Palm Culture with Special Reference to Fertilization*

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The subject of palm culture is a most difficult one to discuss in a brief article for several reasons. Most important, the palms constitute a family of more than 2,500 species growing in all parts of the tropical world, under many situations so far as soils, climate, and other environmental factors are concerned. The saw palmetto in Florida grows on highly infertile soil with poor drainage. In Mexico, braheas grow on dry limestone hillsides in competition with cactus and other xerophytes. Such palms survive under conditions that are unfavorable for the majority of ornamental plants. Many palms, however, seem to grow poorly except when provided with fertile soils of good physical structure and containing abundant quantities of nutrient elements. For the most part, palms seem to grow more rapidly under conditions favorable to the growth of plants generally. However, there appears to be wide variation in the need for both primary and secondary elements among palms.

The object of this study is to bring together available information on fertilization and culture of palms in Florida and similar areas. The information has been secured in three ways:

1. A search through literature relating to palm culture and to research on palm nutrition in various parts of the world.
2. A survey of nurserymen, park superintendents, and others engaged in the business of growing palms to determine the methods developed by these individuals, and to learn of any observations they have made on problems concerning palms in Florida.
3. An attempt to learn the history of specific palm specimens in Florida which exhibit particularly good or particularly poor growth in order to arrive at some understanding of environmental factors affecting palms.

There are several obvious drawbacks to these methods of gathering information. Most research is limited to that on species grown commercially for their products, particularly coconuts, dates, and oil palms. Our interest is generally in the ornamental value of palms so research conclusions concerned with the yield of commercial products may not necessarily apply. Information from the second and third sources does not represent controlled or carefully observed experiments, but is based only on the opinions and memories of the persons consulted. However, the information received suggests a number of ways to provide palms with optimum cultural conditions, especially in Florida, and it shows the need for research under our conditions to furnish a sounder basis for cultural practices.

Soil Preparation and Planting

Mowry (20) offers a very complete discussion of soil preparation and planting, but his statements are based almost

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entirely on observation rather than on research. When transplanting, he recommends the digging of large holes where palms are to be set. "The holes are then filled with a mixture of compost, decayed leaves and grass or other litter, well rotted manures in fairly large quantities, and some muck and clay if the soil is quite sandy." This preparation "should be made two or three months prior to time of planting so that the whole mixture will have become well settled and more or less thoroughly decayed."

He further states that palms can be planted at any time of year but that the warm, rainy, sunny months are to be given preference. Palm roots do not form new root caps when severed so a ball of earth extending a foot from the base of the trunk should be moved with the tree. In this way, the small roots emerging from the base are preserved intact and their power to function is undisturbed. The pruning of leaves is recommended to reduce loss of moisture by transpiration, fan-leaved palms seeming to require removal of a larger proportion of leaves than the feather-leaved types. "With the cabbage palmetto it is best when transplanting to remove all of the leaves other than the central one that is just unfolding . . . Extreme caution must be exercised when undermining large trees to prevent them from falling heavily. Frequently such falls so injure trees that, regardless of other attention, they do not survive. The underground portion with its roots should not be exposed to the sun and wind in moving." Regular watering is required to insure success in transplanting and large trees must be well braced either with planks or wires for some months.

Dent Smith wrote of his experience with soil preparation in answer to our survey "From my own experience in growing palms here [Daytona Beach, Florida], I have long since concluded that 90 per cent of the battle consists in planting the palms properly in the first place, that is, in huge holes filled with the best organic matter obtainable, mixed, preferably not with sand, but with good soil . . . In nature many palms grow in heavy soils but here we have no clay, and marl is not a good substitute except for lime-loving palms. Palms . . . hardly require additional fertilization if painstakingly (and sometimes expensively) planted to begin with.

