38a

[y] Marketed by W. R. Grace and Co., Cambridge, Mass.
[x] Mean separation within column by Duncan's New Multiple Range Test, 5% level.

Table 3. Metro Mix 500[y] Zn and Cu analysis as affected by 50% and 100% increases in dolomitic limestone of container grown pigmy date palm 17 weeks after application.

Treatments	Mean Soil Mix Zn (ppm)	Mean Soil Mix Cu (ppm)
1. No additional lime added to Metro Mix 500[y]	29.85a[x]	22.72a
2. 50% (35.4 g/11.4 l) lime added to Metro Mix 500	20.46b	18.12b
3. 100% (70.8 g/11.4 l) lime added to Metro Mix 500	20.93b	18.03b

[y] Marketed by W. R. Grace and Co., Cambridge, Mass.
[x] Mean separation within column by Duncan's New Multiple Range Test, 5% level.

similar decreases in solubility with increased pH. Knezek and Ellis (1980) reviewed evidence that Cu and Zn could be absorbed from a very dilute solution of Ca saturated peat. It was thought that the bonding might be through the hydroxyl groups in the peat.

A study by the senior author (unpublished) using Metro Mix 500, with the same rates of lime, but growing a sorghum-sudangrass hybrid in 11 cm containers for seven weeks seemed to cause similar Cu concentrations in foliar tissue.

The significant increase of Fe in treatments 2 and 3 is difficult to explain. However, according to Krauskopf (1977) in soil containing abundant organic matter much of the Fe may be reduced to $Fe^{\pm\pm}$. Iron may also be present in soil solutions, adsorbed on colloid surfaces as $Fe^{\pm\pm}$, or complexes thereof.

As the soil pH increases, adsorption increases and the formation of specific Fe(II) minerals such as $Fe(OH)_2$, $FeSiO_3$, and $FeCO_2$ is possible. According to Lindsey (1977) the Fe(II) minerals are very soluble and readily dissolve in soils. Small changes in O_2 and CO_2 partial pressures can also cause a slight shift in the solubility of Fe(II) compounds.

The mean pH values for treatments 1, 2, and 3 were 6.38, 6.78, and 6.82 respectively. The solubility of Fe apparently was sufficient due to the natural chelates present in organic soils (humic acid).

Metro Mix 500 pH analysis increased in a linear fashion, as expected with 50 and 100 percent increases in lime. Of the micronutrient elements tested, only mean Mn and Fe were not significantly affected by treatments. However, mean soil Zn and Cu were significantly influenced by treatment (Table 3). As the dolomitic limestone rate increased, the concentration of soil Zn and Cu significantly decreased.

The pigmy date palm, although subjected to 50 and 100 percent increases in dolomitic limestone, exhibited no apparent chlorosis or other symptoms at any time during the experiment. *Phoenix roebelenii* palms were not affected by increased lime, demonstrating the buffering capacity of Metro Mix 500 due to the inhibition of large pH increases. This experiment also showed that as the rate of lime increased the pH significantly increased along with tissue Fe and Cu, but soil Zn and Cu and foliage, root, and total dry weights decreased.

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