"An example of good and bad cultivation was observed here in the case of two African oil palms (*Elaeis guineensis*), each of the same age and size when planted. One was indifferently planted in sandy soil, moderately enriched with leaf-mold and some manure; the other was planted in a huge hole, back-filled with a ton of manure (cow) and moisture-retaining 'black soil'—a treatment entirely disproportionate to its size. The former plant grew skimpily, but the latter one grew mightily, and when only six years old had leaves eighteen feet long—longer than any I have seen on a plant of its age."

The *Third Annual Report* of the West African Institute for Oil Palm Research contains a report that 50 tons of bunch refuse per acre worked in before planting had a very marked beneficial effect on oil palms and mulching also produced response. Several transplanting trials there showed the superiority of ball-of-earth planting over bare-root planting. Dipping the bare roots in clay slurry before planting also gave fair establishment. Root-pruning a month before lifting gave better development in the ball-planting system and resulted

in markedly improved development over the bare-rooted system. These trials also showed that applying fertilizer in the planting hole was beneficial.

NPK (Nitrogen-Phosphoric Acid-Potassium) Requirements

Mowry states, and most local nurserymen and growers seem to agree, that organic sources of nitrogen are more satisfactory than inorganic fertilizers. Mowry says "Cottonseed meal, ground steamed bone meal, tankage, blood, guano, fish scrap and manures are satisfactory. Tankage, steamed bone meal and manures in combination will tend to keep the palms in a thrifty growing condition. Such fertilizers may be applied during the early spring and summer months. Ten to 25 pounds of such fertilizer scattered under the spread of the leaves is not too much for large specimens. Manures should be applied as a mulch.

"The nutritional requirements of palms can be met also by the use of commercial fertilizers. For this purpose fertilizers containing from 4 to 8 percent nitrogen, 6 to 8 percent phosphoric acid and 4 to 8 percent potash should be satisfactory. The amount to apply will vary with age and size of the plants, fertility of the soil and quantity of organic matter supplied but may range from approximately 1 to 2 ounces for very small recently planted palms to 15 pounds for large, mature palms per application. In the northern half of Florida two applications per year should be given, the first in late winter or early spring, the second in mid-summer. In the southern half of the peninsula, where growth may continue practically the year round, a third application in late summer or early fall may be advantageous."

The Florida Agricultural Extension Service recommends an all purpose mixture such as 6-6-6 (6 parts Nitrogen, 6 parts Phosphoric Acid, 6 parts Potassium) or 9-6-6 for palms, but Dr. E. W. McElwee, Extension Ornamental Horticulturist, from whose office this recommendation originates, frankly admits that we have no research on palm fertilization in Florida. The recommendation is based on practice and experience only.

Mr. John T. Poulos of the Miami Beach Parks Department, contributed the following information concerning practices at Miami Beach worked out over a period of years for their special conditions: *Cocos nucifera* needs no fertilizer except sulphate of potash on ailing trees, one pint per 32 gallons; *Ptychosperma Macarthuri,* a heavy feeder, needs one-half pound to two and one-half pounds of 6-6-6 fertilizer four times yearly depending on size and requires preventive spraying; *Veitchia Merrillii* can tolerate one to three pounds of 6-6-6 or 5-10-5 per tree approximately four times a year; *Chrysalidocarpus lutescens* is fertilized with two to four pounds of organic fertilizer (Milorganite or rotted manure) approximately six times a year plus nutritional spray of manganese as needed; *Chamaedorea elegans* and *C. erumpens* receive one-half to one pound of 6-6-6 twice yearly; *Ptychosperma elegans* needs one and one-half to four pounds of 6-6-6 three times a year plus soluble spray three times every three weeks, 20-0-20 *after cold winters*; *Coccothrinax* species are fertilized once yearly with one-fourth to one pound of 6-6-6; *Phoenix* species are given five to ten pounds of 6-6-6 per tree once yearly if needed.

H. H. Worssam of the Dade County Parks Department says that on coconut

palms newly transplanted he makes three applications of 10-20-10 water soluble fertilizer applied at the roots at intervals of two weeks. Complete fertilizer is applied three or four times during the first year after transplanting.

Many growers are of the opinion that application of potash in the fall increases resistance to cold damage, but are without supporting evidence. Dent Smith reports results of experimenting with potash at Daytona Beach as follows: "The much-touted benefit of potash to increase the cold tolerance of palms is a plain fake in my experience. Here there has been no difference between the ability to withstand cold of the treated and untreated palms . . . Morever, I can say that too much of it will cause the palm to decline in a hurry . . ."

Various workers, after extensive research, report that potassium in comparatively small dressings produced marked response in yield one year after application. In widespread field tests in India, applications of NPK in a 1-1-2 ratio resulted in a substantial increase in yield from the third year onward. Sankarasubramoney (22) found from soil analysis taken in high- versus low-producing areas in India that the high areas contained high concentrations of potash while the soils in areas of low production were low in potash. Most workers report that applications of phosphate gave no increase in yield over plots receiving no phosphate even after eighteen years. However, at one station in Ceylon, response to phosphate application was highly significant. Generally speaking, potash seems to be by far the most important element influencing yield in coconuts.

Broeshart (4) found in Trinidad that young oil palms deprived of nitrogen had uniformly yellow leaves. Those lacking potash showed marginal yellowing. In Africa, however, potassium deficiency causes orange or yellow spotting on the fronds. Nitrogen and phosphate do not appear to affect yield there except that excess nitrogen reduced yield.

Secondary Element Deficiencies

Although the majority of palms grow successfully in Florida under various maintenance programs without showing obvious effects of minor element deficiencies, many of the most important species are subject to deficiency diseases.

Dickey (10) found that curly top or frizzle leaf of *Arecastrum* was completely corrected by applications of one-half to five pounds of 80 per cent manganese sulphate, depending on size of the tree. He suggested applying by plugging, particularly where palms are growing in lawns. The application gave control under conditions of high pH (8.2). A one per cent lime manganese spray gave equally good results. Although curly top is more common on *Arecastrum* in alkaline soils, according to Dickey, it is frequently found on acid soils in central Florida.

Other palms are also affected. Leaves of *Phoenix canariensis*, particularly young ones unfolding from the bud, are pale green to greenish yellow. Dickey states that the characteristic frizzled condition is lacking in this species but a number of *Phoenix* species exhibiting frizzled leaf appearance associated with chlorosis have been observed in the Miami area. *Roystonea regia, Caryota urens, Livistona chinensis,* and *Acrocomia Totai* develop a serious disorder similar to that found in *Arecastrum* for which Dickey recommends manganese

treatment. Manganese deficiency can become so serious in *Arecastrum* that growth is so reduced in the final stages that new leaves are unable to push out and the tree finally dies. Both Dickey and Mowry state that chlorosis is always associated with frizzle leaf but the writer has seen lush green palms showing the characteristic frizzle leaf symptoms.

Species of *Caryota* frequently develop a pale coloration on the alkaline soils of southern Florida which has been corrected in some instances by application of chelated iron. Stanley Kiem, Superintendent of the Fairchild Tropical Garden, has cleared up this chlorosis by application of neutral iron. In some cases iron seems to be ineffective, however, and Dent Smith has never detected an improvement from use of chelated iron in Daytona Beach. After observing numerous unhealthy palms in Dade County over a period of time, the writer strongly suspects that lack of secondary elements other than manganese and iron may occasionally create a problem.

A condition affecting the lower fronds of various *Phoenix* species resulting in their premature death is very similar to magnesium deficiency described by Bull (6) in *Elaeis guineensis*. Various workers have established the high magnesium requirement of both oil palms and coconut palms. In the oil palm, *Elaeis guineensis*, symptoms of magnesium deficiency are yellowing and dying of the lower and middle leaflets and vascular necrosis of the rachis. These symptoms disappeared within nine months, according to Bull (6, 7), when magnesium was applied at five to ten pounds per palm. It was found that yield increased significantly in response to copper and manganese applications.

It has also been noted that boron and molybdenum deficiencies may also occur in the oil palm. Broeshart and others (5) found that the disease known as little leaf was induced when boron was lacking. Lack of sulphur may result in yellowing of the young leaves and intra-veinal chlorosis.

Conclusions

Although most palms grow in Florida with minimum attention to nutritional and cultural requirements, deficiency diseases exist in many species. The application of nutritional sprays containing copper, zinc, manganese, and chelated iron applied once or twice per year generally keeps palms in vigorous condition. At the same time, research on nutritional requirements of ornamental palms grown in Florida is badly needed to complement that already done on economic palms. The leaf injection method for tracing deficiencies has proved highly effective in African work on the oil palm. Its use is suggested for ornamental species as well.

The importance of proper soil preparation before planting, however, cannot be overemphasized, particularly in our sandy Florida soils. In Africa, sandy soils containing less than 30 per cent clay are not considered suitable for oil palms unless large amounts of organic matter are added to the soil thus improving physical structure and compensating for lack of clay in the soil. The same requirements probably hold for a majority of ornamental species in Florida.

Acknowledgements

The writer wishes to express his gratitude to Mr. Dent Smith, former President of The Palm Society, to Mr. Stanley Kiem, Superintendent of the Fairchild Tropical Garden, to Mr. John Poulos of the Miami Beach Parks Department, and to Mr. H. H. Worssam of the Dade

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The Main Distinguishing Characteristics of Pseudophoenix Sargentii and P. vinifera

P. SARGENTII	P. VINIFERA
Slow growing.	Much faster growing.
Trunk thinner, becoming 10-12 inches in diameter, rarely larger, usually smaller; plants in shade with taller slender trunk; plants in sun flowering when only 3 feet high, giving the aspect of a dwarf palm.	Trunk becoming over 12 inches in diameter, sometimes if bulged becoming almost 2 feet through; plants in shade taller growing.
Leaves generally stiff, spreading or arching, but hardly drooping; becoming 6-8 feet long, often only 3 feet long; plants in shade with longer leaves and less stiff pinnae.	Leaves 9-12 feet long or longer, gracefully arching and drooping.
Pinnae straight, sometimes more or less erect, rarely slightly drooping.	Pinnae longer and more drooping.
Petioles just below leaflets only 2-3 inches in diameter.	Petioles thicker and wider, 3½-6 inches in diameter.
Inflorescences short, usually as long as broad, sometimes longer, but much shorter than the leaves, to 3 feet long (Figure 20).	Inflorescence longer, 2-3 times longer than broad, to 6 feet long. (Figure 19).
Branches of the inflorescence standing at right angles to the main axis.	Branches of the inflorescence all pointing downward.
Fruit 1.5 cm. (½ inch) long and wide, in two- and three-lobed fruit to 2.5 cm. (1 inch) wide.	Fruit 2.5 cm. (one inch) long and wide; in two- and three-lobed fruit to 4 cm. (1½ inches) wide.

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County Parks Department who, together, contributed much of the information contained in this paper.

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EDITOR'S CORNER

Volume 3 commences a new palm year with articles by some authors already familiar as former contributors. New names are those of Douglas Knapp, a native Floridian and graduate of the University of Florida, who is Assistant County Agricultural Agent of Dade County, Florida; of Robert W. Read, a New Jerseyite recently graduated from the University of Miami, who has worked at the Fairchild Tropical Garden and who is continuing his studies in the graduate school at Cornell University; of Dr. M. K. Corbett, a native of Nova Scotia, graduate of McGill University with a Ph.D. in plant pathology from Cornell University in 1954, and now on the staff of the University of Florida. Dr. Corbett's article is the first of seven which will appear in PRINCIPES.

Mrs. Wait has forwarded several interesting letters which lack of space prevents printing in this issue. They will appear in succeeding issues. If you have notes or comments which may be of interest to other members of the Society they will be welcomed in this or other columns.